# PHYS 501
# Mathematical Physics I

*Fall 2022*


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| **Instructor:** | Prof. S. McMillan |
| **Time and place:** | MW 12:30-1:50 pm, Disque 919, or `https://drexel.zoom.us/my/slm23` |
| **e-mail:** | `slm23 (at) drexel.edu` |


## Course Outline

The goal of this course is the application of classical analytical methods to problems drawn from physics and elsewhere. Emphasis will be placed on application of the methods studied to partial and ordinary differential equations and to Fourier and other special function expansions, as well as variational techniqies as applies ot odrinary and partial differential equations. Limited computational examples my be included, although this course will not be specifically aimed at computional techniques. Topics covered will include:

1. Classification of partial differential equations
2. Methods of solution—separation of variables
3. Second-order linear ordinary differential equations—first and second solutions
4. Eigenfunction expansions
5. Fourier series
6. Bessel and Legendre functions—Bessel and Legendre series
7. Review of complex analysis—the residue theorem
8. Integral transforms
9. Green's functions and applications
10. Variational methods

Topics may change or be rearranged at short notice, depending on circumstances. If necessary, in case of isolation or quarantine, zoom lectures will be used, and recorded for asynchronous viewing, and all lecture slides will be placed on DrexelLearn in PDF form.

## Texts

*Essential Mathematical Methods for the Physical Sciences* (K. F. Riley & M. P. Hobson, Cambridge University Press, 2011). Our limited discussion of computational material will be based on *Numerical Recipes in C* (W. Press, S. Teukolsky, W. Vetterling, & B. Flannery 1992, Cambridge University Press; 2nd edition). This book contains a wealth of useful explanatory text, along with numerous practical implementations of the algorithms discussed. C and Fortran versions of this book are available free online. However, the recommended programming language for any examples and test problems presented in the course is Python.

## Evaluation

The final grade for the course will be based on (1) a mid-term (30% of the total), tentatively scheduled for Wednesday, October 26 (week 6), (2) a final examination (34%), to be held during finals week, at a time TBD, and (3) 6–7 homework assignments completed during the quarter (lowest score dropped, total of 36%). Assignments will be due one week after they are distributed. Late homeworks will receive reduced credit, at a rate of -10% per class period late. Homeworks turned in after they are discussed in class (about 1 week after they are due) or after the final examination will receive zero credit.

## Learning Outcomes

On completing this course, students should be able to

- Explain the classification of second-order linear partial differential equations.
- Use separation of variables to reduce the standard PDEs commonly encountered in Physics applications to coupled ordinary differential equations.
- Solve these ordinary differential equations as eigenfunction expansions using Fourier, Bessel, and Laplace series.
- Explain how the residue theorem can be used to evaluate integral transforms.
- Apply Greens function techniques to the solution of inhomogeneous PDEs.
- Explain the use of variational methods in solving problems in ordinary and partial differential equations.

## Drexel Learning Priorities

- Information Literacy – Possess the skills and knowledge to access, evaluate and use information effectively, competently and creatively.
- Technology Use – Make appropriate use of technologies to communicate, collaborate, solve problems, make decisions, and conduct research, as well as foster creativity and life-long learning.
- Professional Practice – Apply knowledge and skills gained from a program of study to the achievement of goals in a work, clinical, or other professional setting.

## Academic Policies

Discussion is strongly encouraged when solving problem sets, but the work you turn in must be your own. If a friend describes how to solve a problem without specifically writing down any equations, then you may use that information in your own words in your own solution. However, if you directly transcribe someone else's work, you are committing plagiarism.

You may not copy anyone else's exam, homework, or program. All of these actions are considered cheating and will be dealt with in the following manner. The first infraction will result in a zero for all parties involved. The second infraction will result in an "F" for the course and a report to the Office of Academic Affairs.

For more detailed information on University policies, please refer to the Drexel Academic Policies document on the DrexelLearn page for this course.