Core Curriculum Course Submission
Criteria: Math

1. General Information

a. Originating Person	b. Contact Person's E-mail	c. Contact Phone	d. Date
Dr. Thomas C. McMillan	tcmcmillan@ualr.edu	569-8102	10/10/14

e. College/School	f. Department/Program
Select from this Dropdown . . .	Mathematics and Statistics

☒ **Submission Statement**
By submitting this form, we acknowledge our understanding that the Core Council has the authority to review approved courses to ensure they continue to meet the established goals and outcomes of that category of the core; that the Council has authority to develop a core assessment program; and that the Council will be developing review and assessment policies by the end of 2014. Further, we agree that if this course is approved, we will participate in the university-wide assessment of the core.

☒ **Chair and Dean Awareness**
A separate statement from the chair must be included that states that the department faculty have approved this course for submission to the core and that the chair takes responsibility for informing the Dean about the submission of the course.

2. Course Information

a. Course ID	b. Current Title
MATH 1311	Applied Calculus I

c. Catalog Description

Prerequisite: a grade of C or greater in MATH 1302 or an equivalent transfer course or an ACT Mathematics score of 24. Not intended for mathematical science majors or minors. Introduction to differential and integral calculus of algebraic functions and their technical applications in the areas of optimization, mean values, and area. Three hours lecture. Three credit hours.

d. How will your department ensure a level of consistency among sections of this course? Who will be responsible for this?

The department has a standardized syllabus that instructors are obligated to follow so that all students can be prepared for subsequent courses in the Calculus sequence. The department chair monitors the progress of individual sections and consults with faculty when coverage of required material appears to be falling behind schedule. Faculty are generally faithful in following the syllabus, because all faculty will teach subsequent courses in the sequence. It is rare that the department chair has to intervene.

Educational Goals	Learning Outcomes students will	Learning Objectives: At the end of the course students will be able to	Assignments	Explanation
Knowledge 1 – **Concepts, methodologies, findings, and applications of mathematics and the social and natural sciences, engineering and technology.**	1. understand mathematical relationships among quantities;	**Learning Objectives 1.1** Analyze the relationships between the graphs of many different functions with respect to their symmetry, translations, asymptotes, domain, range, and intervals of increase, decrease, and constant.	**Assignments 1.1** Class discussions, quizzes homework and exams.	**Explanation 1.1** That students maintain an understanding of mathematical relationships is continuously monitored by checking the quality of their mathematical presentations. As described in the other learning objectives, new mathematical relationships are introduced in Applied Calculus I
	2. understand fundamental mathematical/algebraic operations;	**Learning Objectives 1.2** develop an understanding of the rules for differentiation and integration.	**Assignments 1.2** Class discussions, quizzes homework and exams.	**Explanation 1.2** That students maintain competence in fundamental mathematical/algebraic operations is continuously monitored by checking the quality of their mathematical presentations. The calculus introduces new mathematical operations (e.g. methods of differentiation and integration) that rely on a competence with algebraic operations.

Educational Goals	Learning Outcomes students will	Learning Objectives: At the end of the course students will be able to	Assignments	Explanation
Skills 1 – Communication	1. use basic mathematical formulas and terminology:	**Learning Objectives 1.1** a) Demonstrate competence in calculating limits. b) Demonstrate an understanding of derivatives. c) Demonstrate an understanding of definite and indefinite integrals.	**Assignments 1.1** Class discussions, quizzes homework and exams.	**Explanation 1.1** a) An understanding of limits is necessary in order to understand the definition of the derivative and to interpret its meaning. An understanding of limits is also necessary in order to understand the definition of the definite integral and to interpret its meaning. b) The derivative of a function is its rate of change, and is used to find the slopes of its tangent lines. c) The integral is a limit of sums that, for nonnegative functions, represents areas. The integral of a function represents a net change in value.
	2. explain orally and in writing the mathematical "reasonableness" of a statement that is presented as being implied by data	**Learning Objectives 1.2** a) Interpret the meaning of derivative of a function in terms of its graph. b) Use the value of the first and second derivatives to analyze the shape of a function's graph c) Interpret the value of a definite integral in terms of the graph of the integrand.	**Assignments 1.2** Class discussions, quizzes homework and exams.	**Explanation 1.2** a) The derivative is a function's rate of change (or slope of tangent line). The derivative of a function can be seen as consistent with the graph of the function. b) The zeroes and sign changes of the first and second derivatives can

		d) Use derivatives and integrals in application problems and interpret the solution in terms of original problem		be used to analyze the graph of a function. c) The definite integral of a nonnegative function is the area under its graph and above the x-axis. The Fundamental Theorem of Calculus relates integration and differentiation. d) Derivatives are used in related rates problems (two quantities are related, how are their rates of change related?), and optimization problems (e.g., how can we maximize profit, minimize cost, minimize time, etc.?) Integration is used in calculating areas and net change.
	3. communicate about math precisely orally and in writing	**Learning Objectives 1.3** a) Use mathematical notation correctly to express mathematical ideas. b) Use English language sentences where necessary in the solutions of applied problems	**Assignments 1.3** Class discussions, quizzes homework and exams.	**Explanation 1.3** Mathematical notation communicates intricate mathematical ideas using a precise notation with an economy of symbolism, but it does have a grammar that must be adhered to (e.g. "=" is a verb with a specific meaning). A complete description of a solution may, especially in applications problems, require the use of grammatically correct paragraphs, and careful attention must be given to

				appropriately using units of measure.
Educational Goals	**Learning Outcomes students will**	**Learning Objectives: At the end of the course students will be able to**	**Assignments**	**Explanation**
Skills 2 – Critical Thinking, Quantitative Reasoning, and Solving Problems Individually and Collaboratively	1. interpret, analyze, and identify appropriate applied math models, data and graphs;	**Learning Objectives 2.1** a) Solve related rates problems b) Solve optimization problems c) Make area calculations d) Solve net change problems	**Assignments 2.1** Class discussions, quizzes homework and exams.	**Explanation 2.1** a) Related rates problems require a mathematical model describing how continuously changing quantities are related. b) Optimization problems require a mathematical model relating quantity to be optimized to the independent variables affecting its value. c) Area calculations are applications of the Fundamental Theorem of Calculus that introduce analytical techniques for applying integration. d) Net change problems are applications of the Fundamental Theorem of Calculus that determine the net change for a quantity whose value changes at a continuous rate. All of these categories of applied problems require expository writing to explain the model and to interpret the results. Students are

				given the opportunity to work collaboratively in the development of mathematical models.
	2. develop abstract and quantitative reasoning ability;	**Learning Objectives 2.2** a) Solve applications problems (see Learning objectives 2.1) b) Understand applications of The Minimax Theorem c) Understand applications of The Mean Value Theorem d) Understand applications of The Fundamental Theorem of Calculus e) Understand the natural logarithm as defined using the Fundamental Theorem of Calculus	**Assignments 2.2** Class discussions, quizzes homework and exams.	**Explanation 2.2** a) See learning objectives 2.1 b) This theorem states that a continuous function on a closed interval attains a maximum and minimum value. Used in optimization problems. c) This theorem states that at some point in a closed interval the instantaneous rate of change is equal to the average rate of change over the entire interval. The theorem is used to interpret the meaning of rate of change, and to determine bounds on the values of functions. d) The Fundamental Theorem of Calculus expresses how the differential calculus and the integral calculus are related. e) The Fundamental Theorem of Calculus is used in an abstract development of the natural logarithm and exponential functions that extends the

				concept of exponentiation from the rational numbers to the real numbers.

Educational Goals	Learning Outcomes students will	Learning Objectives: At the end of the course students will be able to	Assignments	Explanation
Skills 3 – Information Technology	1. make appropriate decisions regarding the use of technology when solving problems, recognizing both the insight to be gained and the limitation;	**Learning Objectives 3.1** a. Recognize when to use available technology to assist in analyzing problems, to apply calculus procedures, and to validate results obtained analytically b. Competently use technology to explore mathematical concepts. c. Recognize when solutions obtained using technology are reasonable with respect to the data being analyzed.	**Assignments 3.1** Class discussions, quizzes homework and exams.	**Explanation 3.1** a) The graphing calculator is used for the validation of limit calculations, to implement Newton's methods for finding the zeroes of a function and to approximate the values of an integral using Riemann sums. b) Maple is used to explore and illustrate the relationships among functions and their higher derivatives and to do numerical integration. The graphics capabilities of Maple are used extensively.
	2. use information resources like the internet reflectively for inquiry, exploration, and communication;	**Learning Objectives 3.2** Use the internet to communicate via email, and as a resource for research	**Assignments 3.1** Class discussions, quizzes homework and exams.	**Explanation 3.1** Students are encourage to use information resources to supplement their understanding of the material and to answer questions that occur to them

Educational Goals	Learning Outcomes students will	Learning Objectives: At the end of the course students will be able to	Assignments	Explanation
Values 1 – Personal Responsibility and Ethical Behavior	1. take responsibility for completing assignments in an honest and ethical manner, working on their own when required and acknowledging resources when used;	**Learning Objectives 1.1** Understand the importance of following the UALR policies on academic integrity.	**Assignments 1.1** Class discussions, quizzes homework and exams.	**Explanation 1.1** Students are expected to present their work in a clear, organized and well-written fashion. Students are expected to acknowledge when they have received outside help or consulted another author in developing their solution.

				Students, unless explicitly involved in a group project, are expected to work on their own.
	2. understand the duty to be precise and accurate with data;	**Learning Objectives 1.2** Present mathematical results in a consistent and organized fashion. Use correct mathematical notation and include verbal explanations when necessary. Understand that mathematical writing has the same requirements as writing in other contexts, plus the need for correct use of mathematical notation.	**Assignments 1.2** Class discussions, quizzes homework and exams.	**Explanation 1.2** All applications problems (mentioned above) require that care be taken with the accuracy of the data provided.
Educational Goals	**Learning Outcomes students will**	**Learning Objectives: At the end of the course students will be able to**	**Assignments**	**Explanation**
Value 3-Global and cultural Understanding	1. analyze "real world" implications and develop mathematical models that aid in the understanding of current global issues.	**Learning Objectives 3.1** Apply calculus to "real world" problems. Understand how real-world problems and social issues can be analyzed using the power and rigor of mathematical models. Recognize that many mathematical models will only work under a given set of initial conditions.	**Assignments 3.1** Class discussions, quizzes homework and exams.	**Explanation 3.1** Calculus is applied to problems in business and economics, physics and to studies in population growth. Examples include minimizing cost, maximizing profit or revenue, developing strategies to minimize costs, studying price/demand situations, studying problems related to motion, minimizing time (e.g. deriving laws of reflection and refraction using Fermat's Principle in optics). Care is taken to illustrate that models are derived from observable data.

Additional Comments:

Belinda Blevins-Knabe
Approved by Core Curriculum Committee

10-27-14
Date

[signature]
Approved by Provost

11/7/2014
Date

JE Anderson, Jr.
Approved by Chancellor

11/11/14
Date