Florida International University
Department of Mechanical and Materials Engineering

EGM 5346 **Computational Engineering Analysis** **Spring 2019**

The FIU Civility Initiative is a collaborative effort by students, faculty, and staff to promote civility as a cornerstone of the FIU Community. We believe that civility is an essential component of the core values of our University. We strive to include civility in our daily actions and look to promote the efforts of others that do the same. Show respect to all people, regardless of differences; always act with integrity, even when no one is watching; be a positive contributing member of the FIU community.

Objective(s) of Course:

1) To provide the graduate student with some basic tools necessary for more advanced coursework that use more advanced numerical methods employed in mechanical engineering such as FEM, BIEM and FDM; and
2) To provide the senior undergraduate student with a computer applications course that can act as a "capstone" to undergraduate engineering science courses such as dynamics, fluid mechanics and heat transfer.

Prerequisites

Differential Equations; FORTRAN or equivalent; Heat Transfer; Fluid Dynamics; Dynamics

Course Coordinator

Dr. Cesar Levy, EC3442, (305) 348-3643. levyez@fiu.edu. **Please send me an email with your preferred email address.**

Office hours: M 10am-12pm and W 3pm-430pm or by appointment

Course Outline

1. Review of errors encountered in computing and ways to minimize these types of errors
2. Root Solving Methodologies: example of when used -- Modelling of feedback control problems leading to system transfer functions
   System stability analysis by the determination of poles and zeroes of the feedback control transfer function employing root solving methodologies
3. Matrix Equations and their solutions: example of where used--
   Modelling of dynamic systems or curve fitting. Generation of systems of equations from the discretization process. Defining matrix equations.
4. Review of matrix notation, matrix norms, conditioning of matrices. What does the ill-conditioning of matrices mean from an engineering point of view.
5. Solution of Matrix equations using Gauss elimination, Gauss- Jordan and other methods (LU) decomposition.
6. Review of finite difference formulae (FDF) and errors incurred in the forms chosen
7. Physical implications of the constitutive relations at the boundaries. How the initial information known can influence the forms of the FDF used.

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8. Modelling of translational, rotational, thermal and fluidic systems using pure ideal (linear) type system elements. Discretization of different types of systems employing basic equations of motion, mass conservation laws, and other constitutive relations. For the pure (nonlinear) elements -- the solution of such equations
9. Matrix equations generated by the FDF and the methods of solution available (Gauss Elimination, Gauss-Seidel, etc.)
10. Solution of differential equations - available methods (Euler, Runge-Kutta, Predictor-Corrector)
11. Review of numerical integration employed in these techniques; errors involved in these integration routines and how to increase accuracy
12. Review of the importance of step size in computational work in the solution of differential equations; convergence checks in computation
13. Interpolation and extrapolation of data at points other than data points - convergence of solution based on stepsize
14. Curve fitting - a manner of linearizing system elements

Textbook

C.F. Gerald and P.O. Wheatley, *Applied Numerical Analysis*, Addison-Wesley, 7th Ed
Possibly class notes on various topics relevant to the course.

Other Textbooks

- Applied Numerical Methods by Carnahan, Krieger Publishers
- Applied Numerical Methods for Digital Computations by James, Smith and Wolford, Harper and Row Publishers, 4th Edition, 1993

HW assignments are due one week from the assignment date, unless otherwise stated.

Grades will be determined on the basis of
1 Midterm Exam 40%
HW/computer prog. 20%
Final exam 40%

Tentative Grading Scheme

95 and above	A	80 - 84	B	
90 - 94	A-	77 - 79	B-	60 - 66 D
85 - 89	B+	74 - 76	C+	Below 60 F
		67 - 73	C	

We will meet twice week M 200-350pm, W 200-250pm in EC1113.

This is a preliminary syllabus subject to change. All changes will be announced in class.