Core Curriculum Course Justification and Assessment Plan

Subject Prefix and Course Number: MATH 1650

Note that this form will typically be used as an attachment to curriculum forms UCC-A-102 (Request for Addition of Course to Core Curriculum) or UCC-C-108 (Request for Change in Existing Core Curriculum Course). This form alone cannot be used to make catalog changes. All courses proposed to be newly added to the core must complete UCC-A-102, and any changes to existing core curriculum courses other than only realigning or updating the core curriculum justification and assessment plan must complete UCC-C-108. Existing core curriculum courses that are not changing core curriculum categories and only need to realign their justifications and assessment plans may complete this form alone.

Course title (cut and paste from catalog or form UCC-A-102):

Pre-Calculus

Course is in, or proposed to be in, the university core curriculum:

in a single foundational component area only.

The foundational component area that describes the heart and soul of the core curriculum course and accurately describes the course consistently throughout the entire course is:

Mathematics

Justification for the course to be added (or remain) in the core curriculum:

Describe how the course consistently and thoroughly focuses on quantitative literacy in logic, patterns, and relationships:

After completing MATH1650, students will have developed problem-solving skills using mathematical tools and will be able to judge whether a solution seems reasonable (both in the abstract and applied sense).

In section 1.11 (from our current text), students are given information about how two or more quantities are related; the student then finds an equation that represents the relationship and is asked to use the model to make a prediction. In section 2.4, students are given tabular data and are asked how fast the variables are changing and when, if ever, the quantities change between increasing and decreasing. In section 7.1, students are given a trigonometric identity which the student must verify using algebra skills and their knowledge of basic facts from trigonometry.

Throughout the course (e.g., sections 1.10, 2.5, 3.1, 3.2, 4.1, 4.3, and 5.3), students examine a function, represented by an equation, and identify important features of its graph. Using this knowledge, they learn how to sketch an accurate graph with minimal effort.

Describe how the course consistently and thoroughly involves the understanding of key mathematical concepts and the application of appropriate quantitative tools to everyday experience:

After completing MATH1650, students know how to apply arithmetic, algebraic and geometric thinking to applied modeling problems. They learn a variety of functions (linear, quadratic, exponential, and trigonometric) and how to apply them to everyday problems. This process motivates students to higher-order thinking.

Consider these key mathematical concepts and their applications:

In section 3.1, students learn about quadratic functions. From the shape of the graph of a quadratic function, they determine
whether the function has a maximum or a minimum value. Students use quadratic functions to model certain applications and how to optimize such quantities such as maximizing a manufacturer’s revenue, maximizing an enclosed area, and minimizing the cost to manufacture a can.

In section 4.1, students use a formula from finance that computes the value of an investment. In section 4.6, students use exponential models to represent a population that is growing exponentially and how to use that model to make predictions (such as how long, at the current rate, would it take for the population to reach a certain level).

In section 5.6, students use the sine and cosine functions to model quantities that are periodic (e.g., the length of daylight during the year, the height of a wave in the ocean). Throughout Chapter 6, students use trigonometric ratios to measure distance.

Describe how the course will actively help students develop their critical thinking skills, which include creative thinking, innovation, inquiry, and analysis, evaluation and synthesis of information:

After completing MATH1650, students know how to use, interpret, and evaluate mathematical models such as formulas, graphs, tables and schematics, and draw inferences from them. When given a set of data or a description of a problem, students learn how to determine which of several functions best represents the relationship between variables and how to use the function to solve a problem.

When students learn a new function (linear, quadratic, exponential, logarithmic trigonometric), they are introduced to the real-world applications of the function in the form of “word problems.” Students develop their critical thinking skills as they use information stated in the problem to find a specific model for the problem.

When proving trigonometric identities, students must solve a problem for which there is no set of algorithms. Using their knowledge of trigonometry, their algebra skills, and their own ingenuity, they must establish a given relationship. This process requires creative thinking on the part of the student and requires them to be flexible and innovative in their approach to thinking about mathematics.

Some instructors introduce their students to the power of mathematical induction (one of the optional topics), a method that can be used to prove many common formulas. As students learn about mathematical induction, they develop insight by generalizing some common features of some standard examples but where successfully writing an induction proof cannot be done by following any step-by-step algorithm.

Describe how the course will actively help students develop their communication skills, which include effective development, interpretation and expression of ideas through written, oral and visual communication:

After completing MATH1650, students know how to represent and evaluate basic mathematical information given verbally, numerically, graphically, and symbolically. Because applied problems are stated in English sentences, students sharpen their reading comprehension by analyzing the information presented in the problem. In many of these problems, students must visually communicate relationships with a diagram or graph. Throughout the course, students learn how to represent functions both symbolically and graphically.

Throughout Chapter 2 (of the text currently in use), students are given a graph and are asked to draw conclusions from the graph (e.g., describe how the change in one quantity results in a change in the other, where is a quantity optimized, how fast a quantity is changing).

Describe how the course will actively help students develop their empirical and quantitative skills, which include the manipulation and analysis of numerical data or observable facts resulting in informed conclusions:

Upon completion of MATH1650, students will be able to locate, evaluate and organize information as well as draw inferences. They work with numerous models (linear, quadratic, exponential, trigonometric), in equation form, tabular form, and graphic form. From their knowledge of these models, and their algebraic skills, students draw quantitative conclusions.
Assessment Plan:

Assessment Approach:
- Individually designed course-level plan
- Core Academy Facilitated Communal Assessment

Note, if it is easier to do so, you may attach an assessment plan. In particular, if you are using standard or table-formatted scoring rubrics, you may attach the scoring rubrics, rather than re-typing them here. Do be sure that your assessment plan addresses all of the areas prompted for below.

Give an overview of your assessment plan, including a description of how frequently you will assess each assigned core curriculum objective (at least once per year) and describe any use of sampling, such as choosing a random sample of sections or choosing a random sample of students within sections:

The Math 1650 course coordinator will maintain a library of target exam questions and projects suitable for measuring the stated objectives: Critical Thinking, Communication, and Empirical and Quantitative Skills. The course coordinator will work with instructors so that during the course of the year, all three objectives are measured. Data will be collected each year from the instructors by the course coordinator and reviewed by the course coordinator and the department’s director of core courses. Based on the results of the assessment, the course coordinator may make recommendations for adjusting the syllabus, improving the treatment of certain topics, working with instructors on improving aspects of the course, or tweaking the assessment questions. The specific rubrics and methods for collecting this data are discussed in the Assessment Method outlined in each objective.

Additionally, the Department’s Undergraduate Affairs Committee will review the assessment data for each of the department’s core courses on a rotating basis. The Department’s courses will be grouped into four groups, according to target audience: Group I will include courses intended for general university students: Math 1580/1581 and Math 1680/1681; Group II will include courses intended primarily for business students: Math 1180 and 1190; Group III will include courses intended primarily for math, science, and engineering students: Math 1600, Math 1610, Math 1650, Math 1710; and Group IV will include courses intended for elementary education majors: Math 1350 and Math 1351. The Undergraduate Affairs Committee will review the assessment data for one group of courses each academic year and make recommendations about how the courses and the assessment process can be improved.

Note that each core curriculum objective below must be assessed by at least one direct assessment of student ability, such as a series of test questions or a targeted assignment. Indirect assessment methods, such as surveys of student attitudes, may be used as secondary assessment methods to supplement a direct assessment, but are not required.

Remember, each assessment method must also be narrowly targeted at the core curriculum objective. An overall grade on a broad assignment will probably not be a sufficiently precise measure of student mastery of the specific core curriculum objective.

Core Curriculum Objective: Critical Thinking

Assessment Method:

Students could be asked to analyze a mathematical computation that has a flaw in it. The student must identify the flaw and explain
what mistake was made. Then, the student must give possible alternatives for finding the solution. This helps the students develop their thinking process by asking them to verify, in a mathematical context, the step-by-step logic embedded in a mathematical computation. Students might also be asked to examine a real-world situation through the use of mathematical models. The students would be asked to model to the data given, and then to think critically about possible limitations and implied assumptions of the model and how much trust they should have in predictions made by the model.

Targeted Exam Question allowing open-ended response: As part of one of the course exams, instructors will select one or several exam questions (from the library of questions mentioned earlier) targeting critical thinking. The instructor would select a sample and grade students' work according to the supplied rubric. The instructor would then report the results to the coordinator at the end of each semester.

Sample Student Prompt (e.g. sample test question or sample essay prompt):

In the flawed solution to ln (x+1) - ln (2x - 3) = ln (5), the first line of the solution to the problem contains the error: (x+1) - (2x - 3) = 5. The student must explain that the first step is incorrect; instead, a property of logarithms must be used before eliminating the logarithm.

When calculating the distance between two cities that lie on the same meridian, students must use the arc length formula, s = rx, where x must be in radians. The problem would be given with degrees. The flaw in the solution is that the formula is applied with x in degrees.

When completing the square to identify the vertex for the graph of a quadratic function such as y = 3x^2 + 18x + 4, the first step of the solution would be y = 3x^2 + 18x + 81 - 81 + 4. The error is that 3 must be factored from the two variable terms before calculating the appropriate constant that "completes the square."

A student might be given a modeling analysis problem such as:
Biologists have observed a decline in the population of certain species of bird in a nature reserve. The population over the past decade is given in the table below. (a) Use a linear model to estimate how the bird population will change over the next decade; (b) Repeat your analysis, but this time using an exponential model. (c) Comment on the differences in the long-term outcomes predicted by each model and address any limitations of the models.

Description of Scoring Rubric:

Sample Rubric for an Algorithmic Analysis:

1 point -- Identify the step in which the error occurred

2 points -- Explain what the specific error is

1 point -- Correctly solve the problem

Sample Rubric for a modeling Analysis:

2 points -- Correctly fitting the model to the data

1 point -- Addressing limitations of the models

1 point -- Comparing and contrasting the predictions of the different models.
Criteria (i.e., benchmark) for success:
At the end of the semester, the instructor will select a sample of those taking the exam and use the provided rubric to assign credit. The benchmark for success is for at least 70% of students in the sample to earn at least 3 points on the assessment question.

Core Curriculum Objective: Communication

Assessment Method:
Targeted exam question requiring essay response: When given an applied problem, the student should be able to communicate both visually (via a graph or other figure) and write a short paragraph describing a strategy for solving it. Once the problem is solved, the student would state the conclusion.

During the Fall or Spring semesters, students would be given a project or open-ended questions on a course exam that would assess how well we have met this objective. The instructor would collect a sample and grade the students' work using the supplied rubric. The instructor would then report the results to the coordinator at the end of the semester.

Sample Student Prompt (e.g. sample test question or sample essay prompt):
Finding the height of a tall object using right triangle trigonometry;
Representing an oscillating spring with simple harmonic motion and explaining why damped harmonic motion is a better model
Computing the maximum altitude of an object thrust upward

Description of Scoring Rubric:
1 point
Correctly represent the problem with a graph or other model

1 point
The figure would be correctly labeled with all relevant information provided in the problem

1 point
Determine which function is appropriate for solving the problem and explain the strategy for solving the problem

1 point
State the conclusion (the student should answer the question using a complete sentence)
Criteria (i.e., benchmark) for success:

At the end of the semester, the instructor will select a sample of those taking the exam or turning in the project and use the provided rubric to assign credit. The benchmark for success is for at least 70% of students in the sample earning at least 3 points on the assessment question.

Core Curriculum Objective: Empirical and Quantitative Skills

Assessment Method:

Targeted exam question(s), possibly multiple choice or free response: Given a data set (either some basic facts or pairs of data values) the student should be able to apply an appropriate mathematical strategy to draw conclusions from the data and to make a prediction.

During the Fall or Spring semesters, students would be given a series of questions on the final exam that would assess how well we have met our objectives. The course coordinator would provide the instructor with the rubric. The instructor would report the results to the coordinator at the end of each semester.

Sample Student Prompt (e.g., sample test question or sample essay prompt):

- Computing the value of an investment using a financial formula;
- Modeling harmonic motion (tides, blood pressure, and ideal pendulum);
- Finding a price that maximizes revenue (the relationship being quadratic);
- Predicting the altitude of a ball on the nth bounce (the altitude of the ball forming a geometric sequence);
- Calculating the number of cans in a supermarket display if the number of cans in each row forms an arithmetic sequence

Description of Scoring Rubric:

This type of question can easily be represented as a multiple-choice problem. If the instructor chooses to ask the question as an open-ended question, the instructor would use the following rubric.

1 point
Represent the data graphically (properly labeling the graph). Representing the data graphically would entail determining which variable is independent and which is dependent.

1 point
Determine which function appropriately models the data.

1 point
Using the data to fill in any coefficients in the model (for example, a student would need to identify m and b
for \( y = mx + b \), two variables, \( x \) and \( y \), that are linearly related

1 point
Correctly make computations to answer the question

1 point
Make an inference (draw a conclusion, make a prediction) from the model

Criteria (i.e., benchmark) for success:
The benchmark for success is for at least 70\% of those students taking the exam earning at least 3 points from the supplied rubric (for open-ended questions) or correctly answering at least 75\% of the points possible on the series of targeted exam questions.

Assessment Method:
Quantitative Skills Quiz/Test: Because Math 1650 is a course for math and science majors, it is especially important that its student population becomes proficient in mathematical computation. Math 1650 instructors will be asked to give a specially designated quiz or test sometime toward the second half of the semester that tests the students basic computational skills in algebra and trigonometry.

Sample Student Prompt (e.g. sample test question or sample essay prompt):

Find all solutions to the equation: \((\tan 3t)(\tan t - 1) = 0\): (a) \( \pi/3^*n \), \( \pi/4^*n \); (b) \( \pi/3^*n \), \( \pi/4^2^*p^*n \); (c) \( \pi^*n \), \( \pi/4 + 2^*p^*n \), (d) \( \pi/6^*n \); (e) \( 2^*p^*n \n
In each answer above, \( n \) denotes an arbitrary integer.

Description of Scoring Rubric:
As each question on the test will be computational in nature, students will either receive 0 or 1 for each computation.

Criteria (i.e., benchmark) for success:
At least 70\% of the student taking the quiz/test earning at least 85\% of the possible points on this "basic computation" quiz/test.
Consultation with Oversight Committee on the Core Curriculum:

Member: Oscar García

Date: 11/16/2012

APPROVED:

Department Chair

(print name)

(signature)

Date 11/27/12

College/School Curriculum Committee Chair

Lawrence Williams

(print name)

(signature)

Date 12-6-12

Dean of College/School

(print name)

(signature)

Date 12-6-12

Oversight Cmte on the Core Curriculum Chair

(print name)

(signature)

Date

University Curriculum Cmte (VPAA)

(print name)

(signature)

Date
# MATH 1650

**Semester Year/Dates**

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<tr>
<th>COURSE/Section #</th>
<th>MATH 1650</th>
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<tr>
<td>COURSE TITLE:</td>
<td>Pre-Calculus</td>
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<td>INSTRUCTOR:</td>
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<td>OFFICE:</td>
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<td>OFFICE HOURS:</td>
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<td>CLASS MEETS:</td>
<td>Five (5) hours/wk.</td>
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<td>WEB ACCESS:</td>
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**COURSE DESCRIPTION:** 5 hours. A preparatory course for calculus: trigonometric functions, their graphs and applications; sequences and series; exponential and logarithmic functions and their graphs; graphs of polynomial and rational functions; general discussion of functions and their properties. MATH 1650 covers approximately the same material as MATH 1600 and 1610 together. Students who already have credit for both MATH 1600 and MATH 1610 may not receive credit for MATH 1650. Satisfies the Mathematics requirement of the University Core Curriculum.

**Prerequisite(s):** Math 1100 with a grade of C or better or appropriate placement. Enrollment in the class does not guarantee that the student has met the prerequisite. If a student is enrolled in the class without having met the prerequisite, the student could receive a grade of F or WF.

**TEXT:** *Precalculus*, 6th edition, by J. Stewart, L. Redlin and S. Watson and WebAssign. **WebAssign** is an online course delivery platform through which students access and complete assignments.

**GRAPHING CALCULATOR:** TI 83, TI 83Plus, TI 84 or equivalent.

**MATH LAB:**
- **Web site:** [www.math.unt.edu/mathlab](http://www.math.unt.edu/mathlab)
- The UNT Math Lab is located in GAB 440
- Monday - Thursday: 7 am - 9 pm
- Friday: 7 am - 4 pm
- Saturday: Noon - 5 pm
- (Closed Sundays and holidays)

**ATTENDANCE POLICY:** Class attendance is mandatory. Students are responsible for all information given in class, regardless of his/her attendance.

**MAKE-UP TEST POLICY:** Tests and exams must be taken in class as scheduled. Makeup exams will only be given in very exceptional circumstances, such as serious illness, and must be arranged in advance.

**ACADEMIC DISHONESTY:** Cheating on final exams, on in-class tests, or on quizzes is a serious breach of academic standards and will be punished severely and generally result in a student failing the course. All work done on in-class exams and quizzes must represent only the student’s own work, unless otherwise stated in the directions. See [http://vpaa.unt.edu/academic-integrity.htm](http://vpaa.unt.edu/academic-integrity.htm) for details on academic integrity at UNT.

**EVALUATION:**
- Average of in-class exams: 45%
- Homework (online): 10%
- Algebra Quiz (online): 5%
- Quizzes: 15%
- Final Exam: 25%

**GRADE ASSIGNMENT:**
- A: [90%, 100%]; B: [80%, 90%]; C: [70%, 80%]; D: [60%, 70%];
- F: [0%, 60%], 59% is an F

The student’s grade is determined by his/her performance on the evaluation criteria and the grade assignments listed above.

**POLICY REGARDING INCOMPLETES:** Beginning specified date, a student that qualifies may request a grade of “I”, incomplete. An “I” is a non-punitive grade given only if ALL three of the following criteria are satisfied:
- They are: 1) The student is passing the course; 2) The student has a justifiable (and verifiable) reason why the work cannot be completed as scheduled; and 3) The student arranges with the instructor to complete the work within one academic year.

**FINAL GRADE:**
- Final grades online access: [http://www.unt.edu/grades](http://www.unt.edu/grades)

**DISABILITY ACCOMMODATIONS:**
It is the responsibility of students with certified disabilities to provide the instructor with appropriate documentation from the Dean of Students Office.

Electronic access for homework assistance is available at: [www.math.unt.edu/mathlab/cmathlab](http://www.math.unt.edu/mathlab/cmathlab)

Students are responsible for meeting all university deadlines (registration, fee payment, prerequisite verification, drop deadlines, etc.). See the printed Schedule of Classes and/or University Catalog for policies and dates.
UNT Mathematics Core Component

Math 1650 contributes to the following core curriculum learning objectives:

- **Critical thinking**: After completing MATH1650, students know how to use, interpret, and evaluate mathematical models such as formulas, graphs, tables and schematics, and draw inferences from them. When given a set of data or a description of a problem, students learn how to determine which of several functions best represents the relationship between variables and how to use the function to solve a problem.

Using their knowledge of trigonometry, their algebra skills, and their own creativity, students will be able to establish a given relationship. This process requires creative thinking on the part of the student and requires them to be flexible and innovative in their approach to thinking about mathematics.

- **Communication**: After completing MATH1650, students know how to represent and evaluate basic mathematical information verbally, numerically, graphically, and symbolically. Applied problems are generally stated in paragraph form. Students develop their reading comprehension by analyzing the information presented in the problem and representing the information provided in the problem both symbolically and with a diagram (if appropriate). Students also represent functions both symbolically and graphically.

At times, students are given a graph and are asked to draw conclusions from the graph (e.g., describe how the change in one quantity results in a change in the other, where is a quantity optimized, how fast a quantity is changing).

- **Empirical and Quantitative Skills**: Upon completion of MATH1650, students will be able to locate, evaluate and organize information as well as draw inferences. They work with numerous models (linear, quadratic, exponential, trigonometric), in algebraic form, tabular form, and graphic form. From these models, and their algebraic skills, students make predictions and draw conclusions.
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<tr>
<td>9/3 Labor Day No Class</td>
<td>9/4 1.10 Last day for late registration</td>
<td>9/5 2.1</td>
<td>9/6 1.11 Last day for add/drop</td>
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<td>9/11 Polynomial division (3.3)</td>
<td>9/12 2.5 Census Day</td>
<td>9/13 Student can drop with instructor consent (automatic W)</td>
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<td>9/17 2.7</td>
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<td>9/19 5.1</td>
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<td>10/1 Finish 3.5, begin 3.6</td>
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<td>10/3 Finish 3.6, begin 3.7</td>
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<td>10/8 4.1, begin 4.2</td>
<td>10/9 Last day for automatic W</td>
<td>10/10 Finish 4.2, begin 4.3 Beginning this date, instructors may drop students with grade of WF for nonattendance.</td>
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<td>10/12 Finish 4.3, begin 4.4</td>
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<td>10/15 Finish 4.4, begin 4.5</td>
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<td>10/18 Test 2</td>
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<td>3.2 Polynomial Functions and Their Graphs</td>
<td>*8.3 Polar Form of Complex Numbers; DeMoivre’s Theorem</td>
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