

UNIVERSITY OF CALGARY
DEPARTMENT OF PHYSICS and ASTRONOMY
COURSE OUTLINE

1. Course: **Physics 609, Advanced Classical Mechanics**

Lecture Sections:

L01: TuTh, 9:30-10:45, ST 130

Instructor: Dr. J. Davidsen

Office: SB 505, 403-210-7964

Office Hours: Tu 15:30 – 16:30

Email: joern.davidsen@ucalgary.ca

Physics and Astronomy Office: SB 605, 403-220-5385

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

3. **GRADING:** The University policy on grading and related matters is described sections F.1 and F.2 of the online University Calendar. In determining the overall grade in the course the following weights will be used:

Assignments	35%
Midterm test	25% (Th March 10, in-class)
Final Examination	40% (To be scheduled by the Registrar)

Percentage grades will be given for all elements of term work and examinations in Physics 609. A weighted course percentage will be calculated for each student after the final exam is written. A table of conversion from final course percentage to final course letter grade will be published on the Phys 609 Blackboard site later in the term.

4. **Missed Components of Term Work.** The regulations of the Faculty of Science pertaining to this matter are found in the Faculty of Science area of the Calendar in section 3.6: <http://www.ucalgary.ca/pubs/calendar/current/sc-3-6.html>. It is the student's responsibility to familiarize himself/herself with these regulations. See also <http://www.ucalgary.ca/pubs/calendar/current/e-3.html>.

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.

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

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

7. **EXAMINATION POLICY:** All exams are closed book exams, no calculators are permitted. Students are encouraged to read the Calendar, Section G, on Examinations: <http://www.ucalgary.ca/pubs/calendar/current/g.html>.

Department Approval _____ Date _____

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

11. OTHER IMPORTANT INFORMATION FOR STUDENTS:

(a) **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 K. Student Misconduct (<http://www.ucalgary.ca/pubs/calendar/current/k.html>) to inform yourself of definitions, processes and penalties

(b) **ASSEMBLY POINTS in case of emergency during class time.** Be sure to FAMILIARIZE YOURSELF with the information at <http://www.ucalgary.ca/emergencyplan/assemblypoints>.

(c) **ACADEMIC ACCOMMODATION POLICY.** Students with documentable disabilities are referred to the following links:

Calendar entry on students with disabilities: <http://www.ucalgary.ca/pubs/calendar/current/b-1.html>

Disability Resource Centre: <http://www.ucalgary.ca/drc/>

- (d) **SAFEWALK:** Campus Security will escort individuals day or night (<http://www.ucalgary.ca/security/safewalk/>). Call **220-5333** for assistance. Use any campus phone, emergency phone or the yellow phones located at most parking lot pay booths.
- (e) **FREEDOM OF INFORMATION AND PRIVACY:** This course will be conducted in accordance with the Freedom of Information and Protection of Privacy Act (FOIPP). 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.** For more information see also <http://www.ucalgary.ca/secretariat/privacy>.
- (f) **STUDENT UNION INFORMATION:** VP Academic **Phone:** 220-3911 **Email:** suypaca@ucalgary.ca.
SU Faculty Rep. **Phone:** 220-3913 **Email:** sciencerep@su.ucalgary.ca Website <http://www.su.ucalgary.ca/home/contact.html>.
Student Ombudsman: <http://www.su.ucalgary.ca/services/student-services/student-rights.html>
- (i) **INTERNET and ELECTRONIC COMMUNICATION DEVICE Information.** You can assume that in all classes that you attend, **your cell phone should be turned off.** Also, communication with other individuals, via laptop computers, Blackberries or other devices connectable to the Internet is not allowed in class time unless specifically permitted by the instructor. If you violate this policy you may be asked to leave the classroom. Repeated abuse may result in a charge of misconduct.

DETAILED COURSE SYLLABUS

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

Specifically, we will cover:

- 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** (time permitting): wave mechanics
- 10. Canonical perturbation theory:** 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.

Homework assignments will typically be handed out on Thursdays and are due the following Thursday before class. All course related material will be posted on Blackboard.

Important dates for Winter 2011

M 10-01	Lectures begin.
F 21-01	Drop date deadline
M 24-01	Add date deadline
F 28-01	Fee payment deadline
M 21-02	Alberta Family Day – University Closed
Su 20-02 to Su 27-02	Reading Week
F 15-04	Lectures end.
M 18-04 to F 29-04	Final Exam period
F 22-04	Good Friday – University Closed

