

MATHEMATICS 428/609D

Mathematical Classical Mechanics

This course is intended to complement physics department classical mechanics courses in the sense that the physical background will be developed but the emphasis will be on the associated mathematics.

PREREQUISITES:

- Students should already have some experience with rigorous mathematics (like Math 320 and 321) and with classical mechanics (like Physics 206) although these prerequisites may be waived at the discretion of the instructor.

INSTRUCTOR:

- Joel Feldman
- Math building room 221
- 822-5660
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- <http://www.math.ubc.ca/~feldman/>

TEXT: V. I. Arnold, *Mathematical Methods of Classical Mechanics*, Springer Verlag.

I will post all handouts, problem sets, etc. on the web at

<http://www.math.ubc.ca/~feldman/m428/>

OTHER REFERENCES:

- G. Gallavotti, *The Elements of Mechanics*
- H. Goldstein, *Classical Mechanics*

TOPICS:

1. Newtonian Mechanics:
 - The principles of relativity and determinacy, the galilean group, Newton's equations
 - Examples: the harmonic oscillator, pendulum and central fields
 - An introduction to phase space, conservation of energy, momentum and angular momentum
2. Constraint Free Lagrangian Mechanics:
 - Variational problems and the Euler-Lagrange equation
 - The lagrangian and Hamilton's principle of least action
 - The hamiltonian and Hamilton's equations
 - Liouville's theorem
 - Poincaré recurrence theorem
3. Lagrangian Mechanics on Manifolds:
 - The introduction of manifolds through constraints
 - Differentiable manifolds and tangent bundles
 - Lagrangian dynamics
 - Symmetry and Conservation laws: Noether's theorem
4. Differential Forms:
 - Exterior algebra, differential forms on manifolds, exterior differentiation, vector analysis
 - Chains, integration of differential forms
 - Stokes' theorem
 - Poincaré lemma

GRADING:

- There will be weekly problem sets accounting for about 50% of the final mark.
- The final exam will account for about 50% of the final mark.
- Grades **will** probably **be scaled**.

POLICIES:

- Working together on homework is encouraged, but you should write your solutions on your own.
- The final examination will be strictly closed book: no formula sheets or calculators will be allowed.
- There is no supplemental examination in this course.
- Missing a homework normally results in a mark of 0. Exceptions may be granted in two cases: prior consent of the instructor or a medical emergency.