1-2014

PHSX 301.01: Introduction to Theoretical Physics

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PHYSICS 301 – INTRODUCTION TO THEORETICAL PHYSICS

Spring Semester 2014

LECTURES: Mon., Wed., & Fri. 11:10 a.m. – 12:00 noon, CHCB 230 (3-credit course)

INSTRUCTOR: Eijiro ('Ebo') Uchimoto Office: CHCB 127 (Tel. No. 243-6223)
E-mail address: eijiro.uchimoto@umontana.edu
Office Hrs: Mon. 9 – 10 a.m., Tue. 12 noon – 1 p.m., Wed. 3 – 4 p.m.,
Thu. 1 – 2 p.m., Fri. 2 – 3 p.m., (and by appointment).

TEXTBOOK: Mathematical Methods in the Physical Sciences, third edition by *Mary L. Boas* (Wiley, 2006). [ISBN 0-471-19826-9]

PREREQUISITES: Multivariable calculus (M 273) or equivalent
Second semester of general physics (PHSX 217-218) or equivalent

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)
Laplace transforms (Chapter 8)

OUTCOMES: *Will be proficient in applied mathematics at the upper undergraduate level in physics.*

Will be able to effectively pursue advanced study in physics including classical mechanics, electrodynamics, quantum mechanics, and thermal physics.

HOMEWORK: Reading assignments and problem sets

EXAMS: Three midterm exams (**Wed. 2/26/14, Wed. 3/26/14, and Mon. 5/5/14**)
Closed book but each student is permitted to bring one 3" x 5" card

One final exam (**10:10 a.m. – 12:10 p.m. Mon. 5/12/14**)
Closed book but each student is permitted to bring three 3" x 5" cards

GRADING:

problem sets	25 %	[This course can be taken for
midterm exams	45 % (15 % each)	a traditional letter grade only.]
final exam	30 %	

Drop/add by CyberBear through Fri. 2/14/14; drop/add by paper form through Mon. 4/7/14; drop/add by petition through Fri. 5/9/14.

This course is accessible to and usable by otherwise qualified students with disabilities. To request reasonable program modifications, please consult with the instructor. Disability Services for Students will assist the instructor and student in the modification process. For more information, visit the Disability Services website at http://www.umt.edu/disability.

TENTATIVE COURSE OUTLINE:

Week	Dates	Topics	Exams
1	1/27, 29, 31	**Applied Linear Algebra I** (Ch. 3, Sec. 1, 2, 3, & 6) set of linear algebraic equations, Gaussian elimination, determinants, inverse matrix, matrix operations.	
2	2/3, 5, 7	**Applied Linear Algebra II** (Ch. 3, Sec. 4, 5, &7) addition, subtraction, scalar product, vector product, geometric applications, linear transformations	
3	2/10, 12, 14	**Applied Linear Algebra III** (Ch. 3, Sec. 8, 9, & 11) linear dependence and independence, Wronskian, special matricies eigenvalue problems.	
4	2/19, 21	**Partial Differentiation** (Ch. 4, Sec. 5, 6, & 7) chain rule, implicit differentiation, more chain rule.	
5	2/24, 26, 28	**Partial Differentiation** (Ch. 4, Sec. 11) change of variables, applications to PDE's.	**No. 1 (2/26)**
6	3/3, 5, 7	**Multiple integrals** (Ch. 5, Sec. 4) curvilinear coordinates, change of variables, Jacobian.	
7	3/10, 12, 14	**Vector Analysis I** (Ch. 6, Sec 1, 2, &3) triple scalar product, triple vector product. **Vector Analysis II** (Ch. 6, Sec. 4, 5, 6, & 7) differentiation of vectors, gradient, divergence, curl, Laplacian.	
8	3/17, 19, 21	**Vector Analysis III** (Ch. 6, Sec. 8, 9, & 10) line integrals, scalar potentials, Green's theorem, divergence theorem.	
9	3/24, 26, 28	**Vector Analysis III** (Ch. 6, Sec. 11) Stokes' theorem, vector potentials. **Complex Numbers** (Ch. 2, Sec. 1, 2, 3, 4, 5, 6, & 7) complex algebra, Euler's formula, powers and roots, series	**No. 2 (3/26)**
	**** SPRING VACATION WEEK ****		
10	4/7, 9, 11	**Complex Numbers** (Ch. 2, Sec. 8, 9, 10, 11, 12, & 13) exponential, trigonometric, and logarithmic functions of a complex variable	
11	4/14, 16, 18	**Functions of a Complex Variable** (Ch. 14, Sec. 1, 2, 3, 5, 6 & 7) analytic functions, Cauchy-Riemann conditions, contour integrals, Cauchy's integral formula, residue theorem, *etc.*	
12	4/21, 23, 25	more on **Functions of a Complex Variable** **Fourier Series** (Ch. 7, selected sections)	
13	4/28, 30, 5/2	**Fourier Transforms and Laplace Transforms** (Ch.7 & Ch. 8, selected sections)	
14	5/5, 7, 9	**Review**	**No. 3 (5/5)**
15	5/12	**FINAL EXAM WEEK**	**Final (5/12)**