DEPARTMENT OF PHYSICS & ASTRONOMY
TRENT UNIVERSITY

PHYS 4140H: ADVANCED CLASSICAL MECHANICS 2016 FA

Peterborough

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Course Description: This course concerns the study of applied mathematics as found in the classical mechanics of particles, rigid bodies, and continuous media. Topics to be covered include: Lagrangian mechanics, Hamiltonian mechanics, dynamics of systems of particles, motion of rigid bodies, and dynamics of oscillating systems.

Course Prerequisites: MATH 2110H (Calculus III: Calculus of Several Variables), MATH-PHYS 2150H (Ordinary Differential Equations), and PHYS-MATH 3130H (Classical Mechanics). Excludes PHYS-MATH 3140H (Advanced Classical Mechanics).

Required Text: Grant R. Fowles & George L. Cassiday, *Analytical Mechanics*, 7th Edition, Brooks/Cole, 2005.

Supplementary Text (Optional): Stephen T. Thornton & Jerry B. Marion, *Classical Dynamics of Particles and Systems*, 5th Edition, Brooks/Cole, 2008. [Another standard Classical Mechanics textbook at a similar level to Fowles & Cassiday]

learningSystem/Blackboard: The course website is available on Blackboard and can be accessed through the myTrent portal. Announcements, lecture notes, assignments, solutions, and other supplemental course material will be posted on this website throughout the term. As such, it is recommended that you log on to check the learningSystem/Blackboard regularly.

Course Format:

Type	Day	Time	Location
Lecture	Monday	1:00-2:50 pm	SC 317
Seminar	Monday	3:00-3:50 pm	SC 317
Lecture	Wednesday	9:00-9:50 am	GCS 110

Learning Outcomes/Objectives/Goals/Expectations: This course has been developed to address several learning outcomes. By the end of the course a successful student should be able to:

1. Understand the fundamental principles of Hamiltonian and Lagrangian mechanics, and describe how these principles relate to the formulations of Newtonian and quantum mechanics.
2. Determine the Lagrangian and/or Hamiltonian for a physical system, and obtain the relevant equations of motion.
3. Analyze and evaluate problems involving systems of particles (e.g. motion of interacting bodies, collisions and scattering, rocket motion).
4. Solve problems related to the motion and mechanics of rigid bodies (e.g. centre of mass, moment of inertia, Euler's equations of motion, physical pendulum, dynamics of a top).
5. Analyze and evaluate problems involving oscillating systems (e.g. coupled harmonic oscillators, vibrating systems, loaded and continuous string).

Course Evaluation:

Type of Assessment	Weighting	Due Date
Assignments (x5)	30%	Throughout the term
Midterm	20%	October 17th
Class Presentation	15%	November 14th
Final Exam	35%	December exam period

Assignments (30%): There will be five assignments throughout the term, consisting of problems similar to those discussed in class, solved in the tutorials, or provided in the textbook. Assignments will be due at ~2 to 3 week intervals, and each assignment will be given equal weight.

Midterm (20%): There will be a one hour and 50 minute long midterm examination held on Monday, October 17th, during the normal class timeslot (1:00-2:50 pm).

Class Presentation (15%): There will be 30 minute student presentations (plus question and answer period) held on Monday, November 14th. The topics for these presentations will be drawn from either: (a) recent peer-reviewed articles or (b) practical applications (e.g. astrophysics, engineering, physics of sport) related to course content. Topics must be approved by the instructor at least two weeks in advance (i.e. by Monday, October 31st).

Final Exam (35%): There will a three hour long final examination for this course, which will be held during the December exam period. This exam will be cumulative, and may encompass any material covered from the beginning of the course.

Week-by-Week Schedule:

This course will cover material taken from Chapters 7 to 11 in Fowles & Cassiday. The schedule of topics is listed below:

- Lagrangian Mechanics (Ch. 10)
- Hamiltonian Mechanics (Ch. 10)
- Dynamics of Systems of Particles (Ch. 7)
- Motion of Rigid Bodies (Ch. 8, Ch. 9)

- Dynamics of Oscillating Systems (Ch. 11)
- Dynamics of Continuous Systems (Ch. 11)

Although specific dates are not listed, I will follow the order of topics as given and will regularly communicate in class and on the learningSystem/Blackboard about the pacing of the lectures. For this reason, it is important for you to attend class and to log on to the learningSystem/ Blackboard regularly.

Department and/or Course Policies:

Midterms and Exams: Regardless of the final grade calculated using the marking scheme above, a weighted average of at least 40% must be obtained on the midterm and the final exam in order to pass this course. If this condition is not met, a final grade not exceeding 45% (F) will be assigned.

Late Policy: Marks will be deducted for late assignments at a rate of 10% per day (including weekends). Assignments will normally be accepted up to one week beyond the due date, after which a mark of zero will be assigned.

University Policies

Academic Integrity:

Academic dishonesty, which includes plagiarism and cheating, is an extremely serious academic offence and carries penalties varying from failure on an assignment to expulsion from the University. Definitions, penalties, and procedures for dealing with plagiarism and cheating are set out in Trent University's *Academic Integrity Policy*. You have a responsibility to educate yourself – unfamiliarity with the policy is not an excuse. You are strongly encouraged to visit Trent's Academic Integrity website to learn more: www.trentu.ca/academicintegrity.

Access to Instruction:

It is Trent University's intent to create an inclusive learning environment. If a student has a disability and documentation from a regulated health care practitioner and feels that he/she may need accommodations to succeed in a course, the student should contact the Student Accessibility Services Office (SAS) at the respective campus as soon as possible.