ME/MSE 241 Engineering Computations

Course description:	This course introduces the use of computers to solve engineering and other applied mathematics problems.
Number of credits:	3
Course Coordinator:	N. Boddeti
Prerequisites by course:	Math 273 or concurrent enrollment Physics 201 or concurrent enrollment
Prerequisites by topic:	1. Algebra 2. Integration 3. Geometry 4. Vectors
Postrequisites:	ME 313 Engineering Analysis ME 485 Introduction to Robotics & AI
Textbooks/other required materials	Required: • *Algorithmic Problem Solving with Python* by John B. Schneider, Shira Lynn Broschat, and Jess Dahmen. 2013. www.eecs.wsu.edu/~schneidj/swan References: • *Foundations of Python Programming* by the Runestone Interactive Project. https://runestone.academy/ns/books/published//fopp/index.html • *Think Python: How to Think Like a Computer Scientist* by Allan B. Downey. https://greenteapress.com/wp/think-python-2e/
Course Objectives:	1. Understand the basic concepts of computer programming (datatypes, operators, conditional and iterative statements, classes and objects etc.) via the Python programming language 2. Synthesize logic and implement data structures and algorithms to solve mathematical problems 3. Understand the use of scientific python packages of numpy, scipy, and matplotlib 4. Develop and implement algorithms to solve engineering problems that require solution to mathematical problems involving linear system of equations, curve fitting, system of ordinary differential equations, and optimization

Topics Covered:

1. Language independent fundamentals including data types, expressions, operators, input/output, functions, lists, iterations, loops, conditional statements.
2. Language-dependent basics, such as syntax, structure, conventions, etc. as they support Outcomes 1-3. For WSU ME/MSE 241, these will be taught using the Python programming language.
3. Solving complex problems through data representation and sequential decision making.
4. Fundamentals of debugging and troubleshooting.
5. Solving simple numerical and data analysis problems by applying publicly available library routines.
6. Solving numerical and data analysis problems by implementing traditional numerical algorithms including at least the following:
   a. Linear systems of equations
   b. Curve fitting and interpolation (including splines)
   c. Numerical differentiation and integration
   d. Ordinary differential equations (initial value problems, boundary value problems, systems of ODEs)
7. Language extensions including objects, importing, and using libraries and modules.
8. Extending fundamental principles learned in Python to other languages used during the ME/MSE curriculum.

Expected Learning Outcomes:

1. Use an integrated development environment to write and debug code with data type control, mathematical expressions, and file I/O.
2. Develop and debug programs that include branching, loops, and functions.
3. Implement data structures including 1-D arrays, 2-D arrays, and mixed data type structures.
4. Solve numerical and data analysis problems by implementing traditional numerical recipes.
5. Select appropriate numerical methods to apply to various types of problems in engineering and science in consideration of the mathematical operations involved, accuracy requirements, and available computational resources.
6. Develop computer programs of increasing complexity that involve multiple interacting programming structures and computational methods.
7. Interpret, format, and present results including visualizations of data.

Class and Laboratory Schedule:

Three 50-minute lecture sessions per week, for one semester. This is augmented with a 2-hour laboratory session where students apply the concepts learned in the prior week to programming problems.

Contribution to meeting the professional component:	Engineering Topics
Relationship of course to student outcomes:	Meets: ABET EAC 2024-25 Criterion 3 student outcomes: 1, 3, 5, 6, & 7 7
Prepared by:	Teresa Fuller and N. Boddeti Date: September 30, 2024