



UiO : **Fysisk institutt**

Det matematisk-naturvitenskapelige fakultet

FYS3120 – Classical mechanics and electrodynamics

Are Raklev

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Plan for today

Part 1

- Practical information for FYS3120.
- Survival guide.

Part 2

- Course content/overview.
- Analytical mechanics: Constraints and generalized coordinates. (Section 1.1)

Weekly schedule

- **Monday:** lectures (14.15–16.00).
- **Wednesday:** lectures (12.15–14.00).
- **Wednesday:** problem solving classes (14.15–16.00) with **Jørgen “Sleet” Midtbø**.
- Problem sets to be handed in on **Mondays** before 12.00.
- More details (in particular lecture content) listed on the course home-page schedule (Timeplan).

Mandatory problem sets

- We will give **12 problem sets**. To be admitted to the final exam a **minimum of six** of these must be handed in and graded pass.
- The **deadline is Mondays at 12.00** the week following the corresponding problem class
 - Submitted electronically as a pdf-file.
 - We will be using devilry.ifi.uio.no for submissions.
 - Note that the portal is not open for submission yet, we are still waiting for class lists.
 - Jørgen may offer another option.

Mid-term exam

- Dates: 19–23 March.
- No lectures or problem classes that week.
- The problem set is uploaded the week before (probably Friday) and is to be handed in at the latest Friday March 23 at 15.00 (using devilry).
- Counts as ~25% of the total grade. Must be passed in order to pass the course.
- Individual answers please!

Final exam

- Date: June 11 at 14.30 (4 hours).
- Counts as $\sim 75\%$ of the total grade. Must be passed in order to pass the course.
- In English (you can answer in Norwegian).
- You are allowed to bring the following:
 - Approved calculator.
 - Angell and Lian: “Fysiske størrelser og enheter”.
 - Rottmann: “Matematisk formelsamling”.
 - Collection of formulae for FYS3120.

What you need to know for the exam(s)

- The stated **learning outcomes (læringsmål)**
 - See the course page and a specification later today.
- These will be covered by:
 - *The lecture notes* (by Jon Magne Leinaas). Can be downloaded from the course page.
 - The lectures.
 - The mandatory problem sets.

Course evaluation

- Mid-term evaluation and end-evaluation.
- We need one or two student volunteers for the end-evaluation. (Same day as the exam!)

This week

- **Wednesday (now):** practical information (done), an overview of the course and a slow start on generalized coordinates. (Section 1.1)
- No problem set this week, first set will be uploaded on Monday.

Survival guide

- 1) Prepare for lectures (read the lecture notes).
- 2) Use the problem classes.
- 3) Learn to use relevant parts of Rottmann and the formulae collection.
- 4) Solve problems.

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- 5) Solve more problems.
- 6) Return to 4).

Course content

- Three main parts: 1) analytical mechanics, 2) relativity, 3) electrodynamics.
- Part I: Analytical Mechanics
 - Generalized coordinates and conjugate momenta
 - Lagrange's equations
 - Symmetries and constants of motion
 - Hamiltonian dynamics
 - Calculus of variations

Lagrange–Hamilton formalism

Course content

- Part II: Relativity
 - The symmetry transformations of four-dimensional spacetime
 - Physical consequences of the Lorentz transformations
 - The four-vector formalism and covariant equations
 - Vectors and tensors
 - Relativistic kinematics, relativistic conservation laws
 - Relativistic dynamics, Newton's second law in relativistic form

Course content

- Part III: Electrodynamics
 - Maxwell's equations
 - Electromagnetic waves, polarization
 - Solutions with stationary sources, multipole expansions
 - Solutions with time dependent sources, electromagnetic radiation
 - Electric dipole radiation, Larmor's radiation formula

Summary

- Lagrange-Hamilton formalism is an (abstract) alternative to Newton's mechanics.
- The degrees of freedom (d.o.f.) d is the number of coordinates r_i minus the number of constraints $f_j(r_i) = 0$ on a system.
- We use generalized coordinates q_k , where $k=1, \dots, d$, after the constraints have been applied. Good taste is vital in choice of q !
- Can express K and V in terms of q and \dot{q} .