

# PHYSICS 301 – Intro to Theoretical Physics

## Spring Semester 2020

### LECTURES

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

### INSTRUCTOR

Eijiro ('Ebo') Uchimoto

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Office Hours: Mon. 9 – 10 a.m., Tue. 2 – 3 p.m., Wed. 3 – 4 p.m., Thu. 10 – 11 a.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 with their physical applications in mind:*

- 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)

### 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, 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 (**Mon. 2/10, Fri. 3/13, and Wed. 4/22**)

Final exam (**10:10 a.m. – 12:10 p.m. on Mon. 5/4**)

## 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 13, 15, 17</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: Jan 22, 24</b> (no class on Jan 20 - M.L. King Jr. Day)	<b>Applied Linear Algebra II</b> (Ch. 3, Sec. 4 & 5) Addition, subtraction, scalar product, vector product, geometric applications, linear transformations
<b>Week 3: Jan 27, 29, 31</b>	<b>Applied Linear Algebra III</b> (Ch. 3, Sec. 5, 7, 8 & 9) More geometric applications, linear dependence and independence, Wronskian, special matrices
<b>Week 4: Feb 3, 5, 7</b>	<b>Applied Linear Algebra IV</b> (Ch. 3, Sec. 11) Eigenvalue problems
<b>Week 5: Feb 10, 12, 14</b>	<b>EXAM #1</b> (Mon. 2/10)  <b>Partial Differentiation I</b> (Ch. 4, Sec. 5, 6 & 7) Chain rule, implicit differentiation, extensive applications
<b>Week 6: Feb 19, 21</b> (no class on Feb 17 - Presidents' Day)	<b>Partial Differentiation II</b> (Ch. 4, Sec. 11) Change of variables, applications to PDE's
<b>Week 7: Feb 24, 26, 28</b>	<b>Multiple Integrals</b> (Ch. 5, Sec. 4) Review, change of variables, curvilinear coordinates
<b>Week 8: Mar 2, 4, 6</b>	<b>Vector Analysis I</b> (Ch. 6, Sec. 1, 2, 3 & 4) Triple scalar product, triple vector product, line integrals
<b>Week 9: Mar 9, 11, 13</b>	<b>Vector Analysis II</b> (Ch. 6, Sec. 5, 6 & 7) Differentiation of vectors, gradient, divergence, curl, Laplacian, etc.  <b>EXAM #2</b> (Fri. 3/13)
<b>SPRING VACATION WEEK (Mar 16 – 20)</b>	
<b>Week 10: Mar 23, 25, 27</b>	<b>Vector Analysis III</b> (Ch. 6, Sec. 8 & 9) Scalar potentials, Green's theorem
<b>Week 11: Mar 30, Apr 1, 3</b>	<b>Vector Analysis IV</b> (Ch. 6, Sec. 10 & 11) Divergence theorem, Stokes' theorem, vector potential

<b>Week 12: Apr 6, 8, 10</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 13: Apr 13, 15, 17</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 14: Apr 20, 22, 24</b>	<b>EXAM #3</b> (Wed. 4/22)  <b>More on Functions of a Complex Variable</b> (Ch. 14, Sec 5, 6 &7)
<b>Week 15: Apr 27,29, May 1</b>	Review
<b>Week 16: May 4</b>	<b>FINAL EXAM</b> (Mon. 5/2)