**Instructor:** Narendra Goel  
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Phone: 313-577-5422  
Office Hours: Tuesdays and Thursdays 7:50 PM-8:20 PM, 237 State Hall. Other hours by appointment

**Teaching Assistant:** Xin Guo; ee3459@wayne.edu  
Office Hours: Wednesday and Thursday 2:30 P.M.-4:30 P.M.; Room 3211, 5057 Woodward Ave.

**Lectures:** Tuesdays & Thursdays, 6:00 P.M. – 7:50 P.M.; 237 State Hall

**Recommended Books:**

(You can freely download chapters from http://www.matrixanalysis.com/DownloadChapters.html)  

**Prerequisites:** CSC 2110, or equiv.; and MAT 2250 for computer science students, BE 3040 for engineering students. The student should have some level of mathematical maturity (calculus, discrete mathematics, elementary algebra) and computer science maturity (programming and data structure).

The course is designed for upper level undergraduate and graduate students (including those pursuing Ph.D.) from a variety of backgrounds (computer science, biology, physics, chemistry, and engineering)

**Course Objectives:** This course will introduce the methodology of matrix analysis and applied linear algebra using computers. Considerable attention will be given to use of matrices to practical problems involving development of models and their simulations.

The course material will be some what custom designed for the class. One key aspect of the course is for the student to do a significant project using matrices and present it to the class. It is strongly encouraged for the student to select a project of his/her own interest, including those which may become thesis problem. Some of the projects may lead to publications in scientific journals. The project could be from physical, chemical, biological, social and computer sciences, engineering, and bioinformatics

We hope to cover the following topics:

Fundamentals (vectors and matrices, norms, inner products, the singular value decompositions), QR factorization and least squares (projectors, Gram-Schmidt orthogonalization, Householder triangulation), condition and stability, solving systems of equations (iterative methods, Gaussian elimination, Cholesky factorization), eigenvalue problems (principal component analysis), stochastic matrices and Markov chains, hidden Markov chains, and various software packages.

Applications: GPS systems, input-output models, net work flow, population growth and population stability, optimal allocation of resources, Google search engine, speech recognition, image processing and image compression (wavelets, DCT, fractals, SDV), image reconstructions, least square fitting, heat and electrical conduction in complex media, mechanical stress and strain, robotics, animation, cluster analysis, principal component and factor analyses, manufacturing assembly, control theory and other applications depending upon the class makeup.
Learning Objectives: After completing this course, students should be able to do the following:

1. Develop software to solve matrix equations $ax=b$ for different kinds of matrices using various methods.
2. Develop software to determine eigenvalues and eigenvectors for different kinds of matrices using various methods.
3. Know how to formulate different problems in the form of matrices and then solve them.
4. Be proficient in the use of commercial software Matlab to solve various problems involving matrices. This includes writing programs in Matlab.
5. Define and develop a project on their own where matrices are used, find the relevant literature, write a paper on the project and make a 15 minute presentation on the project and the findings of research.

Outcome Coverage:

(a) An ability to apply math, science, and engineering knowledge. The assignments, midterm exam and project require direct application of mathematical, scientific, and engineering knowledge to successfully complete the course. This requires solving problems from different fields.

(b) An ability to identify how matrices are used in a problem, write the software to solve the matrix problem, and analyze the results of the computations.

(c) An ability to understand the errors and unstable solutions in matrix analysis and what techniques should be used to get the most accurate and stable solution using least amount of computer time and computer storage.

(d) An ability to identify, formulate and solve engineering and scientific problems. The students achieve this item during the final project where they choose their own problem, analyze the problem, determine the techniques to be used, write a computer program to solve the problem and get results.

(e) An ability to communicate effectively: All students are required to make an oral presentation on their project work. The students are also required to submit a well-written technical report on their project work. The oral presentation and technical report writing process help them in achieving effective communication skills.

(f) An ability to use the techniques and skills of matrix analysis necessary for engineering practice: Students learn to use the Matlab software and learn how to write their own software in C++ or Java.

Attendance: Attending all lectures is REQUIRED. Attendance will be taken at randomly chosen times; a student will be allowed to miss up to two lectures. If a student misses more lectures, the instructor will have the option of administratively withdrawing the student from the class or failing him/her. The assignments, exams, quizzes, etc. will be based primarily (although not exclusively) on the material presented in the lectures. Also, assignments due dates, explanation and clarification of assignments, and material outside textbook will be presented during lectures. If due to an emergency, you miss a lecture, it is your responsibility to obtain the information covered in the session from your fellow classmates.

Homework and Examinations: There will be 8-10 homework assignments, due at the beginning of the lecture period of the due date. No late assignment will be accepted. Since each assignment is an integral part of the course, the instructor reserves the right to give a failing grade to anyone who is turning in 50% or less of the homework. The homework is a very important tool for learning the material taught in the lecture. Therefore, it is very important that you do the homework on your own.

There will be held two examinations on or about Feb. 16 and March 22, 2012 (dates are subject to change, but at least one week notice will be given). All the examinations will be held during the regular lecture hours. The examinations will be closed books, closed notes and closed neighbors. In order to pass the course, you must pass all exams. There will be no make-up examinations.

An important part of the course is for you to choose a topic of interest to you and model the system. You must specify the project no later than March 9, 2012. I will help you through the analysis of the problem and formulation of the approach. You will be required to write a report on your findings and make a 10 min presentation (with 5 minutes for questions) to the class.
The presentations will be held on Thursday April 19, 2012, 8:00 AM-11:15 PM; 4 :15 PM -8:00 PM, and on Friday April 20, 2012, 8.00 AM-?

**Final grade:** For the final grade, home works and exams are weighted as follows:

- **Homework:** 20%
- **Exam 1:** 20%
- **Exam 2:** 20%
- **Final project** 40%

The final letter grades will be determined approximately as follows:

- A  92-100% ; A-  90-91% ; B+  88-89% ; B  82-87%
- B- 80-82% ; C+ 78-79% ; C  72-77% ; C- 70-71% D+ 68-69% ; D 62-67% ; D-  60-61% ; E  0-59%

A grade of Incomplete (I) will be not be given.

**Students Responsibilities and Academic Honesty:** As a college student, who is committed to seek a higher education, we expect you be a very responsible person. At the least, please:

* Do your best to understand the material covered in the class; ask questions when you do not understand.
* Be aware of the homework assignments and deadlines.
* Obtain notes and handouts from your classmates if you miss a class for unavoidable circumstances. *Turn in your assignments in neat, readable and easily accessible form.* Obtain notes and handouts from your classmates if you miss a class for unavoidable circumstances.

Also we expect all of you to have the highest level of academic honesty. We expect each of you to do your work (assignments, and exams) yourself and strongly encourage you to discuss with the instructor(s) regarding any problems which you might have in the course work. However, in fairness to all, if we find two or more assignments, which appear to be copied from each other, we will split the points evenly among all those involved (no matter who copied from whom). Repeated incidents will be dealt with severe disciplinary actions.