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	2017/2018
Semester Start Date	01/28/2018
Semester End Date	05/24/2018
Class Schedule (Days & Time)	10:30 AM - 12:00 PM | Tue 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	**25.00**% - Exam 2 **50.00**% - Homework /Assignments **25.00**% - Exam 1
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	Tue 01/30/2018 Thu 02/01/2018	Review of numerical analysis and numerical linear algebra
2	Tue 02/06/2018 Thu 02/08/2018	Review of numerical analysis and numerical linear algebra
3	Tue 02/13/2018 Thu 02/15/2018	Discrete linear systems; Gauss elimination, LU decomposition
4	Tue 02/20/2018 Thu 02/22/2018	Non-linear equations
5	Tue 02/27/2018 Thu 03/01/2018	Interpolation and numerical differentiation
6	Tue 03/06/2018 Thu 03/08/2018	Numerical integration Equilibrium in continuous systems
7	Tue 03/13/2018 Thu 03/15/2018	Equilibrium in continuous systems
8	Tue 03/20/2018 Thu 03/22/2018	Equilibrium in continuous systems Discrete non-equilibrium problems
9	Tue 03/27/2018 Thu 03/29/2018	Numerical integration of ODEs
10	Tue 04/03/2018 Thu 04/05/2018	Numerical integration of ODEs Quiz I
11	Tue 04/10/2018 Thu 04/12/2018	Break
12	Tue 04/17/2018 Thu 04/19/2018	Introduction to spectral and finite-element approximation
13	Tue 04/24/2018 Thu 04/26/2018	Finite-difference solution of heat equation
14	Tue 05/01/2018 Thu 05/03/2018	Finite-difference solution of heat equation
15	Tue 05/08/2018 Thu 05/10/2018	Finite-difference solution of wave equation
16	Tue 05/15/2018 Thu 05/17/2018	Finite-difference solution of wave equation Quiz II
17	Tue 05/22/2018 Thu 05/24/2018	Convection-diffusion equation
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Note

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