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

CISE 301 Numerical Methods (3-0-3)

Instructor: Dr. Marwan Abu-Amara
Office: 22-145
Phone: 1632
E-mail: marwan@kfupm.edu.sa

Term: 152 (2nd term 2015–2016)
Day & Time: UT 12:45 PM – 02:00 PM
Location: 24-106
Prerequisites: (ICS 101 or ICS 103) and MATH 201.
Textbook: *Numerical Methods for Engineers*, Steven C. Chapra and Raymond P. Canale, 6th Edition, McGraw Hill, 2010.
Office Hours: UT 10:00 AM – 10:50 AM (or by appointment)
Web Site: http://faculty.kfupm.edu.sa/COE/marwan

Tentative Grading Policy:

- Attendance **5%**
- Homeworks **7%**
- Quizzes **10%**
- Programming Project **3%**
- Major Exam I **20%** (End of Week 06 – Saturday February 27, 2016, 10:00 AM – 12:00 PM)
- Major Exam II **25%** (End of Week 11 – Saturday April 09, 2016, 10:00 AM – 12:00 PM)
- Final Exam **30%** (Sunday May 22, 2016, 08:00 AM)

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, C++, Java, or any other language to write programs to solve computer homework assignments/project.

IMPORTANT NOTES:

- All KFUPM regulations and standards will be enforced. Attendance will be checked each class. The KFUPM rule pertaining to a DN grade will be strictly enforced (i.e. **> 6 absences** will result in a DN grade).
- If you are late to the class for more than 10 minutes (i.e. arrive after 12:55 PM), you will **NOT be allowed to enter** the classroom and you will be considered absent for that class.
- Only university approved/certified excuses will be accepted, and should be presented **no later than 1 week** after absence.
- Use of cell phones, smart phones, and tablets during class period and during exams is absolutely **prohibited**.
- Homeworks are to be submitted **in class** on the due date during the class period. Late homeworks will **NOT be accepted**.
- You have up to the next class period to object to the grade of a homework, a quiz, or a major exam from the end of the class time in which the graded papers have been distributed back. If for some reason you cannot contact me within this period, send me an email requesting an appointment. The email should be sent within the 48-hour time period.
- **NO make up exams**. ALL homeworks and quizzes will be counted towards your grade.
- Final exam is **common**.

Tentative schedule:

75 min Lectures	Topics
3	**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	**2. *Roots of Algebraic Equations*** Graphical Methods (Sec 5.1), Bisection method (Sec 5.2), Newton method (Sec 6.2), Secant method (Sec 6.3), Multiple Roots (Sec 6.5), Systems of nonlinear equations (Sec 6.6)*.
3	**3. *Systems of Linear Equations*** Naïve Gaussian elimination (Sec 9.2), Gaussian elimination with scaled partial pivoting (Sec 9.4), Tri-diagonal systems (Sec 11.1), Gauss-Jordan method (Sec 9.7)*.
3	**4. *The Method of Least Squares*** Linear Regression (Sec 17.1), Polynomial Regression (Sec 17.2), Multiple Linear Regression (Sec 17.3)*.
2.5	**5. *Interpolation*** Newton's Divided-Difference method (Sec 18.1), Lagrange interpolation (Sec 18.2), Inverse Interpolation (Sec 18.4).
2.5	**6. *Numerical Differentiation*** Finite Difference 1^{st} and 2^{nd} derivatives approximation (Sec 23.1), Richardson's Extrapolation (Sec 23.2).
2	**7. *Numerical Integration*** Trapezoid rule (Sec 21.1), Romberg algorithm (Sec 22.2), Gauss Quadrature (Sec 22.3)*.
7	**8. *Ordinary Differential Equations (ODEs)*** 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, 27.2.4).
3	**9. *Partial Differential Equations*** Elliptic Equations (Sec 29.1-29.2), Parabolic Equations (Sec 30.1-30.4).

**** If time permits.***