

MATHEMATICS 5102

**Linear Mathematics in Infinite Dimensions**

Time: 9:10-10:05 am MWF

Class Number: 28536 (UG), 28535 (GRAD)

Prerequisites: *By the second week:* know how to solve (a) a second order ordinary differential equation with constant coefficients, (b) Euler's homogeneous differential equation.

*By the seventh week:* know

(a) The CAUCHY-GOURSAT theorem,

(b) the RESIDUE of a complex analytic function, and

(c) CAUCHY'S INTEGRAL FORMULA.

Look them up in a text on complex variables; R.V. Churchill's "Complex Analysis and Applications" is a good possibility.

Primary Text: *Linear Mathematics in Infinite Dimensions*, Beta edition, by U.H. Gerlach (Typeset lecture notes)

Auxiliary Texts: 1.) For Sturm-Liouville and Prüfer Theory *Ordinary Differential Equations, 3rd Ed.* by G. Birkhoff & G.-C. Rota

2.) *Methods of Theoretical Physics, Vol. I* by P. Morse & H. Feshbach

3.) *Mathematics of Classical and Quantum Physics* by F.W. Byron & R.W. Fuller (Dover paperback)

4.) *Mathematical Methods in Physics and Engineering* by J.W. Dettman (Dover paperback)

Syllabus (in essence): Sturm-Liouville and Prüfer Theory

Fourier theory.

Wave packets and wavelets.

Green's function theory.

Integral equations.

Theory of cylinder harmonics and Bessel functions.

Applications: Waves, scattering, vibrating systems, and Helmholtz's equation

Potential theory via spherical harmonics.

Partial differential equations: elliptic, parabolic, and hyperbolic (time permitting).

Website: If you haven't done so already, visit

<https://www.asc.ohio-state.edu/gerlach.1/math5102>

for useful and *mandatory* information about this course.

Homeworks: One homework set every week, generally handed out each Friday and due the following Friday AT THE START OF CLASS.

Exams: One take-home final (counts about 2 or 3 homework sets). It will be handed out on Friday, the last day of classes. It will be due on the registrar's in class exam day.

Who is Who: Ulrich Gerlach

MA 334 (Mathematics Building)

Telephone number: (614) 292-7235

e-mail: gerlach.1@osu.edu

Office hours: Usually right after class or MWF 10:00-11:00 am or by appointment.

Homework policy: For the first four assignments, TEAMS are allowed, but not required.

Q: Why teams? A: The purpose is to have you become proficient in verbalizing your line of reasoning to one-another.

We shall start with a limit of 3 persons per team. Each team submits ONE SET OF SOLUTIONS, signed by each member, and every team member receives the same grade. Teams

disband after each assignment. Teams then re-constitute for every assignment. This way you are encouraged to select partners who contribute to the final product that you hand in.

Grading Guidelines: Each assignment paper will be graded for mathematical correctness AND PRESENTATION. *You are encouraged to use Latex.* Separate problems and their solutions must start on **separate sheets of paper**. *Remember: Trees are a crop to be harvested: Paper is an inexpensive staple commodity.*

- Points will be deducted for hard-to-read non-Latex writing, sloppiness, incoherent or insufficient explanation, or for lack of supporting rationale.
- The solutions should be presented so that your fellow students AND YOUR PROSPECTIVE CLIENT could read them and follow both the calculations and logic. **This means you *must* write your solutions in complete sentences where appropriate, describing your reasoning. This approach will also help you to develop the ability to explain your reasoning to scientific collaborators who lack your mathematical training.**

Each assignment will consist of approximately 70 possible points, and the Final Exam will be worth about 200 points. There is a total of about 800 points.

Late papers will not be accepted except in extreme situations with documented excuse.

It is the student's responsibility to be aware of all instructions that are delivered during class, including departures from general assignments.

Use of software: You are encouraged and sometimes obligated to use a software package such as Maple or Matlab. So, practice with some of that software soon, and get used to working with it. All routine calculations should be checked this way. If we want you to do hand calculations, we will make it explicit. Even then, check yourself. Moreover, when you use software, you must acknowledge that you did, and support the output with some form of explanation: why it was used, and an interpretation of any answer that is not just a routine calculation. A simple solution consisting of output from Matlab or Maple is not sufficient. Common sense should rule here.