SE 301: Numerical Methods

Instructor: Dr. Uthman Baroudi
Lecture: S.T: 12:45-2:00 PM
Location: Bldg. 24-165
Office hours: S.S.M.T.: 11-11:50 am (if it is Not suitable for you, please do not hesitate to call or e-mail me to set an appointment)
Office: building 22, Room 144, Tel: 4283
E-mail: ubaroudi@ccse.kfupm.edu.sa

Catalogue 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.

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.

Prerequisite: ICS 101, & MATH 201

Learning Outcomes:

At the end of the course a student will:

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.

Textbook:

- "Numerical Methods for Engineers", Steven C. Chapra and Raymond P. Canale.

References:

- W. Cheney and Kincaid, Numerical Mathematics and Computing. 4th Edition

Grading:

- Homework 5%
- Participation & Attendance 5% **(-0.5 for each absence, 3 late attendances count as one absence)**
- Quizzes 15% **(Every other Tuesday)**
- Exam–I **(Monday March 24, 2008, 7:00-9:00 pm) 20%**
- Exam-II **(Monday April 28, 2008, 7:00-9:00 pm) 30%**
- Final Exam (**June 14 , 2008**, 12:30pm) **30%**
- **A +> 90, F < 50; a mixed policy of standard and average**

General policy

1. Minimize disruptions -- turn off mobile phone and pager during lectures
2. *Check your exam schedule carefully. NO MAKE-UP EXAM will be given.*
3. Minimum penalty for cheating is 0 for the homework/project/exam where it occurs.
4. Exceeding **6 absences** without official excuse means DN grade automatically. ***Please note that accumulating three late attendances (5-10 minutes late) is considered as one absence***.
5. No WP grade will be given for poorly performing students
6. *You are responsible for all the materials covered in the class. So, it is your responsibility to find out what has been covered in those unattended classes.*

Proposed Outline (Subject to Change)

Topics		
1	Introductory material: • Absolute and relative errors, Rounding and chopping, • Computer errors in representing numbers (sec 3.1-3.4)*. • Review of Taylor series (sec 4.1),	4 Lecturers
2	**Locating roots of algebraic equations:** • 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)*	6 Lectures
3	**Systems of linear equations:** • Naïve Gaussian elimination(sec 9.2) • Gaussian elimination with scaled partial pivoting (Sec 9.7) • Tri-diagonal systems (sec 11.1.1)*	6 Lectures
	Exam I Covers Topics 1,2 and 3 (Thursday March 27, 2008, 9:30-11:00 am)	
4	**The Method of Least Squares;** • Linear Regression (Sect 17.1), Polynomial Regression (17.2) • Multiple Linear Regression (Sec 17.3)*	4 Lectures
5	**Interpolation:** • Newton's Divided Difference method (Sec. 18.1), • Lagrange interpolation (Sec 18.2), Inverse Interpolation (Sec 18.4)	4 Lectures
6	**Numerical Differentiation:** • Estimating derivatives and Richardson's Extrapolation (sec. 23.1-23.2).	2.5 Lectures
	Exam II Covers Topics 4,5 and 6 (Monday April 28, 2008, 7:00-9:00 pm)	
7	**Numerical Integration:** • Trapezoid rule (sec. 21.1), Romberg algorithm (sec 22.2). • Gauss Quadrature (sec 22.3)*	6 Lecturers
8	**Ordinary differential equations:** • Euler's method (sec 25.1), • Improvements of Euler's method (sec 25.2), • Runge-Kutta methods (sec.25.3), • Methods for systems of equations (sec 25.4), • Multistep Methods (Sec 26.2),: • Boundary value problems (Sec. 27.1).	9 Lectures
9	**Partial differential equations:** • Elliptic Equations (sec 29.1-29.2) • Parabolic Equations (sec 30.1-30.4).	2.5 Lectures
	Final Exam Covers Topics 7, 8 and 9 (June 14, 2008)	

* (if time permits)