# Syllabus

## GLG 490/598 Numerical Methods

### Lecture time and place

Tuesday, Thursday 10:30-11:45 am, Zoom (https://asu.zoom.us/j/8690237019)

**Attending lecture is mandatory.** The only exception is if you provide advanced notice that you cannot attend due to research-related reasons (e.g., a scientific meeting, field work), religious practices (in accord with ACD304-04), or university sanctioned events (in accord with ACD 304-02)

### Instructor

Mingming Li

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Office: ISTB4-579

### Office hours

Either immediately after class, or by appointment. Please do not wait until just before the homework is due.

### Course Description

For many mathematical problems in scientific research, there is either no analytical solution or the analytical solution is too tedious. The aim of this course is to provide you with numerical skills that can help you become more successful and competitive in your research. Topics to be covered in this course include solution of equations, interpolation, curve fitting, integration, solving differential equations, discrete Fourier transformation, and spherical harmonics. You will learn how to develop algorithms to solve mathematical problems that typically arise in research, which will be accompanied by writing C program codes, basic Linux commands, and Python plotting. We will focus on practical, workhorse methods toward getting things done. Previous experience in coding is not required.

This course will be very informal, and it will be very different than a typical numerical methods course. We will focus on practical, workhorse methods toward getting things done. The practice of numerical methods is relatively simple and is rooted in the fact that you can replace infinitesimal quantities with finite quantities. In practice this can often be done loosely, and as long as you are smart about checking your answers with analytical solutions, resolution tests, and common sense, you should be just fine. On the other hand, the theory of numerical methods can be quite advanced and mathematically involved. This course will not delve deeply into numerical method theory and advanced proofs. Instead, we will focus on simple, practical applications. These simple, practical applications may not always be the most efficient (in terms of generating the most accurate solutions in the fewest CPU cycles), but they will get the job done for almost every application related to the geological sciences.

This course will involve the following components:

**1. Learning how to program in C language.** C is a lower-level programming language that is one of the most common languages currently in existence. Once you learn to write in C, you can easily learn other languages such as C++, Fortran, and higher-level languages (e.g., Perl, Matlab, Python, etc.).

**2. Learning how to develop algorithms to solve basic problems that typically arise in research.** Many analytical problems are either too tedious or impossible to solve analytically but are easily solved numerically.

## Topics to be included

- Solution of equations
- Integration
- Interpolation
- Differential equations
- Fourier transformation
- Curve fitting
- Spherical harmonics

## Grading

**Homework 100%.** Some homework will include writing computational codes. A code can either run or cannot and there is no partial credit for the computational parts (i.e, the codes).

| Undergraduate students | Graduate students | Grade |
|---|---|---|
| 90-100 % | 93-100 % | A |
| 80-89 % | 84-92 % | B |
| 70-79 % | 75-83 % | C |
| 60-69 % | 68-74 % | D |
| Less than 60 % | Less than 68 % | F |

## Course Materials

https://github.com/mingming-li/numerical-methods.git

## Learning Outcomes

After this class, students will be able to:

- Read and write C programing codes
- Understand the fundamental concepts of numerical methods
- Solve equations numerically in scientific research
- Use Linux commands and write shell scripts for data process
- Make plot with Python codes

## Homework

Homework assignments will typically have variable due dates and point values. Homework sets will usually involve both analytical and numerical tasks.

For the analytical portions, make sure that you write out your solutions neatly and clearly. You should include ample text in your mathematical solutions that fully explains what you are doing. A good rule of thumb is this: pretend that your homework assignments are tutorials that you would provide to a student.

The numerical portions will involve writing your own code using C programming. I will compile and run your code. For most problems, you will be provided with the correct answers ahead of time. If your code does not produce **the exact same answer and format** as provided, the homework will be returned and ungraded. We have this policy because it is absolutely important that numerical codes are well tested and provide the right answer. An incorrect code can lead to losses of hundreds of thousands of dollars of grant money, or even worse, disaster (imagine a planetary space mission relying upon an incorrect code).

## Late Assignments

Requests for modifications in assignment due dates must be made in writing and an approved by the instructor **in advance of the due date of the assignment**. Otherwise, there will be a 10% penalty per day for late homework after the due-date. There will be very little exception to this.

## Email communications

All email communication for this class will be done through your ASU email account. You should be in the habit of checking your ASU email regularly as you will not only receive important information about your classes, but other important university updates and information. You are solely responsible for reading and responding if necessary to any information communicated via email.

## Drop and Add Dates/Withdrawals

This course adheres to a compressed schedule and may be part of a sequenced program, therefore, there is a limited timeline to drop or add the course. Consult with your academic advisor and notify your instructor to add or drop this course. If you are considering a withdrawal, review the following ASU policies: Withdrawal from Classes, Medical/Compassionate Withdrawal, and a Grade of Incomplete. Please consult the advisor before dropping the course. There are often suggestions for improvement that you might not have considered.

## Grade Appeals

Grade disputes must first be addressed by discussing the situation with the instructor. If the dispute is not resolved with the instructor, the student may appeal to the department chair per the University Policy for Student Appeal Procedures on Grades.

## Student Conduct and Academic Integrity

Academic honesty is expected of all students in all examinations, papers, laboratory work, academic transactions and records. The possible sanctions include, but are not limited to, appropriate grade penalties, course failure (indicated on the transcript as a grade of E), course failure due to academic dishonesty (indicated on the transcript as a grade of XE), loss of registration privileges, disqualification and dismissal. For more information, see http://provost.asu.edu/academicintegrity. Additionally, required behavior standards are listed in the Student Code of Conduct and Student Disciplinary Procedures, Computer, Internet, and Electronic Communications policy, and outlined by the Office of Student Rights & Responsibilities. Anyone in violation of these policies is subject to sanctions.

Students are entitled to receive instruction free from interference by other members of the class. An instructor may withdraw a student from the course when the student's behavior disrupts the educational process per Instructor Withdrawal of a Student for Disruptive Classroom Behavior.

Appropriate online behavior (also knows as *netiquette*) is defined by the instructor and includes keeping course discussion posts focused on the assigned topics. Students must maintain a cordial atmosphere and use tact in expressing differences of opinion. Inappropriate discussion board posts may be deleted by the instructor.

The Office of Student Rights and Responsibilities accepts incident reports from students, faculty, staff, or other persons who believe that a student or a student organization may have violated the Student Code of Conduct.

## Copyright Information

All the content in this course, including lectures, are copyrighted materials. Students may not share outside the class, upload, sell or distribute course content or notes taken during the conduct of the course (see ACD 304-06). Students may not upload to any course shell, discussion board or website used by the course instructor or other course forum, material that is not the student's original work, unless the student first complies with all applicable copyright laws. The instructor reserves the right to delete materials on the grounds of suspected copyright infringement (see ACD 304-10).

## Prohibition of Commercial Note Taking Services

In accordance with ACD 304-06 Commercial Note Taking Services, written permission must be secured from the official instructor of the class in order to sell the instructor's oral communication in the form of notes. Notes must have the notetaker's name as well as the instructor's name, the course number, and the date.

## Course Evaluation

Students are expected to complete the course evaluation. The feedback provides valuable information to the instructor and the college and is used to improve student learning. Students are notified when the online evaluation form is available.

## Syllabus Disclaimer

The syllabus is a statement of intent and serves as an implicit agreement between the instructor and the student. Every effort will be made to avoid changing the course schedule but the possibility exists that unforeseen events will make syllabus changes necessary. Please remember to check your ASU email and the course site often.

## Accessibility Statement

In compliance with the Rehabilitation Act of 1973, Section 504, and the Americans with Disabilities Act as amended (ADAAA) of 2008, professional disability specialists and support staff at the Disability Resource Center (DRC) facilitate a comprehensive range of academic support services and accommodations for qualified students with disabilities.

Qualified students with disabilities may be eligible to receive academic support services and accommodations. Eligibility is based on qualifying disability documentation and assessment of individual need. Students who believe they have a current and essential need for disability accommodations are responsible for requesting accommodations and providing qualifying documentation to the DRC. Every effort is made to provide reasonable accommodations for qualified students with disabilities.

Qualified students who wish to request an accommodation for a disability should contact the DRC by going to https://eoss.asu.edu/drc, calling (480) 965-1234 or emailing DRC@asu.edu. To speak with a specific office, please use the following information:

**ASU Online and Downtown Phoenix Campus**
University Center Building, Suite 160
602-496-4321 (Voice)

**Polytechnic Campus**
480-727-1165 (Voice)

**West Campus**
University Center Building (UCB), Room 130
602-543-8145 (Voice)

**Tempe Campus**

480-965-1234 (Voice)

## Title IX

Title IX is a federal law that provides that no person be excluded on the basis of sex from participation in, be denied benefits of, or be subjected to discrimination under any education program or activity. Both Title IX and university policy make clear that sexual violence and harassment based on sex is prohibited. An individual who believes they have been subjected to sexual violence or harassed on the basis of sex can seek support, including counseling and academic support, from the university. If you or someone you know has been harassed on the basis of sex or sexually assaulted, you can find information and resources at https://sexualviolenceprevention.asu.edu/faqs.

As a mandated reporter, I am obligated to report any information I become aware of regarding alleged acts of sexual discrimination, including sexual violence and dating violence. ASU Counseling Services, https://eoss.asu.edu/counseling, is available if you wish discuss any concerns confidentially and privately.