FSD3313 Rail Vehicle Dynamics 7.5 credits

Spårfordonsdynamik

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

Establishment

Course syllabus for FSD3313 valid from Autumn 2018

Grading scale

P, F

Education cycle

Third cycle

Specific prerequisites

Masters degree in mechanical engineering, vehicle engineering, engineering physics or equivalent. Documented knowledge of English corresponding to English B / English 6.

Language of instruction

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

Intended learning outcomes

The overall aim of the course is to become prepared to work as a Vehicle Dynamics engineer in industry or for a railway operator/authority. You shall be familiar to the different problems

involved in dynamic vehicle/track interaction and be capable of actively choosing system parameters that result in good vehicle performance and low wear of components both in vehicle and track.

Specifically that means:

- You shall be able to list the vehicle and track components that influence the dynamic behaviour and to explain their role in the system.
- You shall be able to use the equations derived in the course to calculate permissible vehicle speeds on given lines or necessary line characteristics like curve radius and superelevation curves for a given traffic.

To be able to use Multibody System Programs which are common in industry today, to understand the theory behind them and judge the results you

- shall know how to derive the differential equations of a dynamic system.
- shall be capable of solving as well linear homogeneous differential equations (without excitation) as those for systems with harmonic excitation. You shall be able to analyse the results, i.e. determine eigenfrequencies and frequency response functions and explain them. You should be familiar to this already from basic courses in mechanics.
- In rail vehicle dynamics the concept of hunting and stability is important. You shall be able to explain the mathematical reason why a railway vehicle can become unstable.
- You shall be able to derive the equations for quasistatic curving of a vehicle and to explain the wheel-rail forces arising for different positions of the wheelset on the track.
- Good vehicle stability and curving performance are in principle contradictory. You have to be able to list parameters that lead to good stability or curving respectively. Especially you shall be able to explain the importance of the wheel rail geometry - e.g. concept of conicity - to both phenomena. You shall be able to discuss the implications of suggested parameters to the usability of a vehicle for certain traffic tasks.
- You have to be able to explain how ride comfort in a railway vehicle is evaluated and to discuss the differences between different comfort measures used today.
- Wheel and rail components shall be deteriorated as little as possible. Wear calculations are a good guidance to judge the "track friendliness" of a vehicle. You shall be able to explain how wear between wheel and rail usually is calculated and how parameters can be chosen to minimize it.

Course contents

Introduction into rail vehicle dynamics. The basics of quasistatic and dynamic vehicle-track interaction will be introduced. Equations will be derived and used to solve a number of problems. Among others topics of the course are: the calculation of minimum curve radii and superelevation, the critical hunting speed of a vehicle, wheel rail forces in curves, ride comfort calculation, prediction of wheel and rail wear, introduction to vehicle dynamics simulations.

Disposition

The course consists of lectures, linking to a written exam, two individual assignments and a project task to be carried out and reported in a group of 2-3 persons. An individual extra task, on a selected subtopic of the course, is also to be done and reported.

Course literature

Andersson E, Berg M, Stichel S: Rail Vehicle Dynamics.

In addition to the textbook above, you get access to the presentation material from the lectures.

Equipment

None.

Examination

- TEN1 - Examination, 3.0 credits, grading scale: P, F
- PRO1 - Project work, 2.0 credits, grading scale: P, F
- ÖVN1 - Exercises, 2.5 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 Exam (P), Project Task (P), Extra Task (P)

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.