Spring 2-1-2018

PHSX 301.01: Introduction to Theoretical Physics

Eijiro Uchimoto
University of Montana - Missoula, eijiro.uchimoto@umontana.edu

PHYSICS 301 – Intro to Theoretical Physics Spring Semester 2018

LECTURES

Mon., Wed., & Fri. 11:00 a.m. – 11:50 a.m., CHCB 231

INSTRUCTOR

Eijiro ('Ebo') Uchimoto
Office: CHCB 127 (Tel. No. 243-6223)
Email: eijiro.uchimoto@umontana.edu
Office Hours: Mon. 9 – 10 a.m., Tue. 10 – 11 a.m., Wed. 3 – 4 p.m., Thu. 1 – 2 p.m.,
Fri. 4 – 5 p.m. (and by appointment)

SCOPE

To acquire working knowledge of applied mathematics in preparation for a suite of rigorous junior- and senior-level physics courses. Toward this end, the course will cover the mathematical topics listed below in the context of their physical applications:

matrices, vectors, linear equations, and eigenvalue problems (Chapter 3)
partial derivatives and PDE's emphasizing change of variables (Chapter 4)
multiple integrals emphasizing change of variables (Chapter 5)
differential and integral calculus of vectors (Chapter 6)
complex numbers and functions of a complex variable (Chapters 2 & 14)
Fourier series and transforms (Chapter 7)

OUTCOME

- Will be proficient in applied mathematics at the upper-division undergraduate level in physics
- Will be able to effectively pursue advanced study in physics including classical mechanics, electromagnetism, quantum mechanics, and thermal physics

NUMBER OF CREDITS

3 credits

PREREQUISITE

Multivariable calculus (M273), or equivalent, with a minimum grade of C minus

CO/PREREQUISITE

Second semester of general physics (PHSX 217-218) or equivalent

TEXTBOOK

Mathematical Methods in the Physical Sciences, 3rd ed. by Mary L. Boas
(Wiley, 2006) ISBN 0-471-19826-9

HOMEWORK

Reading assignments and problem sets

EXAMS

Three midterm exams (**Wed. 2/21, Fri. 3/23, and Mon. 4/30**)

One final exam (**10:10 a.m. – 12:10 p.m. on Thu. 5/10**)

COURSE GUIDELINES AND POLICIES

Student Conduct Code

The Student Conduct Code at the University of Montana embodies and promotes honesty, integrity, accountability, rights, and responsibilities associated with constructive citizenship in our academic community. This Code describes expected standards of behavior for all students, including academic conduct and general conduct, and it outlines students' rights, responsibilities, and the campus processes for adjudicating alleged violations. Full student conduct code. http://www.umt.edu/vpsa/policies/student_conduct.php

Course Withdrawal

Students may use Cyberbear to drop courses through the first 15 instructional days of the semester. Beginning the 16th instructional day of the semester through the 45th instructional day, students use paper forms to drop, add and make changes of section, grading option or credit. PHSX 301 may not be taken as credit/no-credit.

Disability Modifications

The University of Montana assures equal access to instruction through collaboration between students with disabilities, instructors, and Disability Services for Students. If you think you may have a disability adversely affecting your academic performance, and you have not already registered with Disability Services, please contact Disability Services in Lommasson Center 154 or call 406.243.2243. I will work with you and Disability Services to provide an appropriate modification.

Grading Policy

Your grade will be based on the following:

Problem sets:	25%
Midterm exams:	45% (15% each)
Final exam:	30%

Typical cutoffs for the final course grade:

A-/B+	84%
B-/C+	72%
C-/D+	58%
D-/F	45%

TENTATIVE COURSE OUTLINE

Date	Topics
Week 1: Jan 22, 24, 26	**Applied Linear Algebra I** (Ch. 3, Sec. 1, 2, 3 & 6) Set of linear algebraic equations, Gaussian elimination, determinants, inverse matrix, matrix operations
Week 2: Jan 29, 31, Feb 2	**Applied Linear Algebra II** (Ch. 3, Sec. 4, 5 & 7) Addition, subtraction, scalar product, vector product, geometric applications, linear transformations
Week 3: Feb 5, 7, 9	**Applied Linear Algebra III** (Ch. 3, Sec. 8, 9 & 11) Linear dependence and independence, Wronskian, special matrices, eigenvalue problems
Week 4: Feb 12, 14, 16	**Partial Differentiation I** (Ch. 4, Sec. 5, 6 & 7) Chain rule, implicit differentiation, extensive applications
Week 5: Feb 21, 23	**EXAM #1** (2/21) **Partial Differentiation II** (Ch. 4, Sec. 11) Change of variables, applications to PDE's
Week 6: Feb 26, 28, Mar 2	**Multiple Integrals I** (Ch. 5, Sec. 5) Review, change of variables, curvilinear coordinates
Week 7: Mar 5, 7, 9	**Multiple Integrals II** (Ch. 5, Sec. 4) More applications **Vector Analysis I** (Ch. 6, Sec. 1, 2 & 3) Triple scalar product, triple vector product
Week 8: Mar 12, 14, 16	**Vector Analysis II** (Ch. 6, Sec. 4, 5, 6 & 7) Differentiation of vectors, gradient, divergence, curl, Laplacian, etc.
Week 9: Mar 19, 21, 23	**Vector Analysis III** (Ch. 6, Sec. 8 & 9) Line integrals, scalar potentials, Green's theorem **EXAM #2** (3/23)
	SPRING VACATION WEEK (Mar 26 – 30)
Week 10: Apr 2, 4, 6	**Vector Analysis IV** (Ch. 6, Sec. 10 & 11) Divergence theorem, Stokes' theorem, vector potential
Week 11: Apr 9, 11, 13	**Complex Numbers** (Ch. 2, most sections) Complex algebra, Euler's formula, powers and roots, series Exponential, trigonometric, and logarithmic functions of a complex variable
Week 12: Apr 16, 18, 20	**Functions of a Complex Variable** (Ch. 14, Sec, 1, 2 & 3) Analytic functions, Cauchy-Riemann conditions, contour integrals, Cauchy's integral formula
Week 13: Apr 23, 25, 27	**Functions of a Complex Variable** (Ch. 14, Sec. 5, 6 & 7) Use of the residue theorem **Fourier Series** (TBD)
Week 14: April 30 May 2, 4	**EXAM #3** (4/30) **Fourier Transform** (TBD) **Review**
Week 15: May 10	**FINAL EXAM** (Thu. 5/10)