

# PHYSICS 3151A

## Classical Mechanics 1

**Lecture Times:** MWF 10:30 am -11:20 am

**Meeting Place:** PAB 117

**Instructor:** Dr. Jamal Sakhr

**Office:** PAB 269

**Phone:** (519) 661-2111, ext. 86400

**E-Mail:** [jsakhr@uwo.ca](mailto:jsakhr@uwo.ca)

**Office Hours:** \_\_\_\_\_ and/or by appointment

**Course Website:** TBA

**PRE-REQUISITES:** It is assumed that students have a solid grasp of vector algebra and (differential, integral, and vector) calculus, and also have a good knowledge of elementary linear algebra and ordinary differential equations.

**FORMAL PRE-REQUISITES:** See Academic Calendar.

**Note:** Unless you have the requisites for this course or written special permission from your Dean to enroll in it, you may be removed from this course and it will be deleted from your record. This decision may not be appealed. You will receive no adjustment to your fees in the event that you are dropped from a course for not having the necessary prerequisites.

**TEXTBOOKS:** There is no *required* textbook for this course. All course material will be provided in lectures and/or posted on the course website. However, it is highly recommended that students own at least one classical mechanics textbook as a reference and as a (secondary) learning resource. There are multitudes of books on classical mechanics. The textbooks listed below are particularly recommended (based on their content and level of presentation) by your instructor. It is advisable that students purchase *one* of these books. The book by Gregory (Ref. [2] below) is particularly recommended and is the optional textbook for this course.

### **BOOK LIST:**

[1] *Classical Dynamics of Particles and Systems*, Marion and Thornton (4<sup>th</sup> or 5<sup>th</sup> edition).

[2] *Classical Mechanics\**, R. Douglas Gregory (2006).

[3] *Analytical Mechanics*, Fowles and Cassiday (5<sup>th</sup>, 6<sup>th</sup>, or 7<sup>th</sup> edition).

[4] *Classical Mechanics: A Modern Perspective*, Barger and Olsson (2<sup>nd</sup> edition).

[5] *Introduction to Classical Mechanics*, A.P. Arya (2<sup>nd</sup> edition).

[6] *Classical Mechanics: Point Particles and Relativity*, W. Greiner (2004).

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\* The paperback edition of this textbook is available for purchase in the Bookstore.

## **COURSE DESCRIPTION:**

As stated in the Western Academic Calendar: “***This course provides students with the [mathematical and theoretical] tools [necessary] to tackle more complex problems than those covered in introductory mechanics.***” The first part of the course focuses on Newtonian mechanics, but will be at a level that is more sophisticated than what you have encountered before in your introductory mechanics course(s). The central-force problem will also be analyzed within the framework of Newtonian mechanics. The Lagrangian approach to mechanics will be introduced in the latter part of the course. The following topics will be covered:

- (1) Newtonian dynamics of single-particle systems in one and higher dimensions
- (2) non-linear oscillations in 1D conservative systems
- (3) free harmonic oscillations in two and three dimensions; coupled oscillations
- (4) the central-force problem
- (5) multi-particle systems (including detailed analyses of two-and three-body problems)
- (6) introduction to Lagrangian mechanics
- (7) introduction to variational methods in classical mechanics (time permitting)

## **HOMEWORK/PROBLEM SETS:**

Homework sheets will be posted on the course website (approximately bi-weekly). On each homework sheet, you will find “Exercises” to work out and “Problems” to be solved and handed in for grading. “Exercises” are for practice and are meant to build up your problem solving skills; answers to these will be provided. “Problems” are to be solved and handed in for credit. Full solutions to “Problems” will be posted after grading.

It is vital that you actually work through the Exercises (i.e., the ones not handed in for credit). Ideally, you should work through the Exercises (or most of them) *before* attempting to solve the (‘hand-in’) Problems. The Problems will be somewhat harder than the Exercises, and so the idea is that by solving the Exercises you will build up the analytical skills necessary to tackle the harder (‘hand-in’) Problems.

**COMMENT ON GROUP PROBLEM SOLVING:** Please feel free to work on problems with other students in the class, but make sure that *you* understand how to solve each problem. Needless to say, *you* should independently write up *your own* solution to every problem regardless of whether or not you solved the problems on your own. Remember, on the exams, *you* will have to solve all the problems by *yourself*.

**POLICY ON LATE SOLUTION SETS:** Solutions to the (‘hand-in’) Problems are due at the beginning of class on the due date. Any solution set that is not handed in at this time will receive a zero. **Solution sets will not be accepted at any other time.** (A grace period *may*

be granted by the instructor in exceptional circumstances.) The due date for an assignment may be extended *if* there is consensus among students that more time is needed.

**GETTING HELP:** If you need help with your homework, or there is something you don't understand, please drop in during office hours or make an appointment to see your instructor to work things out. PLEASE COME PREPARED! Bring your textbook, notebook, lecture notes, and problem(s) you want to discuss. If you are having difficulty with one of the Problems to be handed in for grading, **your instructor will help you *only if there is clear evidence that you have actually attempted to solve the Problem before coming to see him.*** And to be clear, your instructor will only provide guidance on the Problem; he will not solve the Problem for you!

## **EXAMS:**

There will be a mid-term exam and a final exam in this course. The mid-term will be *two hours*. The date of the mid-term will fall during the usual mid-term period; the time and location will be disclosed in due course. The date, time, and location of the final exam in December are set by the Registrar. **Calculators will not be allowed during the exams.**

Exam times will be posted on the course web site when available. Students needing to make travel arrangements are advised to book a travel date *after* the end of the examination period. **No makeup exams will be given to accommodate travel.**

**Missed Midterm Exam:** Documentation must be provided to the instructor in order for you to receive permission to write a make-up. If you miss the make-up for a valid reason, again documentation must be provided, and your mark will be pro-rated.

**Missed Final Exam:** Documentation must be provided to the academic counselors in your faculty in order for you to receive permission to write a make-up, which is usually scheduled for late December to early January (to be announced – plan your travel accordingly). If you miss the make-up for a valid reason, again documentation must be provided, and you will then write the exam at the next sitting of this course's final exam (typically one year later).

## **EVALUATION:**

PROBLEM SETS:	30%	(six sets; approximately bi-weekly)
MID-TERM EXAM:	30%	(during usual mid-term period)
FINAL EXAM:	40%	(date set by Registrar)

**DISCLAIMER:** The Department of Physics and Astronomy may, in exceptional cases, adjust the final course marks in order to conform to Departmental policy.

## **ACADEMIC INTEGRITY:**

### **Scholastic Offences**

Scholastic offenses are taken seriously and students are directed to read the appropriate policy, specifically, the definition of what constitutes a Scholastic Offense, at the following Web site:

[http://www.uwo.ca/univsec/handbook/appeals/scholastic\\_discipline\\_undergrad.pdf](http://www.uwo.ca/univsec/handbook/appeals/scholastic_discipline_undergrad.pdf)

### **Cheating**

Cheating refers, among other things, to access to exam and assignment solutions by illicit means, including theft from other students, copying from other students, illegal access to instructor notes, inappropriate extraction from the world-wide-web, and illegal coercion of teaching assistants and other staff. The definition of cheating is not restricted to these examples, and may be interpreted more broadly at the instructor's discretion. If two submitted assignments are identical, or almost identical, both will be given a grade of zero. Assignment solutions should be distinctively individual.

### **Acknowledging Sources in Assignments**

Whenever students obtain auxiliary information from any source (books, world-wide-web, etc.), they must acknowledge their debt by proper referencing such as footnotes or citations.

### **Classroom Conduct**

Disruptive behaviour will not be tolerated in class. Please respect the rights of your classmates to benefit from the lecture by limiting your conversations to those essential to the class. Students who persist in loud or rude behaviour will be asked to leave.

## **MISCELLANEOUS UNIVERSITY REGULATIONS:**

### **Accommodations for Religious Holidays**

When scheduling unavoidably conflicts with religious holidays which a) require an absence from the University or b) prohibit or require certain activities (i.e., activities that would make it impossible for the student to satisfy the academic requirements scheduled on the day(s) involved), no student will be penalized for absence because of religious reasons, and alternative means will be sought for satisfying the academic requirements involved. If a suitable arrangement cannot be worked out between the student and instructor involved, they should consult the appropriate department chair and, if necessary, the student's Dean.

It is the responsibility of such students to inform themselves concerning the work done in classes from which they are absent and to take appropriate action. A student who, for either of the situations outlined in paragraph one above, is unable to write examinations and term tests on a Sabbath or Holy Day in a particular term shall give notice of this fact in writing to his or her Dean as early as possible, but not later than November 15 for mid-year exams and March 1 for final exams (i.e., approximately two weeks after the posting of the mid-year and final examination schedule respectively). In the case of mid-term tests, such notification is to be given in writing to the instructor within 48 hours of the announcement of the date of the mid-term test. If a Special Examination is offered as an alternative means to satisfy the academic requirements, the instructor(s) in the case of mid-term tests and the dean in the case of mid-year and Spring final examinations will arrange for special examination(s) to be written at another time. In the case of mid-year and Spring final

examinations, the accommodation must occur no later than one month after the end of the examination period involved. It is mandatory that students seeking accommodations under this policy give notification before the deadlines and that Faculty accommodate these requests.

For purposes of this policy the University has approved a list of dates which are recognized religious holidays which require members of those religions to be absent from the University; this list is updated annually and is available at Departmental, Deans' and Faculty advising offices.

### **Make-up Policy**

If you are unable to meet a course requirement due to illness or other serious circumstances, you must provide valid medical or other supporting documentation to the Dean's office as soon as possible and contact your instructor immediately. It is the student's responsibility to make alternative arrangements with their instructor once the accommodation has been approved and the instructor informed. In the event of a missed final exam, a "Recommendation of Special Examination" form must be obtained from the Dean's Office immediately.

For UWO Policy on Accommodation for Medical Illness, see:

[http://www.uwo.ca/univsec/handbook/appeals/accommodation\\_medical.pdf](http://www.uwo.ca/univsec/handbook/appeals/accommodation_medical.pdf).

A student requiring academic accommodation due to illness should use the Student Medical Certificate [see <https://studentservices.uwo.ca/> under the Medical Documentation heading for a downloadable SMC] when visiting an off-campus medical facility, or request a Records Release Form (available in the Dean's Office) for visits to Student Health Services.

Students seeking academic accommodation on medical grounds for any missed tests, exams, participation components and/or assignments worth 10% or more of their final grade must apply to the Academic Counselling office of their home Faculty and provide documentation. Academic accommodation cannot be granted by the instructor or department.

### **Final Examination**

In accordance with Senate Policy, a Special Examination will be held within thirty days of the regular final examination for students who are unable to write the regular examination for medical or other documented reasons. Requests for such a Special Examination must be made to the Associate Dean, Faculty of Science.

Note that if you fail to write a scheduled Special Examination, permission to write another Special Examination will be granted only with the permission of the Dean in exceptional circumstances and with appropriate supporting documents. In such a case, the date of this Special Examination normally will be the scheduled date for the final exam the next time the course is offered.

### **Accessibility**

Services for Students with Disabilities (SSD) works with all academic departments to arrange appropriate accommodations for students with disabilities without compromising the academic integrity of the curriculum.

Please contact the course instructor if you require material in an alternate format or if you require any other arrangements to make this course more accessible to you. You may also wish to contact the SSD at 661-2111 ext. 82147 for any specific question regarding an accommodation.

### Complaints and Suggestions

If you have any concerns, please let us know. We rely on your feedback. Please contact initially the person most directly concerned; this will usually be your instructor. If that is not satisfactory, or if there is something more general bothering you, talk it over with the Physics & Astronomy Department Chair or the Associate Chair of Undergraduate Studies (for contact information see <http://www.physics.uwo.ca>).

### Contacting the Instructor

The instructor will generally be available for quick discussions immediately after each lecture. For longer interactions, please make an appointment. This can be set up after a lecture, or via e-mail. The simplest way to contact him outside of lectures is via your UWO e-mail account.

*We will not **read** or **respond** to emails from addresses that do not end in “@uwo.ca”.*

## TIPS FOR ACING THIS COURSE:

- (1) attend all lectures
- (2) go over your lectures notes after class (and work through the details!)
- (3) read through appropriate (sub)sections of the text (for more information)
- (4) review mathematical material (e.g., geometry, calculus, ODEs, etc.) when needed
- (5) start working on the Homeworks (especially the Exercises) right away
- (6) make sure **you** can (eventually) solve all the Homework questions **on your own**
- (7) if you encounter difficulties, talk to other students, or see your instructor for help

### A FINAL TIP:

**YOU SHOULD RESERVE 3 HOURS PER WEEK FOR HOMEWORK!**

