Department of Physics, University of Windsor

Physics 64-151:
From Symmetry to Chaos in the Universe
Winter 2016

Instructor: Prof. Eugene H. Kim
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Lectures: Tuesday and Thursday – 1:00 – 2:20PM in 354 Dillon Hall
Friday – 1:30 – 2:20PM in 265 Dillon Hall

Office Hours: Tuesday afternoons – 2:30 to 4:00PM
Wednesday afternoons – 2:30 to 4:00PM

Prerequisites:

(1) Physics 64-140: Introductory Physics I
(2) Mathematics 62-140: Differential Calculus
(3) Mathematics 62-120: Linear Algebra I

or equivalents.

Relevant Texts:

(1) The Feynman Lectures on Physics, R.P. Feynman, R.B. Leighton, M. Sands
(2) Revolutions in Twentieth Century Physics, D.J. Griffiths
(3) A Student's Guide to Python for Physical Modeling, J.M. Kinder and P. Nelson
(4) Numerical Recipes, W.H. Press, S.A. Teukolsky, W.T. Vetterling, B.P. Flannery
(5) An Introduction to Error Analysis, J.R. Taylor
(6) Introduction to Special Relativity, R. Resnick
(7) Elementary Differential Geometry, B. O'Neill

Evaluation:

(1) Homework 30%
(2) Midterm Exam 25%
(3) Final Exam 45%

Midterm Exam:

- Date: Thursday, March 3
  in class exam, 1 hour 20 minutes long
- Exam format: worked problems, similar (but not identical) to the homework problems; short-answer and/or conceptual problems may also be given.
- Make-up exam: There will be ***no make-up exam for the midterm exam*** – the percentage will be transferred to the final exam.

Final Exam:

- Date: Wednesday, April 13 at 12:00PM –
  in class exam, 3 hours long
- Exam format: comprehensive exam covering all the material discussed in the course. The final exam will consist of worked problems, similar (but not identical) to the homework problems; short-answer and/or conceptual problems may also be given.
- Make-up exam: A make-up examination for the final exam will only be administered with acceptable and verifiable medical (or equivalent compassionate) reasons.

Homework:

- Homework will be assigned during class weekly; the assignment will be due at the beginning of class one week after it is assigned.
- No late homework will be accepted – an assignment submitted after the deadline will receive a zero.
- Homework is to be done individually by each student and prepared in a legible, professional manner. Multiple sheets should be stapled together prior to submission of the assignment.
- While students may work together, each student must hand in his/her own work – copying from other students is NOT ALLOWED.
  Copying from other students constitutes ***plagiarism***.

  Each student will be responsible for defending his/her solutions if necessary.

Additional Notes:

- Ultimately, the syllabus is given by the contents of the lectures.
- The Student Evaluation of Teaching (SET) forms will be distributed during one of the classes in the final 2 weeks of the semester.
- University-recognized (via the University Disability Services) 'special needs' students should make themselves known to the instructor at the beginning of the course and discuss what arrangements are needed and how they might be accommodated.
- The University's *Student Code of Conduct* provides that all students are expected to commit to a code of behavior based on dignity and individuality, and respect for the rights and property of others.
  - Anyone exhibiting disruptive behavior will be asked to leave the classroom. [Disciplinary actions will be taken for failure to follow directions.]
  - Plagiarism and academic dishonesty are serious offenses; they will be addressed using official University guidelines/policies.

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Course Content

(1) Overview/Goals
- (a) purpose of the course and guiding principles
- (b) preliminaries
  - (i) functions
  - (ii) computation

(2) Physical Quantities and Units
- (a) length, time, energy scales
- (b) dimensional analysis

(3) Linear Systems
- (a) physics: definition and examples
- (b) mathematics:
  - (i) Taylor series
  - (ii) linear algebra: matrices and systems of linear equations

(4) Complexity and Chaos
- (a) physics: definition and examples
- (b) mathematics:
  - (i) multivariable calculus
  - (ii) elements of probability theory

(5) Einstein's Relativity
- (a) Special Relativity
- (b) Introduction to General Relativity

(6) The Quantum Theory
- (a) physics:
  - (i) history
  - (ii) postulates of quantum mechanics
  - (iii) quantum "weirdness"
- (b) mathematics
  - (i) rudiments of complex variables
  - (ii) linear algebra: vector spaces, diagonalization, singular value decomposition

(7) Particle Physics
- (a) history and phenomenology
- (b) physical/mathematical framework: quantum field theory

(8) Cosmology
- (a) physics: how we got here
- (b) mathematics: introduction to differential geometry