Course Syllabus

Course: Methods of Theoretical Physics I (Physics 811)

Fall 2014 MWF 10:30-11:20 a.m., JH 247

Instructor: Prof. Ilya I. Fabrikant, JH 310P, tel. 472-2774
e-mail: ifabrikant1@unl.edu

Office Hours: MWF 1:30-2:30 p.m. or by appointment

Students with disabilities are encouraged to contact the instructor for a confidential discussion of their individual needs for academic accommodation. It is the policy of the University of Nebraska-Lincoln to provide flexible and individualized accommodation to students with documented disabilities that may affect their ability to fully participate in course activities or to meet course requirements. To receive accommodation services, students must be registered with the Services for Students with Disabilities (SSD) office, 132 Canfield Administration, 472-3787 voice or TTY.

PREREQUISITES

Students are expected to be familiar with real calculus, differentiation and integration techniques (including multiple integrals), linear algebra, complex algebra, and ordinary differential equations.

TEXT: Mathematical methods in Physical Sciences, Mary L. Boas, Wiley, NY 3rd edition (2005)

some notes will be available on the blackboard in the section Course Documents

Supplemental reading:

1. G. B. Arfken and H. J. Weber, Mathematical methods for physicists, Elsevier, Amsterdam, 2005.

This is an alternative book containing much more material and examples. I would not mind if you use this as a textbook, but most of the homework problems will be taken from Boas.

2. P. B. Kahn, Mathematical methods for scientists and engineers. Wiley, N.Y. 1990.

"Engineer"-level approach to asymptotic expansions, evaluation of integrals, differential equations, nonlinear systems.

3. P. Bamberg and S. Sternberg, A course in mathematics for students in physics, vol. 1 and 2. Cambridge Univ Press, Cambridge, 1988.

A more formal and rigorous approach to linear operators and linear transformations, complex analysis, appications to electrodynamics and thermodynamics.

Reference books on integrals and special functions (almost all of this material can be found nowadays on the internet or obtained from the software like Maple or Mathematica, but some people including me still prefer books for a reference material) :

1. I. S. Gradshteyn and I. M. Ryzhik, Tables of integrals, series, and products. Academic Press, San Diego, 1980.

2. Handbook of mathematical functions, ed. by M. Abramowitz and I. A. Stegun. Dover, N.Y. 1972.

Reference book on differential equations:

D. Zwillinger, Handbook of differential equations. Academic Press, Boston, 1989.

Outline: (1) Vectors and linear operators, Hilbert space
(2) Tensors
(3) Complex calculus
(4) Special functions in the complex plane
(5) Asymptotic expansions

Homework: specific assignments and due dates are given on the blackboard; Homework should be turned in in the hardcopy form (electron files will not be accepted) by 5 p.m. on the due date by giving it to the instructor personally or placing it in the instructor's mail box. Homework turned in after the due dates lose two points per day. No homework is accepted one week after the due day. In case of illness or a personal emergency the new terms should be negotiated with the instructor. Note that travel (personal or professional) is not an excuse for turning in homework late. In doing homework you are allowed to discuss problems with each other, but you are NOT allowed to cooperate on writing down the solutions on the paper.

Exams: four quizzes, one Midterm Exam and Final Exam. All quizzes are closed-book. At the exams you are allowed to use the textbook (Boas or Arfken), but not allowed to use notes. Any electronic equipment, including calculators, is not allowed on the quizzes and the exams.

QUIZZES (in-class): 9/9, 9/30, 10/30, 11/18 (tentative);
It is the student's responsibility to be in class when quizzes are given. No make-up quizzes will be given unless in case of illness or personal emergency.

MIDTERM EXAM: Thursday, 10/15, 6:00-8:00 p.m. (tentative)

FINAL EXAM: TBA

Grades: midterm exam - 30%; final exam - 30%; quizzes - 20%; homework - 20%

Tentative grade scale

%	grade

>96%	A+
90-96%	A
85-90%	A-
80-85%	B+
75-80%	B
70-75%	B-
65-70%	C+
60-65%	C
57-60%	C-
54-57%	D+
52-54%	D
50-52%	D-
<50%	F

Tentative schedule

8/24- 8/28	Introduction. Linear transformations and linear operators. Chapter 3, Secs 7-9.
8/31- 9/4	Vector space, functional space, Hilbert space. Chapter 3, Secs 10, 14.
9/7	LABOR DAY HOLIDAY
9/9 - 9/11	Tensor analysis. 10.1-10.5
9/14- 9/18	Tensor analysis. Applications to the special relativity. 10.6-10.11 and lecture notes.
9/21- 9/25	Analytical functions, contour integrals, Laurent series 14.1-14.4
9/28-10/2	Residue theorem, evaluation of integrals 14.5-14.7
10/5 -10/9	Integral depending on parameters. Green's functions in Quantum mechanics Lecture notes
10/12-10/16	Gamma and Beta functions, the Error function 11.1-11.9
10/19	FALL BREAK
10/21-10/23	Elliptic integrals and functions, Legendre functions 11.12, 12.1-12.10
10/26-10/30	Bessel functions 12.11-12.19

11/2 -11/6	Bessel and Airy functions and their applications in quantum mechanics Lecture notes
11/9 -11/13	Hermite and Laguerre functions 12.21-12.23
11/16-11/20	Confluent hypergeometric function. Coulomb function. Quantum mechanical applications. Hypergeometric series. Lecture notes
11/23	Asymptotic methods and asymptotic series. 11.10-11.11, Lecture notes
11/25-11/29	Thanksgiving break
11/30-12/4	Further discussion of asymptotic methods. Airy function, Bessel function, WKB approximation. Lecture notes
12/7 -12/11	Review and discussion