Subject to Modification – April 19 2021

# PHYS 6000 – MATHEMATICAL METHODS OF PHYSICS I

## Syllabus Spring 2021

**Dr. David Shiner (shiner@unt.edu)**
**Office: Physics 324 Phone: 565-3874.**
**Office Hours: MW 10:00-10:50 am or by appointment**

**Class time: MWF 9:00-9:50 am**
**Class location: Canvas & Zoom**

Textbooks

Required: *Mathematical Methods for Physicists: A Comprehensive Guide*, by George B. Arfken, Hans J. Weber and Frank E. Harris (7th edition, Academic Press, 2012).

Recommended: *Mathematical Methods in the Physical Sciences*, by Mary L. Boas (3rd edition, John Riley & Sons 2006), ISBN-13 978-0-471-19826-0.
*Mathematics for Physical Sciences and Engineering,* Frank E. Harris (Elsevier, 2014), ISBN 9780128010006.
*Mathematical Methods for Physics and Engineering: A Comprehensive Guide,* K. F. Riley, M. P. Hobson and S. J. Bence (2nd edition, Cambridge University Press, 2002).
*Essential Mathematical Methods for Physicists*, by Hans J. Weber and George B. Arfken (Elsevier, Academic Press, 2003).

Prerequisites: Physics 3310 (Math Methods in the Physical Sciences or equivalent), which requires Math 1710, 1720, 2730, which are Calculus I, II III (Mult. Var. Cal.).

Content: The course involves the introduction and application of advanced mathematical techniques to the solution of physical problems and phenomena.

Objective We will survey a large number of mathematical methods used in physics, engineering and the physical sciences. In particular we will learn methods that are needed for graduate study in physics, as well as chemistry and engineering.

Homework Assignments will be given each week. Please feel free to discuss and work together with others on these problems if you wish. What is important is that you make a good faith effort on each problem set and that you eventually understand how to do the problems and submit your own work. The problem sets will be collected each week and graded pass/not pass. Exams will be largely based on the homework problems assigned.

Office Hours My office is on the third floor of the physics building (room 324), phone number 565-3874, email is shiner@unt.edu. Office hours are MW 10:00 - 10:50 am or by appointment.

Grading If you pass every homework assignment, your low exam score will be dropped. Scores for home work (1 = Pass, 0 = Not Pass), quizzes, and exams will be posted on Canvas.

Course Grade Exams: 50% (No makeup exams) Quizzes: 10% Final Exam: 40%

**You are responsible for modifications to this syllabus and any other information presented in class.**

*The University of North Texas makes reasonable academic accommodation for students with disabilities. Students seeking reasonable accommodation must first register with the Office of Disability Accommodation (ODA) to verify their eligibility. If a disability is verified, the ODA will provide you with a reasonable accommodation letter to be delivered to faculty to begin a private discussion regarding your specific needs in a course. You may request reasonable accommodations at any time, however, ODA notices of reasonable accommodation should be provided as early as possible in the semester to avoid any delay in implementation. Note that students must obtain a new letter of reasonable accommodation for every semester and must meet with each faculty member prior to implementation in each class. Students are strongly encouraged to deliver letters of reasonable accommodation during faculty office hours or by appointment. Faculty members have the authority to ask students to discuss such letters during their designated office hours to protect the privacy of the student. For additional information see the Office of Disability Accommodation website at http://www.unt.edu/oda. You may also contact them by phone at 940.565.4323.*
UNT's policy on Academic Dishonesty can be found at: http://www.vpaa.unt.edu/academic-integrity.htm
Drop information is available in the schedule of classes at: http://essc.unt.edu/registrar/schedule/scheduleclass.html

***The Student Perceptions of Teaching (SPOT) is a requirement for all organized classes at UNT. This short survey will be made available to you on-line at the end of the semester and will provide you with an opportunity to provide feedback to your course instructor. SPOT is considered to be an important part of your participation in this class. In addition to SPOT, there will be a brief in-class course survey during the last two weeks of the semester.*** **For the Spring 2017 semester you will receive an email in April 2017 from "UNT SPOT Course Evaluations via *IASystem* Notification" (no-reply@iasystem.org) with the survey link. Please look for the email in your UNT email inbox. Simply click on the link and complete your survey.**
After logging in to the my.unt.edu portal, students can access the SPOT survey site by clicking on the SPOT icon. A list of their currently enrolled courses will appear. Students complete each course evaluation independently. During the long terms, the SPOT is open for students to complete two weeks prior to final exams. During the summer terms, the SPOT is open for students to complete six days preceding their final exam. See SPOT Calendar for specific dates and deadlines.

| Date | Day | Subject (Chapter) | Assignment | Due |
|---|---|---|---|---|
| Jan. 11 | M | Mathematical Preliminaries (Ch. 1) | Ch. 1: 1.5, 6.1, 7.1, 7.4, 8.1, 8.2, 8.5, 8.10, | |
| 13 | W | Determinants and Matrices (Ch. 2) | Ch. 1: 10.11, 11.1, 11.4, 11.7, 11.8 | |
| 15 | F | " | Ch. 2: 1.1, 2.35, 2.37, 2.51 | |
| 18 | M | No Classes (MLK day) | | **Ch. 1 & 2 due.** |
| 20 | W | Vector Analysis (Ch. 3) | Ch. 3: 2.4, 3.1, 5.1, 6.14, 7.5,8.1, 9.1, 10.16 | |
| 22 | F | Probability and Statistics (Ch. 23) | Ch. 23: 1.9, 2.6, 3.3, 4.4, 7.4 | |
| 25 | M | Vector Spaces (Ch. 5) | Ch. 5: 1.9, 1.10, 2.2, 2.8, 3.4, | |
| 27 | W | | Ch. 5: 5.5, 6.1 | **Ch. 3 & 23 due.** |
| 29 | F | Eigenvalue Problems (Ch. 6) | Ch. 6: 2.13, 4.7, 5.1, 5.3, 5.16 | |
| Feb. 1 | M | Ordinary Differential Eqs. (Ch. 7) | Ch. 7: 2.15, 3.4, 4.1, 4.5, 5.7 | |
| 3 | W | " | Ch. 7: 6.20, 6.25, 7.3 | **Ch. 5 & 6 due.** |
| 5 | F | Sturm-Liouville Theory (Ch. 8) | Ch. 8: 2.2, 2.4, 3.3 | |
| 8 | M | " | | |
| 10 | W | " | | **Ch. 7 & 8 due.** |
| 12 | F | **EXAM 1: Chapters 1, 2, 3, 23, 5, 6, 7, 8** | | |
| 15 | M | | | |
| 17 | W | | | |
| 19 | F | | | |
| 22 | M | Partial Differential Eqs. (Ch. 9) | Ch. 9: 4.4, 4.5, 6.2, 7.1, 7.3 | |
| 24 | W | " | Ch. 9: 7.4 (do not evaluate integrals) | |
| 26 | F | Green's Functions (Ch. 10) | Ch. 10: 1.1, 1.3, 2.2 | |
| Mar. 1 | M | Complex Variable Theory (Ch. 11) | Ch. 11: 2.1, 5.6, 5.7, 5.8 | **Ch. 9 & 10 due.** |
| 3 | W | | Ch. 11: 7.1a-c, 8.12 | |
| 5 | F | Further Topics in Analysis (Ch. 12) | Ch. 12: 1.2, 6.3, 8.2 | |
| 8 | M | Gamma Function (Ch. 13) | Ch. 13: 1.1, 1.3, 3.11, 4.1, 4.2 | **Ch. 11 & 12 due.** |
| 10 | W | | | |
| 12 | F | Bessel Functions (Ch. 14) | Ch. 14: 1.24, 1.25, 1.26, 2.6 | |
| 15 | M | | Ch. 14: 5.5, 7.6, 7.15 | |
| 17 | W | Legendre Functions (Ch. 15) | Ch. 15: 1.6, 1.15, 2.17, 2.24 | **Ch. 13 & 14 due.** |
| 19 | F | " | Ch. 15: 3.1, 4.1, 5.2 | |
| 22 | M | Angular Momentum (Ch. 16) | Ch. 16: 1.8, 2.3, 3.3 | |
| 24 | W | " | | **Ch. 15 due.** |
| 26 | F | **EXAM 2: Chapters 9-15** | | |
| 29 | M | Group Theory (Ch. 17) | Ch. 17: 6.1, 6.2, 7.2 | **Ch. 16 due.** |
| 31 | W | More Special Functions (Ch. 18) | Ch. 18: 1.6, 2.3, 3.7 | |
| Apr. 2 | F | No Classes | | |
| 5 | M | Fourier Series (Ch. 19) | Ch. 19: 1.2, 1.3, 2.7 | **Ch. 17&18 due.** |
| 7 | W | Integral Transforms (Ch. 20) | Ch. 20: 2.8 | |
| 9 | F | " | | |
| 12 | M | Integral Equations (Ch. 21) | Ch. 21: 1.1, 1.2, 3.4 | **Ch. 19&20 due.** |
| 14 | W | Calculus of Variations (Ch. 22) | Ch. 22: 1.3, 2.1, 2.3, 4.1 | |
| 16 | F | " | | |
| 19 | M | Tensors and Differential Forms (Ch. 4) | Ch. 4: 2.3, 4.3 | **Ch. 21&22 due.** |
| 21 | W | Review | | **Ch 4 due (optional).** |
| 23 | F | Reading Day (no classes) | | |

**Comprehensive Final Exam: Wednesday, April 28, 2021, 8:00 a.m. - 10:00 a.m.**