

# Transform Theory

Programme course

6 credits

Transformteori

TATA80

Valid from: 2017 Spring semester

**Determined by**  
Board of Studies for Industrial  
Engineering and Logistics

**Date determined**  
2017-01-25

## Main field of study

Mathematics, Applied Mathematics

## Course level

First cycle

## Advancement level

G1X

## Course offered for

- Industrial Engineering and Management, M Sc in Engineering

## Entry requirements

Note: Admission requirements for non-programme students usually also include admission requirements for the programme and threshold requirements for progression within the programme, or corresponding.

## Prerequisites

Calculus, linear algebra

## Intended learning outcomes

The course aims to give students a deeper knowledge of Fourier analysis and Transform Theory, which have many applications in both technology and mathematics. After successfully completing the course the student is expected to

- be acquainted with necessary conditions for the existence of the transforms,
- know and be able to derive simple properties of the transforms (e.g. behaviour at infinity, scaling and translation rules, rules for differentiation and integration as well as rules for multiplication by the time variable).
- be able to derive the transforms of the elementary functions,
- know the inversion theorems, uniqueness theorems, the convolution formulas and the Parseval and Plancherel theorems,
- be able to use the transforms to solve problems such as differential equations, Difference equations and convolution equations
- be acquainted with and be able to use results about uniform convergence (continuity, differentiability and integrability of limit functions, Weierstrass' Majorant Theorem).

## Course content

In this course we study some important linear transformations which allow us to translate linear problems (differential, integral and difference equations) into more tractable algebraic problems, whose solutions can then be translated back to solutions of the original problem.

We study: Fourier series, which translate periodic functions into function series. These series are used to analyze periodic behaviour. The problem of convergence of the function series is important and we look at uniform and pointwise convergence as well as convergence in the mean for Fourier series. Bessel's and Parseval's Theorems are key results. Fourier transforms: these transforms are used to analyze non-periodic behaviour. The inversion formula for Fourier transforms is of central importance, and other tools at our disposal include the rules of calculation, the convolution formula and Plancherel's Theorem. The Laplace transform: this transforms functions of a real variable into functions defined in the complex plane and it is used amongst other things for solving initial value problems. The tools at our disposal include rules of calculation, the convolution formula as well as initial and final value theorems. The Z-transform: transforms functions of the natural numbers into power series, and it is used to solve difference equations. The tools at our disposal include rules of calculation and the convolution formula.

## Teaching and working methods

Teaching is done through lectures and problem classes.

## Examination

UPG1	Written assignments	2 credits	U, G
TEN1	Written examination	4 credits	U, 3, 4, 5

## Grades

Four-grade scale, LiU, U, 3, 4, 5

## Department

Matematiska institutionen

## Director of Studies or equivalent

Jesper Thorén

## Examiner

Peter Basarab-Horwath

## Education components

Preliminary scheduled hours: 46 h

Recommended self-study hours: 114 h

## Course literature

Pinkus, A., Zafrany, S.: Fourier Series and Integral Transforms. Kompletterande material (exempelsamling) utgivet av MAI.

## Common rules

Regulations (apply to LiU in its entirety)

The university is a government agency whose operations are regulated by legislation and ordinances, which include the Higher Education Act and the Higher Education Ordinance. In addition to legislation and ordinances, operations are subject to several policy documents. The Linköping University rule book collects currently valid decisions of a regulatory nature taken by the university board, the vice-chancellor and faculty/department boards.

LiU's rule book for education at first-cycle and second-cycle levels is available at [http://stydokument.liu.se/Regelsamling/Innehall/Utbildning\\_pa\\_grund-\\_och\\_avancerad\\_niva](http://stydokument.liu.se/Regelsamling/Innehall/Utbildning_pa_grund-_och_avancerad_niva).