ME 2016 Computing Techniques (Required)

Catalog Description: ME 2016 Computing Techniques (3-0-3)
Prerequisites: CS 1371 Introduction to Computing and MATH 1502 Calculus II
Corequisite: MATH 2403 Differential Equations
An introduction to the use of computers and MATLAB programming for the solution of mechanical engineering problems. Topics include: sources of errors in computing, model-based problem solving, basic numerical methods, and signal processing.

Textbook: Steven C. Chapra, and Raymond P. Canale, *Numerical Methods for Engineers*, 5th Edition, McGraw-Hill, 2006.

Topics Covered:

1. Introduction to mathematical modeling and numerical solution of engineering problems.
2. Numerical errors – Computer representation of real numbers. Accuracy, precision, and round-off errors. Taylor series and truncation error.
3. Root finding – Bisection and Newton-Raphson method.
4. Systems of linear equations - Gauss elimination. LU-decomposition. Algorithm complexity.
5. Curve fitting – Least-squares regression methods.
6. Interpolation – Piecewise linear- and cubic-spline interpolation.
7. Numerical integration – The trapezoidal rule and Simpson's rules. Order of convergence.
8. Ordinary differential equations – Euler's methods, Runge-Kutta methods. Truncation error, order of convergence, and stability.
9. Optimization – Golden section search.
10. Signal processing – Sampling and aliasing, spectrum analysis, and digital filters.

Course Outcomes:

Outcome 1: To further develop a student's ability to use computers and computer networks.

1.1 The student will demonstrate an ability to use the Georgia Tech computer network to obtain course information and help using a course web site.
1.2 The student will demonstrate an ability to submit homework electronically.
1.3 The student will demonstrate an ability to use a computer to do the homework assignments.

Outcome 2: To develop a student's ability to use structured software design concepts in the development of efficient computer software for the solution and data visualization of engineering problems.

2.1 The student will demonstrate an ability to write efficient computer programs using the MATLAB programming language.
2.2 The student will demonstrate an ability to write well-structured, well-documented programs.
2.3 The student will demonstrate an ability to use these computer programs to solve simple engineering problems.
2.4 The student will demonstrate an ability to display the results of their computations using the graphics capabilities of MATLAB.

Outcome 3: To give the student a working knowledge of a variety of numerical methods used in mechanical engineering and some practical experience with their use.

3.1 The student will demonstrate a basic understanding of several numerical methods.

3.2 The student will demonstrate the ability to translate a numerical algorithm into a working MATLAB program.
3.3 The student will demonstrate the ability to formulate simple mathematical models of engineering problems.
3.4 The student will use numerical methods and computer models to solve several engineering problems using a computer.

Outcome 4: To give the student a working knowledge of some of the methods used for signal processing and analysis and some practical experience with their use on real-world and laboratory data.

4.1 The student will demonstrate a basic understanding of simple signal processing and analysis.
4.2 The student will demonstrate an ability to process, analyze, and display data from a real-world or laboratory experiment or process.

Outcome 5: To develop a student's ability to formulate a problem, analyze it, and then communicate the results of their work in written and graphical form.

5.1 The student will demonstrate an ability to formulate an open-ended engineering problem into a form suitable for computer analysis.
5.2 The student will demonstrate an ability to solve such problems using the numerical methods from this course.
5.3 The student will demonstrate an ability to communicate the results of their work in a written report format.

Correlation between Course Outcomes and Program Educational Outcomes:

ME 2016												
	Mechanical Engineering Program Educational Outcomes											
Course Outcomes	a	b	c	d	e	f	g	h	i	j	k	l
Course Outcome 1.1											X	
Course Outcome 1.2											X	
Course Outcome 1.3											X	
Course Outcome 2.1	X										X	X
Course Outcome 2.2	X										X	X
Course Outcome 2.3	X				X						X	X
Course Outcome 2.4							X				X	
Course Outcome 3.1	X											X
Course Outcome 3.2	X										X	X
Course Outcome 3.3	X				X						X	X
Course Outcome 3.4	X				X						X	X
Course Outcome 4.1	X											X
Course Outcome 4.2	X	X			X						X	X
Course Outcome 5.1	X				X							X
Course Outcome 5.2	X				X						X	X
Course Outcome 5.3	X						X					X

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