Analytical Mechanics

Prof. Aboelnour Abdalla

*Course syllabus*

**Analytical Mechanics**

**FMEN15, 7,5 credits, A (Second Cycle)**

**Valid for:**2018/19  
**Decided by: Aboelnour Abdalla**

**Date of Decision:**2018-09-05

**General Information**

**Language of instruction:**The course will be given in English

**Aim**

* give basic knowledge about the principles, the conceptions and methods in analytical mechanics based on Langrange’s and Hamilton’s formulation of the laws of the classical mechanics.
* provide a basis for further studies in classical mechanics and quantum mechanics.

**Learning outcomes**

*Knowledge and understanding*  
For a passing grade the student must

* provide knowledge of the most important results in the analytical mechanics.
* be able to formulate theoretical models for mechanical systems based on Langrange’s and Hamilton’s methods.
* have some knowledge about the relation to the classical statistical mechanics and quantum mechanics.

*Competences and skills*  
For a passing grade the student must

* be able to analyze some simple models for mechanical systems using computer program (Matlab, Maple etc.).
* be able to perform an analysis of a mechanical problem and to present the results in a well-written report.
* be able to describe some engineering problems in industrial applications that can be studied using analytical mechanics.

*Judgement and approach*  
For a passing grade the student must

* be able to evaluate achieved results based on the problem formulation at hand as well as physical limitations.

**Contents**

Lagrange’s method: mechanical systems, degrees of freedom, generalized coordinates, the Lagrangian, variational principles, Euler-Lagrange’s equations, cyclic coordinates, constants of motion, Noether’s theorem. Hamilton’s method: canonical momenta, Legendre transformation, phase space, the Hamiltonian, Hamiltonian dynamics, Liouville’s theorem, canonical transformations, the Poisson bracket, integral invariants, transformation theory, integrable systems, action-angle variables. Hanilton-Jacobi’s method: Hamilton-Jacobi and the Schrödinger equation. Periodic and chaotic motions. Somewhat on analytical mechanics and its relation to classical statistical mechanics and quantum mechanics.

**Examination details**

**Grading scale:**TH - (U,3,4,5) - (Fail, Three, Four, Five)  
**Assessment:**Hand in exercises and written exam.

The examiner, in consultation with Disability Support Services, may deviate from the regular form of examination in order to provide a permanently disabled student with a form of examination equivalent to that of a student without a disability.

**Admission**

**Required prior knowledge:**Basic courses in Engineering Mechanics, Linear Algebra and Calculus.  
**The number of participants is limited to:**No  
**The course might be cancelled:**If the number of applicants is less than 12.

**Reading list**

* Goldstein, Poole & Safko: Classical Mechanics. 3rd ed. Addison Wesley. 2002.
* Lidström P.: Lecture Notes on Analytical Mechanics. Div. of Mechanics. Lund University. 2007.