PHY293H1F – WAVES AND MODERN PHYSICS
DEPARTMENT OF PHYSICS UNIVERSITY OF TORONTO
Course Syllabus : FALL 2019-20

This course is taught as two consecutive sections: Waves (Sep. 5 - Oct. 18) and Modern Physics (Oct. 21 - Dec. 3). The general course, tutorial and laboratory information is given on this page. The individual syllabi for the two sections are given on the following pages.

Course Website: on Quercus and https://www.physics.utoronto.ca/students/undergraduate-courses/current/phy293h1.

Course Coordinator and Lecturer:
Dr. Natalia Krasnopolskaia
Office: MP251 B
Office hours: Wednesday 12:30 pm - 1:30 pm; Friday 1:30 pm – 2:30 pm in MP 251 B.
Email: natalia@physics.utoronto.ca
Please contact the course coordinator on matters relating to course administration, e.g. grading.

Lecturer:
Prof. Nicolas Grisouard
Office: MP703
Office Hours: Monday and Tuesday 6 pm – 7 pm in MP 703
E-mail: nicolas.grisouard@physics.utoronto.ca.

Tutorial Instructors:

Tutorial TA	Office	Email
Ms. Kristen Cote	MP 037	kcote@physics.utoronto.ca
Mr. Shayne Gryba	MP 1104A	sgryba@physics.utoronto.ca
Mr. Joseph McGowan	MP 045	jmcgowan@physics.utoronto.ca
Mr. Sreekar Voleti	MP 1026	svoleti@physics.utoronto.ca

Marking Scheme:

Final exam	40 %	2.5 hours
Two midterm tests	30 %	60 minutes each
Quizzes	10 %	20 minutes each
Laboratories	20 %	Four 3-hour sessions

Midterm Tests and Final Examination

- Term Test 1: Monday, October 21, 9:30 – 10:30 am; TBA**.** The test covers material of the Waves component of the course.
- Term Test 2: Monday, November 18, 9:30 – 10:30 am; TBA. The test covers material of the Modern Physics component of the course.
- Final Exam: 2.5 hours in December, 2019 (date and time to be scheduled by Faculty during the December exam period).

There is no make-up test. Absence at the test must be supported by a petition submitted on line along with medical or other valid documentation. If the petition is approved by the Division of Engineering Science, a weight of the missed test will be transferred to the corresponding section of the exam.

Lectures:
3 hours/week, in MP103 (Friday) and MP202 (Monday, Tuesday). The first lecture is on Friday, Sep. 6.

Section	**Monday**	**Tuesday**	**Friday**
LEC0101	3 pm	3 pm	11 am
LEC0102	4 pm	4 pm	12 pm

WAVES SECTION

Lecturer: Prof. Nicolas Grisouard
TEXTBOOK: "Vibrations and Waves" by George C. King (Publisher: Wiley).
COURSE NOTES: Course notes will be posted to Course Materials on Quercus and on GitHub.

Week #	Lecture Date	Topic	Textbook Reference
1	September 6	Intro + Simple harmonic oscillators	Chapter 1
2	September 9	Simple harmonic oscillators: energy + intro to damping	Chapter 1
2	September 10	Over-, under- and critically-damped harmonic oscillators	Chapter 2
2	September 13	Damped harmonic oscillators: energy and Q-factor	Chapter 2
3	September 16	Driven oscillators and resonance	Chapter 3
3	September 17	Driven, damped harmonic oscillators: resonance curve, transients	Chapter 3
3	September 20	Power curve, LRC circuit	Chapter 3
4	September 23	Coupled pendulums; beating	Chapter 4
4	September 24	Coupled pendulums as an eigenvalue problem	Chapter 4
4	September 27	Orthogonality of the normal modes; from two to n coupled oscillators	Chapter 4
5	September 30	The wave equation; standing waves on a taut string	Chapters 5,6
5	October 1	Orthogonality of the standing wave modes; initial value problems theory	Chapter 6
5	October 4	Initial value problems: examples and illustrations; energy	Chapter 6
6	October 7	Travelling waves as a superposition of modes; general solution	Chapter 5
6	October 8	Energy of traveling waves; reflection and transmission	Chapter 5
6	October 11	Dispersion of Waves	Chapter 8
7	October 14	Thanksgiving (no classes)	
7	October 15	Examples of dispersive behaviour	Chapter 8
7	October 18	Wave Packets	Chapter 8

Midterm Test 1 – Monday, October 21.

MODERN PHYSICS SECTION

Lecturer: Prof. Natalia Krasnopolskaia
TEXTS: 1) E-book "Modern Physics" by Michael Fowler (free of charge)
(a) Notes on Special Relativity: http://galileo.phys.virginia.edu/classes/252/SpecRelNotes.pdf
(b) Other topics: http://galileo.phys.virginia.edu/classes/252/home.html
2) Quantum Mechanics, 6th edition by Alastair I.M. Rae (CRC Press)
COURSE NOTES: Course notes will be posted to Course Materials on Quercus.

Week #	Lecture Date	Topic	Text Reference
8	October 21	Introduction to Modern Physics	Fowler (a): p.3, Rae: 3.1
8	October 22	Einstein's postulates. Special Relativity	F (a): p.18; R: 3.1.
8	October 25	Lorentz transformations	F (a): p.30; R: 3.2.
9	October 28	Paradoxes in SR. Relativistic Doppler shift	F (a): p.47, 72; R: 3.2.
9	October 29	The Twin paradox	F (a): p.42-47; R: 3.2.
9	November 1	Four-vectors, Lorentz invariants, light cones, relativistic kinematics	F (a): p.36; R: 3.2-3.3.
10	November 11	Relativistic energy and momentum	F (a): p.52-71; R: 3.3.
10	November 12	Path to quantum mechanics. Quantization.	F (b): Photons; R: 4.1, 4.3
10	November 15	Photo-electric effect. X-ray production	F (b): Photons; R: 4.2
11	November 18	Compton scattering, inelastic processes	R: 4.3
11	November 19	Wave-particle duality of light	F (b): Particles and waves; R: 4.5.
11	November 22	More on wave-particle duality	F (b): Particles and waves; R: 4.5.
12	November 25	Matter Wave. Uncertainty principle	F (b): Particles and waves; R: 4.4, 7.4, 7.5.
12	November 26	Atomic models	F (b): Atoms; R: 5.1-5.3
12	November 29	The Schrödinger equation	F (b): Schrodinger equation; R: 5.4.
13	December 2	Wave-functions. Infinite square well potential	F (b): Schrodinger equation; R: 5.4.
13	December 3	Wave-functions and probability, stationary	F (b): Schrodinger equation; R: 7.3

Midterm Test 2 – Monday, November 18.

Tutorials:
The first tutorial is on Tuesday, September 10, led by teaching assistants in rooms listed below. The 11 tutorials run from Sep 10 to Nov 28.

Section	Day	Time	Tutorial Room	TA
TUT0101	Thu	4 - 5 pm	HA 316	Kristen Cote
TUT0102	Thu	4 - 5 pm	WB 119	Shayne Gryba
TUT0103	Thu	3 - 4 pm	BA 2135	Sreekar Voleti
TUT0104	Thu	3 - 4 pm	BA 1240	Shayne Gryba
TUT0105	Tue	10 -11 am	BAB 024	Joseph McGowan
TUT0106	Tue	10 -11 am	WB 119	Kristen Cote
TUT0107	Tue	11 am - noon	BAB 024	Joseph McGowan
TUT0108	Tue	11 am - noon	MY 440	Sreekar Voleti

TUTORIAL AND IN-CLASS QUIZZES SCHEDULE

- Suggested problems, not to be handed in, will be posted on Quercus and announced in class. Strategies for solving them will be discussed in the tutorials and solutions will be posted.

- Four quizzes, based on past suggested problems, will be given in tutorial. They will be graded by your tutor and handed back the following week.

Week # (week of)	**Tutorial #**	**Notes**
1 (Sep 2)		First lecture on Sep 6. No tutorials this week.
2 (Sep 9)	1	First tutorials: Sep 10 in TUT05 – 08; Sep 12 in TUTU01 – TUT04.
3 (Sep 16)	2	
4 (Sep 23)	3	Quiz 1 (TUT0105-08: Sep 24/ TUT0101-04: Sep 26).
5 (Sep 30)	4	
6 (Oct 7)	5	
7 (Oct 14)	6	Oct 14 – Thanksgiving (no classes). Quiz 2 (Oct 15/17) for Part I.
8 (Oct 21)	7	Term test 1 on Oct 21. Part II starts on Oct 21.
9 (Oct 28)	8	
10 (Nov 4)		Fall Reading Week. No classes.
11 (Nov 11)	9	Quiz 3 (Nov 12/14).
12 (Nov 18)	10	Term test 2 on Nov 18.
13 (Nov 25)	11	Quiz 4 (Nov 26/28).
14 (Dec 2)		Last lecture on Dec 3. No tutorials this week.

Laboratories

The Lab Coordinator for this course is Dr. Natalia Krasnopolskaia (Office: MP251 B).

Laboratory web site is http://www.physics.utoronto.ca/~phy293lab/phy293lab.htm and Quercus.

- The lab experiments are booked by students. As such, the experiments do not necessarily follow the order of the content of lectures and tutorials.
- For each student, one experiment is in Waves, and the other one is in Modern Physics.
- Each student performs experiments in four 3-hour sessions and submits a paperless lab report by uploading it to Blackboard. Students are working in pairs.

The laboratory experiments cover the following topics:

- Mechanical and Electromagnetic Waves, Wave Optics.
- Classic Experiments in Measuring Fundamental Constants (e, e/m, R, h, k).
- Quantum Physics and Particle Physics.

The lab is scheduled once every two weeks on Wednesdays with starting dates indicated below:

Section	Lab Dates	Time	Room
PRA0101	2019/09/11 2019/09/25 2019/10/09 2019/10/23	9 am - noon	MP222
PRA0102	2019/09/18 2019/10/02 2019/10/16 2019/10/30	9 am - noon	MP222
PRA0103	2019/09/11 2019/09/25 2019/10/09 2019/10/23	2 pm – 5 pm	MP222
PRA0104	2019/09/18 2019/10/02 2019/10/16 2019/10/30	2 pm – 5 pm	MP222

Recommended Readings:

1. J.R. Taylor: An Introduction to Error Analysis: The Study of Uncertainties in Physics Measurements, 2nd ed., University Science Books. 1997.
2. P.R. Bevington, D.H. Robinson: Data Reduction and Error Analysis for the Physical Sciences, 3rd ed., McGraw Hill. 2003.

TA/Lab Demonstrator	Lab Section	e-mail address
Mr. Nishant Bhatt	PRA03, PRA04	nishant.bhatt@mail.utoronto.ca
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Mr. Charles Zhang	PRA01, PRA02	cha.zhang@utoronto.ca

Instructors Email Policy:
General questions that refer to physics being discussed in the course should be posted to the course discussion board on the Portal or Piazza – please check your utoronto email address for instructions on how to log in. We will generally provide feedback on these within 48 hours. Only if this fails to resolve your issue should you email one of the instructors directly for further clarification, or to set up an appointment to delve deeper into your question. Instructors **will not** answer administrative questions (about grades, due dates or material covered in tests of exams) by email. Answers to these can be found on the Portal or you can approach the instructor before/after a lecture.

Academic Integrity
Academic integrity is fundamental to learning and scholarship at the University of Toronto. Participating honestly, respectfully, responsibly, and fairly in this academic community ensures that the U of T degree that you earn will be valued as a true indication of your individual academic achievement, and will continue to receive the respect and recognition it deserves. Familiarize yourself with the University of Toronto's Code of Behaviour on Academic Matters (http://www.governingcouncil.utoronto.ca/policies/behaveac.htm). It is the rule book for academic behaviour at the U of T, and you are expected to know the rules.

Tests and Exam
Midterm tests and the final exam must be done individually, involving no communication at all with your peers. It is strongly advised not to engage in any behaviour that might be construed by the invigilators for the tests/exam as an attempt to obtain information from another candidate or from another test/exam paper.

The University of Toronto treats cases of academic misconduct very seriously. All suspected cases of academic dishonesty will be investigated following the procedures outlined in the Code. The consequences for academic misconduct can be severe, including a failure in the course and a notation on your transcript. If you have any questions about what is or is not permitted in this course, please do not hesitate to contact the course coordinator. If you are experiencing personal challenges that are having an impact on your academic work, please speak to the course coordinator or seek the advice of your college registrar.

Accommodations
If you have a learning need requiring an accommodation the University of Toronto recommends that students immediately register at Accessibility Services at http://www.studentlife.utoronto.ca/as.

Location: 4th floor of 455 Spadina Avenue, Suite 400

Voice: 416-978-8060

Fax: 416-978-5729

Email: accessibility.services@utoronto.ca

The University of Toronto supports accommodations of students with special learning needs, which may be associated with learning disabilities, mobility impairments, functional/fine motor disabilities, acquired brain injuries, blindness and low vision, chronic health conditions, addictions, deafness and hearing loss, psychiatric disabilities, communication disorders and/or temporary disabilities, such as fractures and severe sprains, recovery from an operation, serious infections or pregnancy complications.

Equity, Diversity and Excellence
At the University of Toronto, we strive to be an equitable and inclusive community, rich with diversity, protecting the human rights of all persons, and based upon understanding and mutual respect for the dignity and worth of every person. We seek to ensure to the greatest extent possible that all students enjoy the opportunity to participate as they see fit in the full range of activities that the University offers, and to achieve their full potential as members of the University community.

Our support for equity is grounded in an institution-wide commitment to achieving a working, teaching, and learning environment that is free of discrimination and harassment as defined in the Ontario Human Rights Code. In striving to become an equitable community, we will also work to eliminate, reduce or mitigate the adverse effects of any barriers to full participation in University life that we find, including physical, environmental, attitudinal, communication or technological.

Our teaching, scholarship and other activities take place in the context of a highly diverse society. Reflecting this diversity in our own community is uniquely valuable to the University as it contributes to the diversification of ideas and perspectives and thereby enriches our scholarship, teaching and other activities. We will proactively seek to increase diversity among our community members, and it is our aim to have a student body and teaching and administrative staffs that mirror the diversity of the pool of potential qualified applicants for those positions.

We believe that excellence flourishes in an environment that embraces the broadest range of people that helps them to achieve their full potential, that facilitates the free expression of their diverse perspectives through respectful discourse, and in which high standards are maintained for students and staff alike. An equitable and inclusive learning environment creates the conditions for our student body to maximize their creativity and their contributions, thereby supporting excellence in all dimensions of the institution.

Statement on Mental Health and Wellness

As a university student, you may experience a range of health and/or mental health issues that may result in significant barriers to achieving your personal and academic goals. The University of Toronto offers a wide range of free and confidential services and programs that may be able to assist you. We encourage you to seek out these resources early and often.
Student Life Website: http://www.studentlife.utoronto.ca
Health and Wellness Website: http://studentlife.utoronto.ca/hwc

If, at some point during the year, you find yourself feeling distressed and in need of more immediate support, visit the **Feeling Distressed Webpage**: http://www.studentlife.utoronto.ca/feeling-distressed, for more campus resources.

Immediate help is available 24/7 through **Good2Talk**, a post-secondary student helpline at 1-866-925-5454.

All students in the Faculty of Engineering have an Academic Advisor who can advise on academic and personal matters. You can find your department's Academic Advisor here: http://undergrad.engineering.utoronto.ca/advising-support-services/academic-advising/