

Table of Laplace Transforms

$f(t) = \mathcal{L}^{-1}\{F(s)\}$	$F(s) = \mathcal{L}\{f(t)\}$	$f(t) = \mathcal{L}^{-1}\{F(s)\}$	$F(s) = \mathcal{L}\{f(t)\}$
1. 1	$\frac{1}{s}$	2. e^{at}	$\frac{1}{s-a}$
3. $t^n, n=1,2,3,\dots$	$\frac{n!}{s^{n+1}}$	4. $t^p, p > -1$	$\frac{\Gamma(p+1)}{s^{p+1}}$
5. \sqrt{t}	$\frac{\sqrt{\pi}}{2s^{3/2}}$	6. $t^{n-1/2}, n=1,2,3,\dots$	$\frac{1 \cdot 3 \cdot 5 \cdots (2n-1)\sqrt{\pi}}{2^n s^{n+1/2}}$
7. $\sin(at)$	$\frac{a}{s^2+a^2}$	8. $\cos(at)$	$\frac{s}{s^2+a^2}$
9. $t \sin(at)$	$\frac{2as}{(s^2+a^2)^2}$	10. $t \cos(at)$	$\frac{s^2-a^2}{(s^2+a^2)^2}$
11. $\sin(at) - at \cos(at)$	$\frac{2a^3}{(s^2+a^2)^2}$	12. $\sin(at) + at \cos(at)$	$\frac{2as^2}{(s^2+a^2)^2}$
13. $\cos(at) - at \sin(at)$	$\frac{s(s^2-a^2)}{(s^2+a^2)^2}$	14. $\cos(at) + at \sin(at)$	$\frac{s(s^2+3a^2)}{(s^2+a^2)^2}$
15. $\sin(at+b)$	$\frac{s \sin(b) + a \cos(b)}{s^2+a^2}$	16. $\cos(at+b)$	$\frac{s \cos(b) - a \sin(b)}{s^2+a^2}$
17. $\sinh(at)$	$\frac{a}{s^2-a^2}$	18. $\cosh(at)$	$\frac{s}{s^2-a^2}$
19. $e^{at} \sin(bt)$	$\frac{b}{(s-a)^2+b^2}$	20. $e^{at} \cos(bt)$	$\frac{s-a}{(s-a)^2+b^2}$
21. $e^{at} \sinh(bt)$	$\frac{b}{(s-a)^2-b^2}$	22. $e^{at} \cosh(bt)$	$\frac{s-a}{(s-a)^2-b^2}$
23. $t^n e^{at}, n=1,2,3,\dots$	$\frac{n!}{(s-a)^{n+1}}$	24. $f(ct)$	$\frac{1}{c} F\left(\frac{s}{c}\right)$
25. $u_c(t) = u(t-c)$ <i>Heaviside Function</i>	$\frac{e^{-cs}}{s}$	26. $\delta(t-c)$ <i>Dirac Delta Function</i>	e^{-cs}
27. $u_c(t) f(t-c)$	$e^{-cs} F(s)$	28. $u_c(t) g(t)$	$e^{-cs} \mathcal{L}\{g(t+c)\}$
29. $e^{ct} f(t)$	$F(s-c)$	30. $t^n f(t), n=1,2,3,\dots$	$(-1)^n F^{(n)}(s)$
31. $\frac{1}{t} f(t)$	$\int_s^\infty F(u) du$	32. $\int_0^t f(v) dv$	$\frac{F(s)}{s}$
33. $\int_0^t f(t-\tau) g(\tau) d\tau$	$F(s)G(s)$	34. $f(t+T) = f(t)$	$\frac{\int_0^T e^{-st} f(t) dt}{1-e^{-sT}}$
35. $f'(t)$	$sF(s) - f(0)$	36. $f''(t)$	$s^2F(s) - sf(0) - f'(0)$
37. $f^{(n)}(t)$	$s^n F(s) - s^{n-1} f(0) - s^{n-2} f'(0) - \dots - sf^{(n-2)}(0) - f^{(n-1)}(0)$		

Laplace Transforms

Daniel Fleisch



Laplace Transforms:

Laplace Transforms and Their Applications to Differential Equations N.W. McLachlan, 2014-11-19 This introduction to modern operational calculus offers a classic exposition of Laplace transform theory and its application to the solution of ordinary and partial differential equations. The treatment is addressed to graduate students in engineering physics and applied mathematics and may be used as a primary text or supplementary reading. Chief topics include the theorems or rules of the operational calculus, evaluation of integrals, and establishment of mathematical relationships. Derivation of Laplace transforms of various functions, the Laplace transform for a finite interval, and other subjects. Many problems and illustrative examples appear throughout the book, which is further augmented by helpful Appendixes. Dover, 2014. republication of the 1962 Dover revised edition of *Modern Operational Calculus with Applications in Technical Mathematics* Macmillan London 1948. See every Dover book in print at www.doverpublications.com

Laplace Transforms Essentials Morteza Shafii-Mousavi, 2013-01-01 REA's Essentials provide quick and easy access to critical information in a variety of different fields ranging from the most basic to the most advanced. As its name implies, these concise comprehensive study guides summarize the essentials of the field covered. Essentials are helpful when preparing for exams, doing homework, and will remain a lasting reference source for students, teachers, and professionals. Laplace Transforms includes the Laplace transform, the inverse Laplace transform, special functions, and properties, applications to ordinary linear differential equations, Fourier transforms, applications to integral and difference equations, applications to boundary value problems, and tables.

The Laplace Transform Joel L. Schiff, 1999-10-14 The Laplace transform is a wonderful tool for solving ordinary and partial differential equations and has enjoyed much success in this realm. With its success, however, a certain casualness has been bred concerning its application without much regard for hypotheses and when they are valid. Even proofs of theorems often lack rigor, and dubious mathematical practices are not uncommon in the literature for students. In the present text, I have tried to bring to the subject a certain amount of mathematical correctness and make it accessible to undergraduates. To this end, this text addresses a number of issues that are rarely considered. For instance, when we apply the Laplace transform method to a linear ordinary differential equation with constant coefficients, any n th order n th order differential equation, why is it justified to take the Laplace transform of both sides of the equation? Theorem A.6. Or, in many proofs, it is required to take the limit inside an integral. This is always fraught with danger, especially with an improper integral, and not always justified. I have given complete details, sometimes in the Appendix, whenever this procedure is required. IX X Preface. Furthermore, it is sometimes desirable to take the Laplace transform of an infinite series term by term. Again, it is shown that this cannot always be done, and specific sufficient conditions are established to justify this operation.

[Applied Laplace Transforms and z-Transforms for Scientists and Engineers](#) Urs Graf, 2012-12-06 The theory of Laplace transformation is an important part of the mathematical background required for engineers, physicists, and mathematicians. Laplace transformation methods provide

easy and effective techniques for solving many problems arising in various fields of science and engineering especially for solving differential equations What the Laplace transformation does in the field of differential equations the z transformation achieves for difference equations The two theories are parallel and have many analogies Laplace and z transformations are also referred to as operational calculus but this notion is also used in a more restricted sense to denote the operational calculus of Mikusinski This book does not use the operational calculus of Mikusinski whose approach is based on abstract algebra and is not readily accessible to engineers and scientists The symbolic computation capability of Mathematica can now be used in favor of the Laplace and z transformations The first version of the Mathematica Package LaplaceAndzTransforms developed by the author appeared ten years ago The Package computes not only Laplace and z transforms but also includes many routines from various domains of applications Upon loading the Package about one hundred and fifty new commands are added to the built in commands of Mathematica The code is placed in front of the already built in code of Laplace and z transformations of Mathematica so that built in functions not covered by the Package remain available The Package substantially enhances the Laplace and z transformation facilities of Mathematica The book is mainly designed for readers working in the field of applications

Advanced Calculus Edward Walsh, Trafford Publishing, 2006-01 The Laplace Transform is used to solve initial value problems involving differential equations All steps included Conventional methods are also discussed

An Introduction to Laplace Transforms and Fourier Series Phil Dyke, 2000-10-27 This introduction to Laplace transforms and Fourier series is aimed at second year students in applied mathematics It is unusual in treating Laplace transforms at a relatively simple level with many examples Mathematics students do not usually meet this material until later in their degree course but applied mathematicians and engineers need an early introduction Suitable as a course text it will also be of interest to physicists and engineers as supplementary material

Vector-valued Laplace Transforms and Cauchy Problems Wolfgang Arendt, Charles J.K. Batty, Frank Neubrander, 2013-11-11 Linear evolution equations in Banach spaces have seen important developments in the last two decades This is due to the many different applications in the theory of partial differential equations probability theory mathematical physics and other areas and also to the development of new techniques One important technique is given by the Laplace transform It played an important role in the early development of semigroup theory as can be seen in the pioneering monograph by Rille and Phillips HP57 But many new results and concepts have come from Laplace transform techniques in the last 15 years In contrast to the classical theory one particular feature of this method is that functions with values in a Banach space have to be considered The aim of this book is to present the theory of linear evolution equations in a systematic way by using the methods of vector valued Laplace transforms It is simple to describe the basic idea relating these two subjects Let A be a closed linear operator on a Banach space X The Cauchy problem defined by A is the initial value problem $t \geq 0$ $CP u(t) = Au(t) + f(t)$ where $x \in X$ is a given initial value If u is an exponentially bounded continuous function

then we may consider the Laplace transform $\int_0^{\infty} u(t) e^{-st} dt$ of u for large real s

Laplace Transforms, Numerical Methods & Complex Variables T. K. V. Iyengar, B. Krishna Gandhi, S. Ranganatham & M.V.S.S.N. Prasad, Laplace Transforms Numerical Methods Complex Variables *The Laplace Transform* Richard Bellman, Robert S. Roth, 1984 The classical theory of the Laplace Transform can open many new avenues when viewed from a modern semi classical point of view In this book the author re examines the Laplace Transform and presents a study of many of the applications to differential equations differential difference equations and the renewal equation *Laplace Transforms* Mohamed F. El-Hewie, 2013-04-15 This is a revised edition of the chapter on Laplace Transforms which was published few years ago in Part II of My Personal Study Notes in advanced mathematics In this edition I typed the cursive scripts of the personal notes edited the typographic errors but most of all reproduced all the calculations and graphics in a modern style of representation The book is organized into six chapters equally distributed to address 1 The theory of Laplace transformations and inverse transformations of elementary functions supported by solved examples and exercises with given answers 2 Transformation of more complex functions from elementary transformation 3 Practical applications of Laplace transformation to equations of motion of material bodies and deflection stress and strain of elastic beams 4 Solving equations of state of motion of bodies under inertial and gravitational forces 5 Solving heat flow equations through various geometrical bodies and 6 Solving partial differential equations by the operational algebraic properties of transforming and inverse transforming of partial differential equations During the editing process I added plenty of comments of the underlying meaning of the arcane equations such that the reader could discern the practical weight of each mathematical formula In a way I attempted to convey a personal sense and feeling on the significance and philosophy of devising a mathematical equation that transcends into real life emulation The reader will find this edition dense with graphic illustrations that should spare the reader the trouble of searching other references in order to infer any missing steps In my view detailed graphic illustrations could soothe the harshness of arcane mathematical jargon as well as expose the merits of the assumption contemplated in the formulation In lieu of offering a dense textbook on Laplace Transforms I opted to stick to my personal notes that give the memorable zest of a subject that could easily be remembered when not frequently used

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 in solving Linear Partial Differential Equations Integral Transforms and Their Applications Lokenath Debnath,1995-07-03
 Integral Transforms and Their Applications provides a systematic comprehensive review of the properties of integral
 transforms and their applications to the solution of boundary and initial value problems Over 750 worked examples exercises
 and applications illustrate how transform methods can be used to solve problems in applied mathematics mathematical
 physics and engineering The specific applications discussed include problems in differential integral and difference equations
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 material on integral transforms and their applications along with modern applications and examples of transform methods It
 is both an ideal textbook for students and a sound reference for professionals interested in advanced study and research in
 the field **Mathematics for Physical Chemistry** Robert G. Mortimer,1999 This is the ideal textbook for those students
 who want to sharpen their mathematics skills while they are enrolled in a physical chemistry course It provides students with
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 Completeness contains all of the mathematics needed in undergraduate physical chemistry Clarity Every sentence every
 example and every equation have been constructed to make it as clear as possible Applications oriented Designed for
 applications of mathematics not for mathematical theory written for a chemist who needs to use mathematics not for a
 mathematician who needs to study the underlying theory Understanding Engineering Mathematics John Bird,2013-11-20
 Studying engineering whether it is mechanical electrical or civil relies heavily on an understanding of mathematics This new
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Vector-valued Laplace Transforms and Cauchy Problems Wolfgang Arendt, Charles J.K. Batty, Matthias Hieber, Frank Neubrander, 2011-04-05 This monograph gives a systematic account of the theory of vector valued Laplace transforms ranging from representation theory to Tauberian theorems In parallel the theory of linear Cauchy problems and semigroups of operators is developed completely in the spirit of Laplace transforms Existence and uniqueness regularity approximation and above all asymptotic behaviour of solutions are studied Diverse applications to partial differential equations are given The book contains an introduction to the Bochner integral and several appendices on background material It is addressed to students and researchers interested in evolution equations Laplace and Fourier transforms and functional analysis The second edition contains detailed notes on the developments in the last decade They include for instance a new characterization of well posedness of abstract wave equations in Hilbert space due to M Crouzeix Moreover new quantitative results on asymptotic behaviour of Laplace transforms have been added The references are updated and some errors have been corrected

Bird's Comprehensive Engineering Mathematics John Bird, 2018-06-19 Studying engineering whether it is mechanical electrical or civil relies heavily on an understanding of mathematics This textbook clearly demonstrates the relevance of mathematical principles and shows how to apply them in real life engineering problems It deliberately starts at an elementary level so that students who are starting from a low knowledge base will be able to quickly get up to the level required Students who have not studied mathematics for some time will find this an excellent refresher Each chapter starts with the basics before gently increasing in complexity A full outline of essential definitions formulae laws and procedures is presented before real world practical situations and problem solving demonstrate how the theory is applied Focusing on learning through practice it contains simple explanations supported by 1600 worked problems and over 3600 further problems contained within 384 exercises throughout the text In addition 35 Revision tests together with 9 Multiple choice tests are included at regular intervals for further strengthening of knowledge An interactive companion website provides material for students and lecturers including detailed solutions to all 3600 further problems

The Laplace transform : an introduction Earl David Rainville, 1967 *A Student's Guide to Laplace Transforms* Daniel Fleisch, 2022-01-13 Clear explanations and supportive online material develop an intuitive understanding of the meaning and use of Laplace

Introduction to the Laplace Transform Peter K.F. Kuhfittig, 1978-04 The purpose of this book is to give an introduction to the Laplace transform on the undergraduate level The material is drawn from notes for a course taught by the author at the Milwaukee School of Engineering Based on classroom experience an attempt has been made to 1 keep the proofs short 2 introduce applications as soon as possible 3 concentrate on problems that are difficult to

handle by the older classical methods and 4 emphasize periodic phenomena To make it possible to offer the course early in the curriculum after differential equations no knowledge of complex variable theory is assumed However since a thorough study of Laplace transforms requires at least the rudiments of this theory Chapter 3 includes a brief sketch of complex variables with many of the details presented in Appendix A This plan permits an introduction of the complex inversion formula followed by additional applications The author has found that a course taught three hours a week for a quarter can be based on the material in Chapters 1 2 and 5 and the first three sections of Chapter 7 If additional time is available e g four quarter hours or three semester hours the whole book can be covered easily The author is indebted to the students at the Milwaukee School of Engineering for their many helpful comments and criticisms

Fundamentals of Ordinary Differential Equations Mohit Chatterjee, 2025-02-20 *Fundamentals of Ordinary Differential Equations* is a comprehensive guide designed for students researchers and professionals to master ODE theory and applications We cover essential principles advanced techniques and practical applications providing a well rounded resource for understanding differential equations and their real world impact The book offers a multifaceted approach from basic principles to advanced concepts catering to fields like physics engineering biology and economics Mathematical ideas are broken down with step by step explanations examples and illustrations making complex concepts accessible Real world examples throughout each chapter show how ODEs model and analyze systems in diverse disciplines We also explain numerical methods such as Euler's method Runge Kutta and finite differences equipping readers with computational tools for solving ODEs Advanced topics include bifurcation chaos theory Hamiltonian systems and singular perturbations providing an in depth grasp of ODE topics With chapter summaries exercises glossaries and additional resources *Fundamentals of Ordinary Differential Equations* is an essential reference for students professionals and practitioners across science and engineering fields

An Introduction to Complex Analysis and the Laplace Transform Vladimir Eiderman, 2021-12-20 The aim of this comparatively short textbook is a sufficiently full exposition of the fundamentals of the theory of functions of a complex variable to prepare the student for various applications Several important applications in physics and engineering are considered in the book This thorough presentation includes all theorems with a few exceptions presented with proofs No previous exposure to complex numbers is assumed The textbook can be used in one semester or two semester courses In one respect this book is larger than usual namely in the number of detailed solutions of typical problems This together with various problems makes the book useful both for self study and for the instructor as well A specific point of the book is the inclusion of the Laplace transform These two topics are closely related Concepts in complex analysis are needed to formulate and prove basic theorems in Laplace transforms such as the inverse Laplace transform formula Methods of complex analysis provide solutions for problems involving Laplace transforms Complex numbers lend clarity and completion to some areas of classical analysis These numbers found important applications not only in the mathematical theory but in the mathematical descriptions of processes in physics and

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