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Spring 2-1-2016

### PHSX 301.01: Introduction to Theoretical Physics

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# PHYSICS 301 – Intro to Theoretical Physics Spring Semester 2016

## LECTURES

Mon., Wed., & Fri. 11:10 a.m. – 12 noon, CHCB 231

## INSTRUCTOR

Eijiro ('Ebo') Uchimoto

Office: CHCB 127 (Tel. No. 243-6223)

Email: [eijiro.uchimoto@umontana.edu](mailto: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. 2 – 3 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

## CO/PREREQUISITE

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

## TEXTBOOK

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

## HOMEWORK

Reading assignments and problem sets

## EXAMS

Three midterm exams (**Fri. 2/26, Fri. 3/25, and Mon. 5/2**)

One final exam (**10:10 a.m. – 12:10 p.m. on Fri. 5/13**)

## 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](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 16<sup>th</sup> instructional day of the semester through the 45<sup>th</sup> 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
<b>Week 1: Jan 25, 27, 29</b>	<b>Applied Linear Algebra I</b> (Ch. 3, Sec. 1, 2, 3 & 6) Set of linear algebraic equations, Gaussian elimination, determinants, inverse matrix, matrix operations
<b>Week 2: Feb 1, 3, 5</b>	<b>Applied Linear Algebra II</b> (Ch. 3, Sec. 4, 5 & 7) Addition, subtraction, scalar product, vector product, geometric applications, linear transformations
<b>Week 3: Feb 8, 10, 12</b>	<b>Applied Linear Algebra III</b> (Ch. 3, Sec. 8, 9 & 11) Linear dependence and independence, Wronskian, special matrices, eigenvalue problems
<b>Week 4: Feb 17, 19</b>	<b>Partial Differentiation I</b> (Ch. 4, Sec. 5, 6 & 7) Chain rule, implicit differentiation, extensive applications
<b>Week 5: Feb 22, 24, 26</b>	<b>Partial Differentiation II</b> (Ch. 4, Sec. 11) Change of variables, applications to PDE's <b>EXAM #1</b> (2/26)
<b>Week 6: Feb 29, Mar 2, 4</b>	<b>Multiple Integrals I</b> (Ch. 5, Sec. 5) Review, change of variables, curvilinear coordinates
<b>Week 7: Mar 7, 9, 11</b>	<b>Multiple Integrals II</b> (Ch. 5, Sec. 4) More applications <b>Vector Analysis I</b> (Ch. 6, Sec. 1, 2 & 3) Triple scalar product, triple vector product
<b>Week 8: Mar 14, 16, 18</b>	<b>Vector Analysis II</b> (Ch. 6, Sec. 4, 5, 6 & 7) Differentiation of vectors, gradient, divergence, curl, Laplacian, etc.
<b>Week 9: Mar 21, 23, 25</b>	<b>Vector Analysis III</b> (Ch. 6, Sec. 8 & 9) Line integrals, scalar potentials, Green's theorem <b>EXAM #2</b> (3/25)
<b>Week 10: Mar 28, 30, Apr 1</b>	<b>Vector Analysis IV</b> (Ch. 6, Sec. 10 & 11) Divergence theorem, Stokes' theorem, vector potential
	<b>SPRING VACATION WEEK</b>
<b>Week 11: Apr 11, 13, 15</b>	<b>Complex Numbers</b> (Ch. 2, most sections) Complex algebra, Euler's formula, powers and roots, series Exponential, trigonometric, and logarithmic functions of a complex variable
<b>Week 12: Apr 18, 20, 22</b>	<b>Functions of a Complex Variable</b> (Ch. 14, Sec. 1, 2 & 3) Analytic functions, Cauchy-Riemann conditions, contour integrals, Cauchy's integral formula
<b>Week 13: Apr 25, 27, 29</b>	<b>Functions of a Complex Variable</b> (Ch. 14, Sec. 5, 6 & 7) Use of residue theorem <b>Fourier Series</b> (TBD)
<b>Week 14: May 2, 4, 6</b>	<b>EXAM #3</b> (5/2) <b>Fourier Transform</b> (TBD) <b>Review</b>
<b>Week 15: May 13</b>	<b>FINAL EXAM</b> (5/13)