Applied Power Electronics

Programme course

8 credits

Tillämpad effektelektronik

TNE102

Valid from: 2017 Spring semester

Determined by
Board of Studies for Electrical Engineering, Physics and Mathematics

Date determined
2017-01-25

Offered for the last time
Spring semester 2022

Replaced by
TNE106

Main field of study
Electrical Engineering

Course level
First cycle

Advancement level
G2X

Course offered for
- Electronics Design Engineering, 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
Circuit theory, Circuit theory, advanced course, Semiconductor technology, Analog electronics

Intended learning outcomes

After completing the course the students should be able to:
PART1:

- Perform calculations on symmetric and on simple non symmetric three phase systems and do simple calculations with symmetric components
- Describe and do calculations on power electronic components and their cooling
- Describe and do calculations on common electric machines and converters
- Describe and do calculations on electric power supplies
- Calculate quantities giving electric quality
- Accurately describe and explain the problems that may arise from interference, EMC and impact on the grid in systems with power semiconductors
- Describe and do design of converter fed AC- and DC-drives
- Describe and perform simple calculations on systems for power transmission with high voltage direct current
- Be familiar with measurement methods in systems with power semiconductors
- Do simulation of power electronic systems with dedicated software

PART2:

- Describe different types of frequency converters and modulation techniques, vector control and direct torque control, DTC
- Describe the design of protective- (snubbers) and drive-circuits used for power semiconductor systems
- Give the main features of motor drives where sensor less control is used
- Describe the function of SVC equipment used in electric transmission
- Describe why and how maximum power point tracking is used in solar cell systems

Course content

PART 1: The three phase system. Electric machines: the DC machine, asynchronous and synchronous (electrically magnetized and permanent magnetized) machines, Single phase and three phase transformers. Power semiconductors and their semiconductor physics. Classification of inverters. Power converters for single and three phase. Converters with inductive load. The need for reactive power. Power calculations. Four-quadrant operation of machines. Commercial inverters and their industrial use. DC-choppers and DC-DC converters. DC Inverters for DC-AC conversion. Multilevel inverters. Resonant converters. Power supply units and uninterruptible power supplies. Dynamic description of switch mode power supplies. Thermal calculations. Thermal resistance and thermal impedance.

PART 2: Space vectors and VSC applications. Transformation between stationary and synchronous coordinate systems. Converter fed DC-drives. Modelling of AC-machines, the inverse gamma model for induction motors, dynamic models for PMSM and reluctance SM. Vector control. Sensorless control. Direct Torque Control. Commercial frequency converters. Power electronic interface between renewable energy sources and the electric grid. Transmission of electric power with high voltage current. HVDC-Classic, VSC-HVDC, FACTS and SVCequipment. Protective circuits, snubbers. Drivers. Simulation of systems with power electronic semiconductor components. PFC.

Teaching and working methods

PART1: Lectures, exercises and laboratory work.
PART 2: Some introductory lectures with excercises followed by project work.

Examination

UPG1	Hand-in Assignments	2 credits	U, G
LAB1	Laboratory work	2 credits	U, G
TEN1	Written examination	4 credits	U, 3, 4, 5

The project work includes a written project report and oral presentation. opposition on another project work and compulsory attendance during all project meetings and presentations.

Grades

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

Other information

Supplementary courses: CDIO-course

Department
Institutionen för teknik och naturvetenskap

Director of Studies or equivalent
Adriana Serban

Examiner
Kjell Karlsson

Course website and other links
http://www2.itn.liu.se/utbildning/kurs/

Education components
Preliminary scheduled hours: 70 h
Recommended self-study hours: 143 h

Course literature

Additional literature

Other

PART1: Mohan, Undeland, Robbins; Power Electronics; Prentice – Hall.
Additional material
PART2: Mohan, Undeland, Robbins: Power Electronics. Wiley. L. Harnefors, M. Hinkkanen, J. Luomi; Control of Power Electronic Converters and Variable Speed Drives (compendium); papers and additional material.

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://styrdokument.liu.se/Regelsamling/Innehall/Utbildning_pa_grund-_och_avancerad_niva.