UiO : Fysisk institutt

Det matematisk-naturvitenskapelige fakultet

FYS3120 – Classical mechanics and electrodynamics

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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

- **Wednesday:** lectures (14.15–16.00).
- **Thursday:** problem solving classes (16.15–18.00) with **Audun Skaugen** in room Ø394.
- **Friday:** lectures (12.15–14.00).
- 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, either generated from LaTeX or scanned from paper.
  - 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.

Mid-term exam

- Dates: 27–31 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 31 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 9 at 14.30 (4 hours).
- Counts as ~ 75% of the total grade. Must be passed in order to pass the course.
- You are allowed to bring the following:
  - Approved calculator.
  - Angell and Lian: “Fysiske størrelser og enheter”.
  - Rottmann: “Matematisk formelsamling”.
  - Collection of formulae for FYS3120. (Bokmål, English or Nynorsk version.)

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)
- **Friday:** Configuration space and virtual displacements. (Sections 1.2 and 1.3)
- 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.

Survival guide

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4) Solve problems.
5) Solve more problems.

Survival guide

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4) Solve problems.

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,…,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 qdot.