MAP2302 Course Outline

Differential Equations *(Elementary)*.....(3) (P)

Description: This course includes the study of first order differential equations, higher order linear differential equations, Laplace transforms, numerical methods, boundary value and initial value problems, qualitative analysis of solutions, and applications of differential equations.

General Education Learning Outcome: The primary General Education Learning Outcome (GELO) for this course is Quantitative Reasoning, which is to understand and apply mathematical concepts and reasoning, and analyze and interpret various types of data. The GELO will be assessed through targeted questions on either the comprehensive final or an outside assignment.

Prerequisite: MAC2312 with a grade of "C" or better, OR the equivalent.

Rationale: In an increasingly complex world, mathematical thinking, understanding, and skill are more important than ever. Differential equations will provide students with the needed working knowledge of advanced mathematical concepts and an awareness of their relationship to complex problems. Students wishing to major in the sciences or engineering are required to study differential equations. It provides a solid foundation for further study in mathematics, the sciences, and engineering.

Impact Assessment: *Elementary Differential Equations* provides students with skills for proficiency in first order differential equations, higher order linear differential equations, the Laplace transform and a conceptual understanding of those topics, and the opportunity for an in-depth understanding of elementary differential equations and the meaning of their solutions. The course applies toward the General Education mathematics requirement area B for an Associate of Arts degree. MAP2302 is a prerequisite for higher level courses and is required for many degrees in mathematics, engineering, and the sciences.

Broad Course Objectives: This course supports the following goals of the Math Department.

- Engage students in sound mathematical thinking and reasoning. This should include students finding patterns, generalizing, and asking/answering relevant questions.
- Provide a setting that prepares students to read and learn mathematics on their own.
- Explore multiple representations of topics including graphical, symbolic, numerical, oral and written. Encourage students to make connections between the various representations to gain a richer, more flexible understanding of each concept.
- Analyze the structure of real-world problems and plan solution strategies. Solve the problems using appropriate tools.
- Develop a mathematical vocabulary by expressing mathematical ideas orally and in writing.
- Enhance and reinforce the student's understanding of concepts through the use of technology when appropriate.

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As a result of successfully completing MAP2302, students should be able to demonstrate the following:

- Analyze and interpret quantitative data verbally, graphically, symbolically and numerically
- Communicate quantitative data verbally, graphically, symbolically and numerically
- Appropriately integrate technology into mathematical processes
- Use mathematical concepts in problem-solving through integration of new material and modeling

Topical Outline with Specific Course Objectives:

I. *First Order Differential Equations*

A. Understand the Existence and Uniqueness Theorem and its ramifications.

B. Apply calculus techniques to first order differential equations to determine properties of solutions such as monotonicity, concavity, symmetry, and singularities.

C. Use graphical techniques such as direction (slope) fields, phase diagrams and orbits to study the relationship between a first order differential equation and its solution.

D. Investigate the sensitivity of models and their solutions to initial conditions and parameters.

E. Use numerical methods to approximate solutions to initial value problems and provide error estimates.

F. Solve first order differential equations which are exact, separable, homogeneous, linear or Bernoulli using symbolic methods.

G. Construct and analyze models, interpret results, and make predictions within the original context.

II. *Higher Order Linear Differential Equations*

A. Use series, graphical, and symbolic methods to generate and analyze solutions to differential equations or boundary value problems.

B. Solve higher order linear differential equations with constant coefficients using symbolic methods.

C. Apply the methods of undetermined coefficients and variation of parameters.

D. Identify and solve Cauchy-Euler equations.

III. *The Laplace Transform*

A. Use the Laplace Transform to solve differential equations.

B. Construct and analyze models, interpret results, and make predictions within the original context.

C. Use Laplace Transforms to solve systems of linear differential equations.

Evaluation: Each instructor will determine the specific criteria for determining the final course grade. These criteria will be delineated in the first day handout provided to each student. Each instructor will give a comprehensive final exam during the assigned final exam period.

Commonality: All instructors will use the same textbook and cover all topics in the topical outline. A computer lab with mathematical software is provided to facilitate collaboration and the use of technology. A graphing calculator will be required for this course. Either the TI-83 or the TI-84 line of calculators is recommended; any other graphing calculator will need to be approved by the instructor.