ACMS 40390: **Numerical Analysis,** Fall 2012
Course Information

Instructor:

Zhiliang Xu zxu2@nd.edu Hayes-Healy 226 Phone: 631-3423

Teaching Assistant:
Dong Lu Dong.Lv.2@nd.edu Hayes-Healy 215

Class time: M, W, F, 8:30am – 9:20am.

Classroom: Edward J. DeBartolo Hall 117

Office hours:
Xu: M 5:00pm - 6:30pm or by appointment and drop-in (when available), HH226.
Lu: R 3:00pm – 4:00pm, HH215.

Textbook: Richard L. Burden and J. Douglas Faires, Numerical Analysis, 9th 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

Grading scheme:

Two – one hour 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.

Assignments and other course information will also be posted on the course webpage
http://www.nd.edu/~zxu2/ACMS40390-F12.html

Important dates:

First exam review:	09/24 (M)
First in class exam:	**09/26 (W)**
Second exam review:	10/22 (M)
Second in class exam:	**10/24 (W)**
Final exam review	Place and time to be announced
Final comprehensive exam:	**Place and time to be announced**

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

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.

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

Honor Code: As a member of the Notre Dame community, I will not tolerate academic dishonesty. You are encouraged to work together on the assignments, but copying in any form or submitting work done by others as your own is a violation of the Honor Code.

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