ACMS 40390 - Section 02: **Numerical Analysis** Fall 2019

Course Information

Instructor:
Guosheng Fu gfu@nd.edu 201D Crowley Hall Phone: 574-631-9291

Teaching Assistant:
Xiaozhi Zhu Xiaozhi.Zhu.60@nd.edu 207 Crowley Hall

Class time: M, W, F, 02:00pm – 02:50pm

Classroom: 109 Pasquerilla Center

Office hours:
Fu: T 3:00pm – 5:00pm or by appointment and drop-in (when available), 201D Crowley Hall.
Zhu: T 1:00pm – 2:00pm, 207 Crowley Hall.

Textbook: Richard L. Burden and J. Douglas Faires, Numerical Analysis, 10th Edition.

Course Description

This course is an introduction to the numerical analysis. The primary objective of the course is to develop the basic understanding of numerical algorithms and skills to implement algorithms to solve mathematical problems on the computer.

Learning Goals

Upon successful completion of this course, you will be able to:

- Derive numerical methods for approximating the solution of problems of continuous mathematics,
- Analyze the error incumbent in any such numerical approximation,
- Implement a variety of numerical algorithms using appropriate technology, and
- Compare the viability of different approaches to the numerical solution of problems arising in roots of solution of non-linear equations, interpolation and approximation, numerical differentiation and integration, solution of linear systems, and solution of differential equations.

Main Topics

1. **Preliminaries of Computing**
   - **a)** Basic concepts: round-off errors, floating point arithmetic, Convergence.
2. **Numerical solution of Nonlinear Equations**
   - **a)** Bisection method, fixed-point iteration, Newton's method.
   - **b)** Error analysis for Iterative Methods.
   - **c)** Computing roots of polynomials*.
3. **Interpolation and Polynomial Approximation**
   - **a)** Lagrange Polynomial.
   - **b)** Divided Differences.

   c) Hermite Interpolation and Cubic Spline Interpolation.
4. **Numerical differentiation and integration**
   a) Numerical differentiation.
   b) Numerical integration (Quadrature rules).
5. **Initial-Value Problems for ODEs**
   a) Euler's, Taylor, Runge-Kutta, and multistep methods, Stability.
6. **Numerical linear algebra**
   a) Direct methods for solving linear systems.
   b) Iterative methods.
7. **Approximation theory**
   a) Least square approximation*.
8. **Approximating Eigenvalues**
   a) Power method, Householder's method*.
9. **BVP for ODEs**
   a) Shooting methods*.

*: if time permits

Grading scheme:

Two – 50 minutes in class exams	200 points (100 points each),
Homework	100 points
Computer project	100 points
Final Exam	150 points

Homework:
Homework is assigned within each lecture. The homework assigned within one week is due in class on the next Wednesday. By this way you can work on the problems over the weekend, and seek help, if necessary, on Monday and Tuesday or by appointments. **One lowest homework grade will be dropped.**

Computer Projects:
There will be a total of four computer projects. The computer code will be collected electronically via Sakai.

Grading Policy:
1). For an unexcused late homework or computer project, there will be a 25% penalty for 1 to 7 days late, and a 50% penalty for 8 to 14 days late. Holidays, Saturdays and Sundays are included in the counting.
2). An unexcused homework or computer project that is late for 15 days or more will receive no credit.

Assignments and other course information will be posted in Sakai and on the course webpage

https://sites.nd.edu/gfu/acms40390-02-f19/

Important dates:

First exam review:	09/23 (M)
First in class exam:	**09/25 (W)**
Second exam review:	10/28 (M)
Second in class exam:	**10/30 (W)**
Final exam review	Place and time to be announced
Final comprehensive exam:	**Place and time to be announced**

The course requires a certain amount of programming. ***Matlab*** *is the preferred programming language. However, you may also use other programming language including C, C++, Fortran, Python or Mathematica.*

Prerequisites:
(MATH 20750 or MATH 20860 or MATH 30650 or ACMS 20750 or PHYS 20452) and (ACMS 20620 or MATH 20610) and ACMS 20210.

Attendance: You are expected to attend every class. Excessive absences may result in lowering your grade and even failing the course.

Missed Exams: There will be two midterm exams and a final Exam. A student who misses an examination will receive zero points for that exam unless he or she has written permission from the Vice president for residential life. If you have a valid excuse (illness, excused athletic absence etc.) for missing an exam, please see me ASAP (preferably before the exam) and a makeup exam will be scheduled.

Exam conflicts: Conflicts with the exams in other courses must be resolved during the first week of classes. Exams may be made up only with an excused absence from the Assistant Vice President for Residence Life.

Honor Code: As a member of the Notre Dame community, I will not tolerate academic dishonesty. All examinations, homework and computer projects are conducted under the Honor Code. You are encouraged to work together on the homework assignments and projects, but copying in any form or submitting work done by others as your own is a violation of the Honor Code. Examinations are closed book and are to be done completely by yourself.

Disability Accommodations: It is the policy and practice of The University of Notre Dame to provide reasonable accommodations for students with properly documented disabilities. Any student who has a documented disability and is registered with Sara Bea Disability Services should speak with me as soon as possible regarding accommodations. Additional information about Sara Bea Disability Services and the process for requesting accommodations can be found at sarabeadisabilityservices.nd.edu