ACMS 40390: **Numerical Analysis,** Fall 2015
Course Information

Instructor:
Zhiliang Xu zxu2@nd.edu 242 Hayes-Healy Phone: 631-3423

Teaching Assistant:
Michael Machen mmachen@nd.edu 215 Hayes-Healy

Class time: M, W, F, 11:30am – 12:20pm

Classroom: 117 Haggar Hall

Office hours:
Xu: T 3:00pm – 5:00pm or by appointment and drop-in (when available), 242 Hayes-Healy.
Michael Machen: T 3:30pm – 4:30pm, 229 Hayes Healy.

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.

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
4. **Numerical integration and differentiation**
   a) Trapezoidal rule, etc., Gaussian quadrature and Euler-Maclaurin* formula.
5. **Applied Linear Algebra**
   a) Direct methods for solving linear systems, numerical factorizations.
   b) Eigenvalue problems*.
6. **IVP problems for ODE**
   a) Euler's, Taylor, Runge-Kutta, and multistep methods, Stability.
7. **Numerical linear algebra**
   a) Direct methods
   b) Iterative methods
8. **Approximation theory**
   a) Least square approximation

9. Approximating Eigenvalues

a) Power method, Householder's method*

10. BVP for ODE

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 a week is due 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.

Computer Projects:

Computer projects must be done individually and will be collected electronically. You must store your project files in your course folder created for this purpose (instructions for using university computers and submitting computer codes are on the course webpage).

Grading Policy:

1). For an unexcused late homework or computer projects, there will be a 10% penalty for 1 to 7 days late, and a 20% 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 also be posted on the course webpage

http://www.nd.edu/~zxu2/ACMS40390-F15.html

Important dates:

First exam review:	09/21 (M)
First in class exam:	**09/23 (W)**
Second exam review:	10/26 (M)
Second in class exam:	**10/28 (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. C, C++ or FORTRAN programming languages are preferred. However, You may also use software programs including Matlab, Mathematica.

Prerequisites:
MATH 20750 or MATH 20860 or MATH 30650 or ACMS 20750 or PHYS 20452
Attendance: You are expected to attend every class including your assigned tutorials. 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.

References
[1] J. Stoer and R. Bulirsch, Introduction to Numerical Analysis, Springer-Verlag, ISBN 0-387-90420-4
[2] L.N. Trefethen and D. Bau, Numerical Linear Algebra, Society of Industrial and Applied Mathematics
[3] C.T. Kelley, Iterative methods for linear and nonlinear equations, Society of Industrial and Applied Mathematics