جامعة الملك عبدالله
للعلوم والتقنية
King Abdullah University of
Science and Technology

Course Syllabus: Applied Numerical Methods - AMCS 206

Division	Computer, Electrical and Mathematical Sciences & Engineering
Course Number	AMCS 206
Course Title	Applied Numerical Methods
Academic Semester	Spring
Academic Year	2016/2017
Semester Start Date	01/22/2017
Semester End Date	05/18/2017
Class Schedule (Days & Time)	01:00 PM - 02:30 PM | Sun Thu

Instructor(s)

Name	Email	Phone	Office Location	Office Hours
Omar Mohamad Knio	Omar.Knio@kaust.edu.sa	+966128080311		By appointment as needed (email to schedule). Office location: Building 1, Room 0113

Teaching Assistant(s)

Name	Email

Course Information

Comprehensive Course Description	We will provide a survey of numerical methods for engineers and scientists. We will start with a review of elementary results from matrix theory and numerical linear algebra. We will then focus on discrete equilibria, and use this setting to illustrate Gauss elimination and LU factorization techniques. We will then consider continuous equilibria, and use this setting to introduce iterative linear solvers. We will then shift our attention to non-linear discrete system, and analyze basic solution techniques. We will then consider non-equilibrium systems, and introduce a general class of numerical integration methods. We will conclude with a brief exploration of numerical solution of transient partial differential equations, and introduce the concepts of truncation error and numerical stability.
Course Description from Program Guide	A fast-paced one-semester survey of numerical methods for engineers and scientists, with an emphasis on technique and software. Computer representation of numbers and floating point errors. Numerical solution of systems of linear and nonlinear algebraic equations, interpolation, least squares, quadrature, optimization, nonlinear equations, approximation of solutions of ordinary and partial differential equations. Truncation error, numerical stability, stiffness, and operation and storage complexity of numerical algorithms.
Goals and Objectives	We will try to integrate algorithms into the mainstream of applied mathematics and use them as intellectual focal points, providing unifying concepts for some basic ideas of applied mathematics.
Required Knowledge	Familiarity with elementary numerical analysis, linear algebra, PDEs and ODEs; proficiency with Fortran, C, Matlab or Python; working knowledge of fundamental equations in classical physics.

Reference Texts	**Primary:** -Course notes **Reference Books:** -Numerical Mathematics and Computing, 7th international edition, 2013, Authors: Ward Cheney, David Kincaid, Cengage Learning -Scientific Computing: An Introductory Survey, 2nd international edi- tion, 2001, Author: Michael T. Heath, McGraw-Hill Europe/ -Numerical Analysis: A Second Course, Ortega, J.M., SIAM, 1990. -Introduction to Applied Mathematics, Strang, G., Wellesley-Cambridge Press, 1986.
Method of evaluation	**50.00**% - Quiz(zes) **50.00**% - Homework /Assignments
Nature of the assignments	Homework assignments will involve analytical work, coding and implementation of numerical algorithms.
Course Policies	Attendance is mandatory. If you need to miss a lecture, please arrange with a classmate to obtain lecture notes.
Additional Information	

Tentative Course Schedule

(Time, topic/emphasis & resources)

Week	Lectures	Topic
1	Sun 01/22/2017 Thu 01/26/2017	Review of numerical analysis and numerical linear algebra
2	Sun 01/29/2017 Thu 02/02/2017	Review of numerical analysis and numerical linear algebra
3	Sun 02/05/2017 Thu 02/09/2017	Discrete linear systems; Gauss elimination, LU decomposition
4	Sun 02/12/2017 Thu 02/16/2017	Non-linear equations
5	Sun 02/19/2017 Thu 02/23/2017	Interpolation and numerical differentiation
6	Sun 02/26/2017 Thu 03/02/2017	Numerical integration Equilibrium in continuous systems
7	Sun 03/05/2017 Thu 03/09/2017	Equilibrium in continuous systems
8	Sun 03/12/2017 Thu 03/16/2017	Equilibrium in continuous systems Discrete non-equilibrium problems
9	Sun 03/19/2017 Thu 03/23/2017	Numerical integration of ODEs
10	Sun 03/26/2017 Thu 03/30/2017	Numerical integration of ODEs Quiz I
11	Sun 04/02/2017 Thu 04/06/2017	Break
12	Sun 04/09/2017 Thu 04/13/2017	Introduction to spectral and finite-element approximation
13	Sun 04/16/2017 Thu 04/20/2017	Finite-difference solution of heat equation
14	Sun 04/23/2017 Thu 04/27/2017	Finite-difference solution of heat equation
15	Sun 04/30/2017 Thu 05/04/2017	Finite-difference solution of wave equation
16	Sun 05/07/2017 Thu 05/11/2017	Finite-difference solution of wave equation Quiz II
17	Sun 05/14/2017 Thu 05/18/2017	Convection-diffusion equation
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Note

The instructor reserves the right to make changes to this syllabus as necessary.