Texas A&M University

Core Curriculum

Initial Request for a Course Addition to the Fall 2014 Core Curriculum

Foundational Component Area: Mathematics

In the box below, describe how the proposed course meets the Foundational Component Area description for Mathematics. Courses in this category focus on quantitative literacy in logic, patterns, and relationships. Courses involve the understanding of key mathematical concepts, and the application of appropriate quantitative tools to everyday experience.

The proposed course must contain all elements of the Foundational Component Area. How does the proposed course specifically address the Foundational Component Area definition above?

This course is focused on quantitative literacy in mathematics with an emphasis on real world applications, especially to the biological sciences. Upon successful completion of this course, students will be able to:

- apply techniques for integration, including integration by parts and partial fraction decomposition.
- identify and compute improper integrals using limits.
- justify why an improper integral converges or diverges by applying the comparison theorem.
- approximate functions with Taylor polynomials and evaluate the error in the approximation by using the Taylor inequality.
- solve separable ordinary differential equations.
- understand how exponential population growth is modeled by a constant per capita growth rate while logistic population growth incorporates density dependence.
- find equilibria of differential equations and analyze their stability both graphically and by using the stability criterion.
- apply various techniques for solving systems of equations, including Gaussian elimination.
- apply basic matrix algebra skills including addition, subtraction, scalar multiplication, and multiplication of matrices and find the inverse of a matrix and be able to use matrix algebra to solve problems.
- compute and interpret eigenvalues and eigenvectors for $2 \times 2$ matrices.
- use matrices in biological applications, including the study of age-structured populations.
- interpret $2 \times 2$ linear maps applied to $2 \times 1$ vectors.
- add, subtract, and scale vectors and compute dot products.
- use vectors in applications, including finding equations of lines and planes.
- understand concepts of limits and continuity for multivariable functions.
- use partial derivatives and linear approximations for solving real-world problems.
- understand and explain the concepts of equilibria and stability for biological systems of difference equations.
- correctly solve applied problems, and write the solutions in a coherent fashion.
- construct and analyze linear and nonlinear systems of differential equations applied in biology and medicine.

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Core Objectives

Describe how the proposed course develops the required core objectives below by indicating how each learning objective will be addressed, what specific strategies will be used for each objective and how student learning of each objective will be evaluated.

The proposed course is required to contain each element of the Core Objective.

Critical Thinking (to include creative thinking, innovation, inquiry, and analysis, evaluation and synthesis of information):
The following critical thinking skills will be assessed on exams and other assignments. Students will:

- Analyze integrals and determine the proper technique for integration, including the integration by parts and partial fraction decomposition methods.
- Identify and compute improper integrals using limits.
- Approximate functions with Taylor polynomials and evaluate the error in the approximation by using the Taylor inequality.
- Solve separable ordinary differential equations.
- Find equilibria of differential equations and analyze their stability both graphically and by using the stability criterion.
- Apply techniques for solving systems of equations, including Gaussian elimination.
- Learn basic matrix algebra skills including addition, subtraction, scalar multiplication, and multiplication of matrices and be able to find the inverse of a matrix.
- Creatively apply matrix algebra to solve systems of equations.
- Compute and interpret eigenvalues and eigenvectors for $2 \times 2$ matrices.
- Understand and apply concepts of limits and continuity for multivariable functions.
- Compute partial derivatives and linear approximations to solve real-world problems.
- Compute equilibria and analyze their stability for biological systems of difference equations.
- Solve applied problems, and write the solutions in a coherent fashion.
- Analyze and construct linear and nonlinear systems of differential equations applied in biology and medicine.

Communication (to include effective development, interpretation and expression of ideas through written, oral and visual communication):

The following communication skills will be assessed on exams, during lecture, and on other assignments. Students will:

- Justify why an improper integral converges or diverges by applying the comparison theorem.
- Understand how exponential population growth is modeled by a constant per capita growth rate while logistic population growth incorporates density dependence.
- Find equilibria of differential equations and analyze their stability both graphically and by using the stability criterion.
- Apply basic matrix algebra skills including addition, subtraction, scalar multiplication, and multiplication of matrices and finding the inverse of a matrix to solving problems.
- Interpret the action of $2 \times 2$ linear maps applied to $2 \times 1$ vectors both graphically and numerically.
- Add, subtract, and scale vectors and compute dot products.
- Use vectors in applications, including finding equations of lines and planes.
- Solve applied problems, and write the solutions in a coherent fashion.
- Construct and analyze linear and nonlinear systems of differential equations applied in biology and medicine.

Empirical and Quantitative Skills (to include the manipulation and analysis of numerical data or observable facts resulting in informed conclusions):

The following empirical and quantitative skills will be assessed on exams and other assignments. Students will:

- Apply techniques for integration, including integration by parts and partial fraction decomposition.
- Solve separable ordinary differential equations.
- Find equilibria of differential equations and analyze their stability both graphically and by using the stability criterion.
- Compute and interpret eigenvalues and eigenvectors for $2 \times 2$ matrices.
- Compute the Leslie matrix associated with a given data set pertaining to an age-structured population and use it to make predictions of population sizes for future generations.
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- Use partial derivatives and linear approximations for solving real-world problems.
- Compute equilibria and analyze their stability for biological systems of difference equations.
- Manipulate given information to construct and analyze linear and nonlinear systems of differential equations applied in biology and medicine.

Please be aware that instructors should be prepared to submit samples/examples of student work as part of the future course recertification process.