Electro Hydraulic Systems

Programme course

6 credits

Elektrohydrauliska system

TMMS13

Valid from: 2018 Spring semester

Determined by
Board of Studies for Mechanical Engineering and Design

Date determined

Offered for the last time
Autumn semester 2023

Replaced by
TMMS32 till viss del.

Main field of study
Mechanical Engineering

Course level
Second cycle

Advancement level
A1X

Course offered for
- Mechanical Engineering, M Sc in Engineering
- Mechanical Engineering, Master's Programme

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
Fluid power systems, Automatic Control

Intended learning outcomes

The course gives a deepened understanding for multi-axis motion controlled systems where all aspects of mechatronics like mechanics, electronics, computer technology and software are essential building blocks of its functionality. The mechanical system under study primarily make use of hydraulics and electromechanics as energy transfer technologies, although others may be in the scope. At the end of the course the student should be able to describe, in detail, the different sub-systems in an design in terms of their functionality, integration and control in typical industry applications like cranes, forklifts, construction equipment or workshop automation centres. One should have a good understanding for the mechanical- and control-engineering challenges often found in such systems, in terms of non-ideal phenomena and the mastering thereof by modern computer technology. In parallel getting an deepened and widened insight in the functionality of such systems should also methods, best practise and operation related to the design and verification of found solutions be studied. The general aim is that a student by the given teaching in simulation and embedded computing be able to establish control of a machine in a reliable manor despite its non-linear characteristics.
After the course the student should

- be able to clearly describe the information transfer in industrial networks.
- understand the coupling between motion, force, magnetic flux and electric current in a electromechanical design together with its limitations.
- be able to handle, value and analyse the results of simulations in mathematical models focused on mechatronic systems.
- be able to create simpler programming code to establish motion control or vector references in control systems.
- be able to evaluate and analyse multi-axis systems in different performance measures like positioning errors, energy consumption and stability. Both in general and detail. An also have an understanding for the mechanical life expectancy and maintenance in multi-axis systems by making use of tests and simulations.
- individually present an mechatronic design in both digital media and written report.

After the completion of the course the student should have a good and general understanding of the application of the modern computer technology in studies, design and handling of machinery around us and in industry.

Course content

In contrast to many other courses in this field this one is primarily using simulation technology to provide an understanding for phenomena and challenges in multi-axis systems. Simulation technology is the very basis of modern evaluation of different designs, some of which the student will reflect upon and analyse. Applications typical to modern machine design. Example of this may include parameter drift, backlash, dry friction, bistable systems, dither motion, stiffness fluctuations in actuators and signal delays. Primarily are studies on solenoid and hydraulic valves used as examples of actuating technologies. Load balancing issues in multi-axis single-supply systems is studied. The knowledge about sensors is extended by more quantities in the field of mechanic engineering. A major part of the methods used focus on the overall analysis of the performance of system solutions. Lectures follow the principle trace of the signal chain, from sensor to actuator.

Teaching and working methods

The teaching takes the form of lectures, lessons, design task and laborations. A number of assignments is used in the course where every student individually do an independent related to design and analysis of mechatronic systems. Lectures and lessons are based on text book literature and some research papers. If suitable, some of the content is adjusted to be aligned with the project work in TMPM01. Elaborative work will require a good deal of preparation and initiative from the student. Computer class work run smoothly with some practical experience of computers and some knowledge about script programming. A number of computer tools/software will be used in the course such like 3D CAD, MATLAB/Simulink and text editors.

Examination

LAB1	Laboratory work	2 credits	U, G
UPG2	Assignments	1 credits	U, G
UPG1	Individual written assignment	3 credits	U, 3, 4, 5

Grades

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

Other information

Supplementary courses

The course is scheduled in close relation to TMPM06 - Project Course Advanced - Mechatronics, where many of the efforts in this course find their application.

Department
Institutionen för ekonomisk och industriell utveckling

Director of Studies or equivalent
Mikael Axin

Examiner
Magnus Sethson

Education components
Preliminary scheduled hours: 48 h
Recommended self-study hours: 112 h

Course literature

Books

Clarence W. de Silva, CRC Press, *Mechatronics, An Integrated Approach*
ISBN: 0-84931274-4
William Bolton, Pearson, *Mechatronics, Electronic control systems in Mechanical and Electrical Engineering* 6
ISBN: 978-1-292-07668-3

Common rules

Course syllabus

A syllabus has been established for each course. The syllabus specifies the aim and contents of the course, and the prior knowledge that a student must have in order to be able to benefit from the course.

Timetabling

Courses are timetabled after a decision has been made for this course concerning its assignment to a timetable module. A central timetable is not drawn up for courses with fewer than five participants. Most project courses do not have a central timetable.

Interrupting a course

The vice-chancellor's decision concerning regulations for registration, deregistration and reporting results (Dnr LiU-2015-01241) states that interruptions in study are to be recorded in Ladok. Thus, all students who do not participate in a course for which they have registered must record the interruption, such that the registration on the course can be removed. Deregistration from a course is carried out using a web-based form: www.lith.liu.se/for-studenter/kurskomplettering?l=sv.

Cancelled courses

Courses with few participants (fewer than 10) may be cancelled or organised in a manner that differs from that stated in the course syllabus. The board of studies is to deliberate and decide whether a course is to be cancelled or changed from the course syllabus.

Regulations relating to examinations and examiners

Details are given in a decision in the university's rule book: http://styrdokument.liu.se/Regelsamling/VisaBeslut/622678.

Forms of examination

Examination

Written and oral examinations are held at least three times a year: once immediately after the end of the course, once in August, and once (usually) in one of the re-examination periods. Examinations held at other times are to follow a decision of the board of studies.

Principles for examination scheduling for courses that follow the study periods:

- courses given in VT1 are examined for the first time in March, with re-

examination in June and August
- courses given in VT2 are examined for the first time in May, with re-examination in August and October
- courses given in HT1 are examined for the first time in October, with re-examination in January and August
- courses given in HT2 are examined for the first time in January, with re-examination at Easter and in August.

The examination schedule is based on the structure of timetable modules, but there may be deviations from this, mainly in the case of courses that are studied and examined for several programmes and in lower grades (i.e. 1 and 2).

- Examinations for courses that the board of studies has decided are to be held in alternate years are held only three times during the year in which the course is given.
- Examinations for courses that are cancelled or rescheduled such that they are not given in one or several years are held three times during the year that immediately follows the course, with examination scheduling that corresponds to the scheduling that was in force before the course was cancelled or rescheduled.
- If teaching is no longer given for a course, three examination occurrences are held during the immediately subsequent year, while examinations are at the same time held for any replacement course that is given, or alternatively in association with other re-examination opportunities. Furthermore, an examination is held on one further occasion during the next subsequent year, unless the board of studies determines otherwise.
- If a course is given during several periods of the year (for programmes, or on different occasions for different programmes) the board or boards of studies determine together the scheduling and frequency of re-examination occasions.

Registration for examination

In order to take an examination, a student must register in advance at the Student Portal during the registration period, which opens 30 days before the date of the examination and closes 10 days before it. Candidates are informed of the location of the examination by email, four days in advance. Students who have not registered for an examination run the risk of being refused admittance to the examination, if space is not available.

Symbols used in the examination registration system:

** denotes that the examination is being given for the penultimate time.

* denotes that the examination is being given for the last time.

Code of conduct for students during examinations

Details are given in a decision in the university's rule book: http://styrdokument.liu.se/Regelsamling/VisaBeslut/622682.

Retakes for higher grade

Students at the Institute of Technology at LiU have the right to retake written examinations and computer-based examinations in an attempt to achieve a higher grade. This is valid for all examination components with code “TEN” and "DAT". The same right may not be exercised for other examination components, unless otherwise specified in the course syllabus.

Retakes of other forms of examination

Regulations concerning retakes of other forms of examination than written examinations and computer-based examinations are given in the LiU regulations for examinations and examiners, http://styrdokument.liu.se/Regelsamling/VisaBeslut/622678.

Plagiarism

For examinations that involve the writing of reports, in cases in which it can be assumed that the student has had access to other sources (such as during project work, writing essays, etc.), the material submitted must be prepared in accordance with principles for acceptable practice when referring to sources (references or quotations for which the source is specified) when the text, images, ideas, data, etc. of other people are used. It is also to be made clear whether the author has reused his or her own text, images, ideas, data, etc. from previous examinations.

A failure to specify such sources may be regarded as attempted deception during examination.

Attempts to cheat

In the event of a suspected attempt by a student to cheat during an examination, or when study performance is to be assessed as specified in Chapter 10 of the Higher Education Ordinance, the examiner is to report this to the disciplinary board of the university. Possible consequences for the student are suspension from study and a formal warning. More information is available at https://www.student.liu.se/studenttjanster/lagar-regler-rattigheter?l=sv.

Grades

The grades that are preferably to be used are Fail (U), Pass (3), Pass not without distinction (4) and Pass with distinction (5). Courses under the auspices of the faculty board of the Faculty of Science and Engineering (Institute of Technology) are to be given special attention in this regard.

1. Grades U, 3, 4, 5 are to be awarded for courses that have written examinations.
2. Grades Fail (U) and Pass (G) may be awarded for courses with a large degree of practical components such as laboratory work, project work and group work.

Examination components

1. Grades U, 3, 4, 5 are to be awarded for written examinations (TEN).
2. Grades Fail (U) and Pass (G) are to be used for undergraduate projects and other independent work.

3. Examination components for which the grades Fail (U) and Pass (G) may be awarded are laboratory work (LAB), project work (PRA), preparatory written examination (KTR), oral examination (MUN), computer-based examination (DAT), home assignment (HEM), and assignment (UPG).
4. Students receive grades either Fail (U) or Pass (G) for other examination components in which the examination criteria are satisfied principally through active attendance such as other examination (ANN), tutorial group (BAS) or examination item (MOM).

The examination results for a student are reported at the relevant department.

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.