

Syllabus

Methods of Theoretical Physics I.

Phys-501, section 01.

Fall 2025.

Yurii Shylnov.

Sessions: Tuesday/Thursday. 1:50 -3:05pm. Classroom: RE-119.

Instructor: Prof. Yurii Shylnov.

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Office hours: MTW 12:45-1:50pm or by appointment.

Textbooks: 1. George B. Arfken, Hans J. Weber, Frank E. Harris. Mathematical Methods for Physicists. 7th edition. Elsevier Academic Press. 2012. 1220 p. ISBN: 978-0123846549.

The most standard textbook for a physics major graduate mathematical course. It is an acceptable hybrid of a reference book and textbook. It will be used for 502 as well.

2. Mark Pinsky. Partial Differential Equations and Boundary-Value Problems with Applications. 3rd edition. American Mathematical Society. 2011. 526 p. ISBN: 978-0821868898.

Quite solid but still readable textbook of partial differential equations and related topics. It is extremely popular and standard.

We are not going to follow the textbooks chapter by chapter but rather use them as a valuable source of exercises, examples, additional information etc.

Course Description:

1. Linear, Hermitian, unitary etc. operators, a concept, their properties and applications.
2. Hilbert space, its basic properties, operators in Hilbert space. Sturm-Liouville operator.
3. Fourier series.
4. Ordinary differential equations. Method of infinite series.
5. First look at special functions. Gamma-, beta-, error, Airy functions.
6. Orthogonal polynomials. Legendre, Hermite, Laguerre etc. polynomials.
7. Vector analysis including curvilinear coordinates.
8. Tensor algebra.
9. Frobenius method.

10. Bessel functions, their properties, basic applications.
11. Partial differential equations. Boundary conditions. Dirichlet problem.
12. Physical models with PDE. The most common and important PDE in physics.
13. Separation of variables method, Cartesian system of coordinates.
14. Separation of variables, cylindrical and spherical system of coordinates. Spherical functions.
15. Fourier transform method. Cauchy problem.

Homework: You will receive your homework mostly every other week. All homework problems are to be done systematically and legibly. I am going to collect it and grade one problem selected randomly.

Project: It should be a mathematical problem of an acceptable level you find interesting and even exciting. Talk to me about your ideas ASAP. This is the key. After our conversation a title and abstract should be submitted by October 20th. A complete draft of a paper should be submitted by November 12th. A final version should be submitted by November 25th and discussed by December 4th. Please, take this part of our course seriously and do not procrastinate.

Tests: There will be three tests, on September 18th, October 21st, and December 2nd. You are allowed to bring an equation sheet, A4 format, one side, handwritten by you personally to every test. **No final exams!**

There are no make-up tests, unless there are unexpected and well-documented emergency reasons and/or permission from the Dean of Students office. A make-up test will be slightly more complicated because a complete solution of the original test will be posted on Canvas.

Grading: Homework -20%, Tests - 60%, Project-20%.

Course Grade Determination: A 90-100%, B 80-89.9%, C 70-79.9%, D 60-69.9%, E below 60%.

Academic honesty: It is presumed that you will do your own work on the homework and tests. Discussing homework problems with others is encouraged but submitting work as your own which is copied or paraphrased from someone else is not permitted. Cheating includes, but not limited to, illegal collaboration, copying, using materials not permitted on tests, and aiding others on tests. Anyone found cheating will not be permitted to withdraw and will receive a grade of E for the course. Your academic dean will be informed and a statement will be placed in your permanent file. For more details, see the student handbook: <https://www.iit.edu/student-affairs/student-handbook/fine-print/code-academic-honesty>

Classroom environment Please, no cellular phones, iPods, iPads etc. in the class. I will be very much indebted to you if you do not eat, talk, text and so on in the classroom, because, believe it or not, it really distracts both me and your classmates. Of course, you are allowed to use your notebooks, tablets etc. to take notes but nothing else. Classes' format is going to be quite traditional. Lectures and discussions will take the most time.

**Americans
with
Disabilities Act
Policy
Statement**

Reasonable accommodation will be made for students with documented disabilities. Contact the Center for Disability Resources to receive necessary support and help. The Center for Disability Resources (CDR) is located in 10 W. 35th St., Suite 3F3-1, phone: [312.567.5744](tel:312.567.5744) , e-mail: disabilities@illinoistech.edu .

**Title IX
Compliance**

Title IX and our school policy prohibits discrimination on the basis of sex as well as all forms of sexual misconduct or harassment. I am always concerned about each and every student's well-being and ready to help. However, I am also required by the law to report any such incident to an Illinois Tech's Title IX coordinator. If you have experienced such an incident, please consult the following link for a list of resources available to you: <https://web.iit.edu/hea-compliance/sexual-harassment-and-misconduct-prevention/title-ix-illinois-tech/resources>.

USEFUL DATES FROM THE ACADEMIC CALENDAR

August 18	Courses Begin
September 1	Labor Day. No Classes.
September 5	Make up of Monday Classes
October 13, 14	Fall Break Day. No Classes.
October 17	Midterm Grades Due.
November 26-29	Thanksgiving Break. No Classes.
December 4	Last Day of Classes (Effective).
December 17	Final Grades are Due at Noon.