King Fahd University of Petroleum & Minerals
College of Computer Sciences and Engineering

CISE 301 - Numerical Methods (3-0-3) – Section 08

SMW: 9:00AM-9:50AM, Room: 23-014

Spring 2010 (Term 092)

Syllabus

Catalog Description

Roots of nonlinear equations. Solutions of systems of linear algebraic equations. Numerical differentiation and integration. Interpolation. Least squares and regression analysis. Numerical solution of ordinary and partial differential equations. Introduction to error analysis. Engineering case studies.

Prerequisites: ICS 101 and MATH 201.

Instructor: Dr. Mohammed Houssaini Sqalli

Office: 22-149 **Phone:** 1725 **Email:** sqalli@kfupm.edu.sa

Office hours: SMW 10:00-11:00AM, and by appointment.

Course Access: We will use WebCT for all course related activities.

Text Book: *"Numerical Methods for Engineers", Steven C. Chapra and Raymond P. Canale, 5th Edition.*

Other references: *W. Cheney and Kincaid, Numerical Mathematics and Computing, 4th Edition.*

Grading Policy:		**Exam dates**
Attendance	5%	
Project	5%	
Assignments/Quizzes	15%	
Exam 1	20%	Thursday, March 25, 2010, 10:00AM-12:00PM
Exam 2	25%	Thursday, May 6, 2010, 10:00AM-12:00PM
Final Exam	30%	Monday, June 14, 2010, 7:00-9:00 PM

Attendance:

Attendance is required by all students. Official excuse for an authorized absence must be presented to the instructor no later than one week following the absence. More than 6 unexcused absences lead to a "DN" grade.

Five points will be given for attendance:
- The first absence and the first late attendance do not affect the attendance points.
- For each subsequent absence, 3/4 point is deducted.
- For each subsequent late attendance, 1/4 point is deducted.

Course Objectives:

The course aims to introduce numerical methods used for the solution of engineering problems. The course emphasizes algorithm development and programming and application to realistic engineering problems.

Course Outcomes:

At the end of this course, students should be able to:

1. Use Taylor Series to approximate functions and evaluate the approximations error.
2. Program algorithms to locate the roots of equations.
3. Program algorithms to solve linear system of equations.
4. Smooth engineering collected data using least square method.
5. Use polynomials to interpolate engineering collected data or approximate function
6. Program algorithms to evaluate the derivative or the integral of a given function and evaluate the approximation error.
7. Program to solve engineering Ordinary Differential Equations (ODE) or Partial Differential Equations (PDE).
8. Grasp relationships among methods, algorithms and computer errors.
9. Apply numerical and computer programming to solve common engineering problems.
10. Apply versatile software tools in attacking numerical problems.

Computer usage:

Students may use MATLAB, FORTRAN, C++, or Java Languages, or any other language to write programs to solve computer homework assignments.

ABET category:

Content as estimated by the faculty member who prepared this course description.

- Mathematical Sciences: 1 credit
- Engineering Science: 2 credits

Important Notes:

- Absence from class does not excuse a missed quiz or homework assignment.
- All assignments submitted after the due date will have 10% of the assignment maximum grade subtracted for every late day. If the submission is one week late, the grade for the assignment will be 0. (e.g.; if you get a grade of 80% in one assignment submitted 2 days later than the due date, you'll only receive a grade of 60%)

- "*Cheating, or attempting to cheat, or violating instructions and examination regulations shall render the offender subject to punishment in accordance with the Students Disciplinary Rules as issued by the University Council (A38).*" taken from the KFUPM "Academic Regulations" document.

Course Topics:

1. *Introductory Material* **1 week**
Absolute and relative errors, Rounding and chopping, Computer errors in representing numbers (Sec 3.1-3.4), Review of Taylor series (Sec 4.1).

2. *Roots of Algebraic Equations* **1.5 weeks**
Graphical Methods (Sec 5.1), Bisection method (Sec 5.2), Newton method (Sec 6.2), Secant method (Sec 6.3), Systems of nonlinear equations (6.5.2)*.

3. *Systems of Linear Equations* **1.5 weeks**
Naïve Gaussian elimination (Sec 9.2), Gaussian elimination with scaled partial pivoting (Sec 9.4), Tri-diagonal systems, Gauss-Jordan method (Sec 9.7)*.

4. *The Method of Least Squares* **1.5 weeks**
Linear Regression (Sec 17.1), Polynomial Regression (Sec 17.2), Multiple Linear Regression (Sec 17.3)*.

5. *Interpolation* **1.5 weeks**
Newton's Divided Difference method (Sec 18.1), Lagrange interpolation (Sec 18.2), Inverse Interpolation (Sec 18.4).

6. *Numerical Differentiation* **1 week**
Finite Difference 1st and 2nd derivatives approximation (Sec 23.1), Richardson's Extrapolation (Sec 23.2).

7. *Numerical Integration* **1.5 weeks**
Trapezoid rule (Sec. 21.1), Romberg algorithm (Sec 22.2), Gauss Quadrature (sec 22.3)*.

8. *Ordinary Differential Equations (ODEs)* **3.5 weeks**
Euler's method (Sec 25.1), Improvements of Euler's method (Sec 25.2), Runge-Kutta methods (Sec 25.3), Methods for systems of ODEs (Sec 25.4), Multistep Methods (Sec 26.2), Boundary value problems, finite difference method (Sec 27.1)*.

9. *Partial Differential Equations* **2 weeks**
Elliptic Equations (Sec 29.1-29.2), Parabolic Equations (Sec 30.1-30.4).

**** : If time permits.***