

**UNIVERSITY OF CALGARY
DEPARTMENT OF PHYSICS AND ASTRONOMY
COURSE INFORMATION SHEET**

Lecture/Time/Session(s): **Physics 609, Advanced Classical Mechanics
L01: WF 13:00-14:15, ST 130, Fall 2009**

Instructor(s): L01 Dr. J. Davidsen Office: SB 505, 403-210-7964
Office Hours: W 15:00 – 16:00
Email: joern.davidsen@ucalgary.ca
Main Physics and Astronomy Office: SB 605, 403-220-5385

2. Prerequisite: It is expected that a student's background will include Physics 343 or equivalent.

Note: The Faculty of Science policy on pre- and co-requisite checking is outlined on page 203, columns 2 and 3 of the 2009-2010 Calendar. A student may not register in a course unless a grade at least "C" has been obtained in each pre-requisite course; it is the responsibility of students to ensure that their registrations are in order.

3 The University policy on grading and related matters is described on pages 41-53 of the 2009 - 2010 Calendar. In determining the overall grade in the course the following weights will be used:

Assignments	45%
Midterm Examination	20%
Final Examination	35%

There will be a final examination scheduled by the Registrar's Office. A passing grade on the final examination is required in order to pass the course.

4. Missed Components of Term Work. The regulations of the Faculty of Science pertaining to this matter are outlined on page 204, column 1 of the 2009-2010 Calendar. It is the student's responsibility to familiarize himself/herself with these regulations..

Assignments: Assignments must be handed in on time. Late assignments will not be marked, unless circumstances such as illness prevent a student from meeting the deadline.

Textbook: *"Classical Mechanics"*, 3rd Edition, Goldstein, Poole, and Safko, Addison Wesley, 2002

Recommended: *"Mathematical Methods of Classical Mechanics"* V.I. Arnold, Springer

Department Approval: _____ Date: _____

Associate Dean's Approval for out of regular
class-time activity: _____ Date: _____

IMPORTANT/SAFEWALK: Campus Security will escort individuals day or night. Call 220-5333 for assistance. Use any campus phone, emergency phone or the yellow phones located at most parking lot pay booths.

Academic misconduct (cheating, plagiarism, or any other form) is a very serious offence that will be dealt with rigorously in all cases. A single offence may lead to disciplinary probation or suspension or expulsion. The Faculty of Science follows a zero tolerance policy regarding dishonesty. Please read the sections of the University Calendar under the heading "Student Misconduct (pages 49-53 for 2009-2010).

FOIP: This course will be conducted in accordance with the Freedom of Information and Protection of Privacy Act (FOIP). As one consequence, students should identify themselves on all written work by placing their name on the front page and their ID number on each subsequent page.

STUDENT UNION INFORMATION: VP Academic **Phone:** 220- 3911 **Email:** suypaca@ucalgary.ca
SU Faculty Rep. **Phone:** 220 3913 **Email:** sciencerep@su.ucalgary.ca

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Physics 609, Advanced Classical Mechanics Fall 2009

Catalog description: Variational principles, Lagrange's equations, Noether's theorem. Hamilton's equations and canonical transformations. Hamilton-Jacobi theory, action-angle variables. Perturbation theory.

Course Content

- 1. Review of Newtonian Mechanics:** mathematical formulation, equations of motion, phase space, conservation laws
- 2. Lagrangian formalism:** constraints, generalized coordinates, virtual displacements, principle of virtual work, d'Alembert's principle, Lagrange's equations, generalized potential, Lagrange multipliers
- 3. Variational principles:** action integral, Hamilton's principle, calculus of variations, Euler-Lagrange equation
- 4. Noether's theorem and symmetries:** conservation laws, cyclic variables
- 5. Small oscillations and stability:** equilibrium, linear stability, normal modes
- 6. Hamiltonian formalism:** Legendre transformation, Hamilton's equations, symplectic notation, Routh's procedure, modified Hamilton's principle, action principles, Liouville's theorem, Poincare recurrence theorem, Poisson brackets
- 7. Canonical transformations:** generating functions, symplectic approach, infinitesimal canonical transformations
- 8. Hamilton-Jacobi formalism:** Hamilton-Jacobi equation, Hamilton's principle function, Hamilton's characteristic function, separability, action-angle variables
- 9. Connection between classical & quantum mechanics:** wave mechanics
- 10. Canonical perturbation theory** (time permitting): time-dependent perturbation theory, adiabatic invariants, KAM theorem

Textbooks

Goldstein, Herbert. Classical Mechanics. 3rd ed. San Francisco, CA: Addison-Wesley, 2002. ISBN: 0201316110.

Errata, corrections and comments can be found at <http://astro.physics.sc.edu/goldstein/>

Recommended:

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

Marion, Jerry B., and Stephen T. Thornton. Classical Dynamics. 4th ed. Fort Worth, TX: Saunders College Pub., 1995. ISBN: 0030973023.

David Tong: Lectures on Classical Dynamics. <http://www.damtp.cam.ac.uk/user/tong/dynamics.html>

Scheck, Florian. Mechanics. 3rd ed. New York, NY: Springer-Verlag, 1999. ISBN: 3540655581.

Landau, L. D., and E. M. Lifshitz. Mechanics. 3rd ed. Translated by J. B. Sykes and J. S. Bell. Oxford, UK: Butterworth-Heinemann, 1996. ISBN: 0750628960.

G. J. Sussman, J. Wisdom: Structure and Interpretation of Classical Mechanics. <http://mitpress.mit.edu/SICM/>

J. Shapiro: Classical Mechanics. <http://www.physics.rutgers.edu/grad/507/>

J. E. Marsden and T. S. Ratiu. Introduction to mechanics and symmetry. 2nd ed. New York, NY: Springer-Verlag, 1999.

There will be one **midterm examination** in late October to early November. **Homework assignments** will typically be handed out on Fridays and are due the following Friday before class. All course related material will be posted on Blackboard.

Important dates for Fall 2009

Tu 8-09	Lectures begin.
M 21-09	Last day to change registration
M 12-10	Thanksgiving Day – University Closed
W 11-11 to Su 15-11	Reading Days
Tu 08-12	Lectures end.
F 11-12 to M 21-12	Final Exam period.