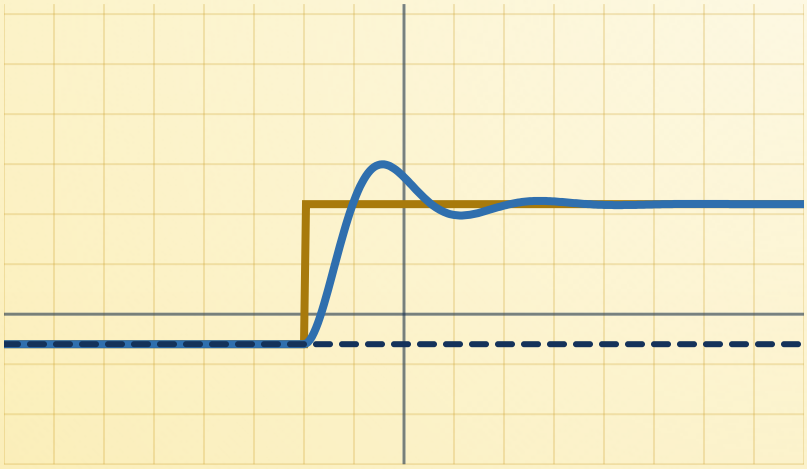
KECUDO

2026 EDITION · COLLEGE MATH SERIES



DIFFERENTIAL EQUATIONS

Class F3

Laplace Transforms

Turning calculus into algebra

PREMIUM EDITION · KECUDO · F3

13 CHAPTERS · 120 SELF-ASSESSMENT QUESTIONS

INTERACTIVE EDITION + PRINT PDF

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FOUNDATION

Chapter 1

Definition of the Laplace Transform

$$L\{f(t)\} = F(s) = \int_0^\infty e^{-st} f(t)\, dt$$

The transform takes a function of time t and produces a function of a new variable s. The improper integral converges for s large enough.

WORKED EXAMPLE $L\{1\}$

1. $\int_0^\infty e^{-st}\, dt = [-e^{-st}/s]_0^\infty = 1/s$ (for $s > 0$).

✓ $1/s$

WORKED EXAMPLE $L\{e^{3t}\}$

1. $\int_0^\infty e^{-(s-3)t}\, dt = 1/(s-3)$ for $s > 3$.

✓ $1/(s-3)$

LINEARITY

$L\{af + bg\} = aL\{f\} + bL\{g\}$. So $L\{5 + 2e^{3t}\} = 5/s + 2/(s-3)$.

FOUNDATION

Chapter 2

The Transform Table

$f(t)$	$F(s)$
1	$1/s$
t^n	$n!/s^{n+1}$
e^{at}	$1/(s - a)$
sin bt	$b/(s^2 + b^2)$
cos bt	$s/(s^2 + b^2)$
$e^{at}\, f(t)$	$F(s - a)$
$f'(t)$	$sF(s) - f(0)$
$f''(t)$	$s^2\, F(s) - s\, f(0) - f'(0)$

WORKED EXAMPLE **$L\{3t^2 - 2 \sin 4t\}$**

1. $3(2/s^3) - 2(4/(s^2 + 16))$.

✓ **$6/s^3 - 8/(s^2 + 16)$**

THE MAGIC ROW

$L\{f'\} = sF - f(0)$: differentiation becomes multiplication by s. That's why ODEs become algebra.

CHECK YOUR UNDERSTANDING

Chapter 1: Definition of the Laplace Transform

5 questions · your answer locks when you choose it

1. What is $L\{1\}$?

- **A** $1/s$
- **B** s
- **C** 1
- **D** $1/s^2$

2. What is $L\{e^{at}\}$?

- **A** e^{as}
- **B** a/s
- **C** $1/(s-a)$
- **D** $1/(s+a)$

3. What is $L\{4\}$?

- **A** 4
- **B** $4/s$
- **C** $4s$
- **D** $1/(4s)$

4. What is $L\{e^{-2t}\}$?

- **A** $1/(s+2)$
- **B** e^{2s}
- **C** $1/(s-2)$
- **D** $-2/s$

5. The Laplace transform is:

- **A** undefined for e^t
- **B** only for polynomials
- **C** linear
- **D** nonlinear

FINAL EXAM

25 Questions on the Whole Book

Parts A–E · 5 questions each

Part A · Basics

1. The Laplace transform is defined by:

A $\int_0^\infty e^{-st} f(t)\,dt$ **B** $\sum f(n)$

C $f'(s)$ **D** $\int f\,dt$

2. $L\{f'\} =$

A $sF - f(0)$ **B** F/s

C sF **D** F'

3. $u(t-a)$ is:

A a unit step switching on at a **B** an impulse

C a ramp **D** a sine

4. $L\{\delta(t-a)\} =$

A a **B** 0

C e^{-as} **D** $1/s$

5. $L\{f \cdot g\} =$

A $F - G$ **B** F/G

C $F + G$ **D** FG



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Thank you for learning with Kecudo.

NEXT IN THE SERIES

Class F4 · Systems of ODEs & Modeling