# EJ2311 Modulation of Power Electronic Converters 6.0 credits

**Effektelektronisk modulation**

This is a translation of the Swedish, legally binding, course syllabus.

## Establishment

The official course syllabus is valid from the autumn semester 2022 in accordance with the decision from the head of school: J-2022-0544.Decision date: 24/03/2022

## Grading scale

P, F

## Education cycle

Second cycle

## Main field of study

Electrical Engineering

## Specific prerequisites

## Language of instruction

The language of instruction is specified in the course offering information in the course catalogue.

## Intended learning outcomes

After passing the course, the student shall be able to

- apply Fourier series developments to analyse arbitrary periodic signals in the frequency level
- calculate all electric units in linear time-invariant (LTI) symmetric three-phase system when these are current supplied by periodic three-phase sources (asymmetric sinusoidal and symmetric non sinusoidal)
- apply waveform symmetries to identify harmonics in periodic signals
- calculate common key ratios to quantify the harmonic distortion of periodic signals specific THD (”the total harmonic distortion”)
- design carrier wave based pulse width modulators for single- and multi-phase voltage-source converters (with or without sampling)
- explain the effect of phase-shift of the carrier wave and the reference on the harmonic components that result from pulse-width modulation (PWM) in phase and line units
- describe different types of zero vector placements in three-phase carrier wave based PWM
- explain the function of a simple space vector modulator and explain the analogies with carrier wave based modulators
- decide appropriate sets of eliminated harmonics at selective harmonic elimination for different applications and calculate equivalent switching angles
- explain the qualitative differences between carrier wave based and programmed PWM with regard to harmonic and dynamic properties
- conceptually design and simulate simple control systems for direct torque including derivation of the connection table
- draw timetables over the most common multi-level converter topologies and explain their function
- describe effect on harmonic spectra to increase the number of levels in the waveform
- describe the synthesis of different types of carrier wave based multi-level waveforms

in order to obtain a solid understanding of modern synthesis and analytical methods for modulation for voltage-source converters

## Course contents

Modulation of power converters plays a crucial role in modern power electronics there both low losses that dynamic requirements, harmonics and electromagnetic interference (EMI) are of great importance.

## Examination

- PRO2 - Project, 1.5 credits, grading scale: P, F

- PRO1 - Project, 1.5 credits, grading scale: P, F
- TEN1 - Written examination, 2.0 credits, grading scale: P, F
- LAB1 - Laboratory Work, 1.0 credits, grading scale: P, F

Based on recommendation from KTH's coordinator for disabilities, the examiner will decide how to adapt an examination for students with documented disability.

The examiner may apply another examination format when re-examining individual students.

If the course is discontinued, students may request to be examined during the following two academic years.

## Other requirements for final grade

Written assignments and written examination

## Ethical approach

- All members of a group are responsible for the group's work.
- In any assessment, every student shall honestly disclose any help received and sources used.
- In an oral assessment, every student shall be able to present and answer questions about the entire assignment and solution.