

SE 301

Numerical Methods

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Introduction 1-1

Course Objective

- ✓ To Learn
 - ✓ Short-term memory
 - ✓ Long-term memory
 - ✓ reinforcement
- ✓ Surface Learning
- ✓ Deep Learning

المفاتيح العشرة للنجاح الدراسي

<http://www.khayma.com/happy-family/0001/000004.html>

- الطموح كنز لا يُفنى : لا يسعى للنجاح من لا يملك طموحاً
- العطاء يساوي الأخذ : النجاح عمل وجد وتضحية وصبر منح
- غير رأيك في نفسك : الإنسان يملك طاقات كبيرة وقوى خفية يحتاج أن يزيل عنها غبار التقصير والكسل ..
- النجاح هو ما تصنعه (فكر بالنجاح - أحب النجاح ...) .. الناجحون لا ينجحون وهم جالسون لاهون ينتظرون النجاح
- الفشل مجرد حدث ..
- املاً نفسك بالإيمان والأمل : الإيمان بالله أساس كل نجاح .. وهو النور الذي يضيء لصاحبه الطريق ..
- اكتشف مواهبك واستفد منها
- الدراسة متعة .. طريق للنجاح : المرحلة الدراسية من أمتع لحظات الحياة .. ولا يعرف متعتها إلا من مرّ بها والتحق بغيرها .. متعة التعلم لا تضاهيها متعة في الحياة ..
- الناجحون يثقون دائماً في قدرتهم على النجاح
- النجاح والتفوق = 1% إلهام وخيال + 99% جهد واجتهاد

Fact:

Our program has no credits for programming courses!

Questions:

How your students coop with this?

Answer:

Our students want to Relevant!

Your expectations out of the
course?!

Introduction 1-5

Learning Outcomes

- At the end of the course a student will:
 - ❖ Use Taylor Series to approximate functions and evaluate the approximations error.
 - ❖ Program algorithms to locate the roots of equations.
 - ❖ Program algorithms to solve linear system of equations.
 - ❖ Smooth engineering collected data using least square method.
 - ❖ Use polynomials to interpolate engineering collected data or approximate function
 - ❖ Program algorithms to evaluate the derivative or the integral of a given function and evaluate the approximation error.

Learning Outcomes

- At the end of the course a student will:
 - ❖ Program to solve engineering Ordinary Differential Equations (ODE) or Partial Differential Equations (PDE).
 - ❖ Grasp relationships among methods, algorithms and computer errors.
 - ❖ Apply numerical and computer programming to solve common engineering problems.
 - ❖ Apply versatile software tools in attacking numerical problems.

Course Information

- *Introductory* (first) course in Numerical Methods
- **Course materials:**
 - Textbook: "Numerical Methods for Engineers", Steven C. Chapra and Raymond P. Canale

Evaluation / Assessment

- ❑ Assignments & Quizzes 20%
 - ✓ Homework
 - ✓ Computer assignments
 - ✓ Quizzes (Every other Tuesday)
- ❑ Participation & Attendance 5% (Bonus)
 - ✓ (-0.5 for every absence, 3 late attendances counts as one absence)
- ❑ Exams:
 - ✓ Exam-I (Monday, March 24, 2008) 20%
 - ✓ Exam-II (Monday, April 28, 2008) 30%
 - ✓ Final Exam (June 14, 2008) 30%
 - ✓ What type of Exam?

- ❑ Any comment/suggestion?

Course Information (more)

Odd and ends...

- ✓ me
- ✓ in-class style: interaction, questions (*please!*)
 - ✓ *Cheating will not be tolerated. At least 0 in quiz, homework, exam, etc.*
 - ✓ *DN Grade (exceeding 6 absences)*
 - ✓ *WF Grade (poor performance)*
- ✓ getting into this course...

- ✓ Questions, comments, ... ???

Course Overview:

Part 1: Introduction (4 Lecturers, text: Chapter 3&4)

- ✓ absolute and relative errors, Rounding and chopping, Computer
- ✓ errors in representing numbers (sec 3.1-3.4).
- ✓ Review of Taylor series (sec 4.1),

Course Overview:

Part 2: Locating roots of algebraic equations (4 *Lectures, text: Ch. 5&6)*

- ✓ 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)

Course Overview:

- ✓ **Part 3: Systems of linear equations: (6 lectures, text Ch. 9)**
- ✓ Naïve Gaussian elimination (sec 9.2)
- ✓ Gaussian elimination with scaled partial pivoting and Tri-diagonal systems, Gauss-Jordan method (Sec 9.7)
- ✓ Transport-layer services and principles

Course Overview:

Part 4: The Method of Least Squares (4 *Lectures, text: Ch. 17)*

- ✓ Linear Regression (Sect 17.1), Polynomial Regression (17.2)
- ✓ Multiple Linear Regression (Sec 17.3)*

Course Overview:

Part 5: Interpolation (*4 Lectures, text: Ch. 18*)

- ✓ Newton's Divided Difference method (Sec. 18.1),
- ✓ Lagrange interpolation (Sec 18.2),
- ✓ Inverse Interpolation (Sec 18.4)

Course Overview:

Part 6: Numerical Integration (*6 Lectures, text: Ch. 21*)

- ✓ Trapezoid rule (sec. 21.1),
- ✓ Romberg algorithm (sec 22.2)
- ✓ Gauss Quadrature (sec 22.3)

Course Overview:

Part 7: Numerical Differentiation (*2.5 Lectures, text: Ch. 23*)

- ✓ Estimating derivatives and Richardson's
- ✓ Extrapolation (sec. 23.1-23.2).

Course Overview:

Part 8: Ordinary differential equations (9 *Lectures, text: Ch. 25,26 & 27)*

- ✓ 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).

Course Overview:

Part 9: Partial differential equations (2.5
Lectures, text: Ch. 29&30)

- ✓ Elliptic Equations (sec 29.1-29.2)
- ✓ Parabolic Equations (sec 30.1-30.4).