UNH Department of Mathematics and Physics

Mathematics Core Curriculum Proposal

Houssein El Turkey & Elizabeth Fiorillo
Mathematics Core Curriculum Proposal

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1 BACKGROUND

1.1 The Journey of Core Curriculum

Year 1: 2007-08

The current core curriculum was put into effect in the Fall of 2006. It was the result of many years of discussion, and replaced a core that was over 20 years old. While the current core was deemed to be a great improvement, it still did not satisfy various needs. So, only one year later, in the fall of 2007, an ad hoc committee was formed to look at re-envisioning the first two years of general education at UNH. Specific considerations included: establishing competency-based outcomes that could be meaningfully assessed; establishing interdisciplinary general education courses; and creating a common set of core courses that all students would take, to help with creating a marketable brand for the university. This committee examined general education cores from many other peer institutions, and eventually focused on the LEAP model as something on which we should base our scheme. At the end of the academic year the committee had come up with some recommendations, but no formal report had been written or presented.

Year 2: 2008-09

The ad hoc committee disbanded at the end of the previous academic year, since it had been led by a visiting fellow. The Dean of Arts and Sciences, who had also been on the committee, was charged with writing up a report. This report was completed at the end of the Spring of 2009. Some of its key components included: a set of 8 competencies containing 28 total learning outcomes based strongly on the LEAP model; learning outcomes were written with action verbs at a mid-level of Bloom’s taxonomy, with a recommendation that higher levels be achieved in major courses outside the core; there would be no university-wide set of common courses, each particular college was encouraged to determine some common courses; any course included in the core should substantially meet all learning outcomes for an intended competency; no new interdisciplinary courses were developed, but their future development would be encouraged. It was proposed that the Fall 2010 freshmen class use this new core.

Year 3: 2009-10

The report was not presented to the UUCC, which is responsible for the core, until the Fall of 2009. Since most of this committee was not familiar with work to date, it first studied the report and recognized that a Fall 2010 start was not feasible. It was very tempting for this new set of people to want to revise many of the learning outcomes (and they did), but it was decided that the entire faculty would need to agree to the contents of the core, and any revision done by the UUCC might just be wasted effort. In late Spring 2010 the ad hoc committee’s report was presented to all the faculty, along with some recommendations for change the UUCC felt strongly about. Faculty were invited to provide feedback on the plan. About a dozen comments on how to change either the set of competencies or their outcomes were collected.

Year 4: 2010-11

During the Summer of 2010 a report for NEASC was produced which included information on the proposed core structure, a means for assessing it, and a revised starting time of Fall 2012. NEASC’s response statement included the following: "UNH still has significant work to do to develop a culture of evidence with respect to the assessment of how and what students are learning", and "It is important that these learning outcomes be evaluate at UNH in the coming years and that the results of that assessment be used to continually improved the program." With these comments ringing in our ears, the UUCC processed all of the
faculty feedback, including its own and that of new committee members that year. The result was a revised competency/outcome set that now included 9 competencies and a total of 34 learning outcomes, with 3-5 outcomes per competency. This set was presented to the Faculty Senate at the end of the Spring of 2011 in hopes that it would be approved and we could potentially reach our goal of a Fall 2012 start. However, the Senate was skeptical about how the remaining process would establish a core with these characteristics, and told the UUCC to bring it back when the rest of the process was defined.

Year 5: 2011-12
During this year the UUCC developed a plan for a multi-phase process that would first certify a set of core courses, and then have individual programs specify how they would implement the core outcomes using these courses. Rules were created for how programs could decide on picking these courses, especially with respect to using courses that were already part of their own major. Draft forms were developed for each of these phases and samples were produced for a couple of courses. Knowing that it was too late to implement a Fall 2012 start, the UUCC brought the entire package back to the Faculty Senate at the end of the Spring of 2012. Once again there was skepticism. The major concern raised was whether a large enough inventory of courses could get properly certified given the set of learning outcomes, which some thought were too restrictive. It was decided that the UUCC would meet with all chairs and coordinators to try and develop a pseudo-inventory without actually going through the entire approval process. If a large enough set could be agreed upon in theory, then the Senate would approve of the entire process moving forward.

Year 6: 2012-13
In the fall the UUCC proceeded to meet with deans and chairs of each college (excepting those of Arts and Sciences who were represented by their dean during the meetings). As more people became involved in this process, it became obvious that there were still too many issues with the set of learning outcomes to develop the pseudo inventory. Two suggestions made by the Dean of Arts and Sciences headed the group toward a compromise: 1) a two-tier structure be adopted, where the first tier corresponds to the current set of learning outcomes, and the second corresponds to greater depth of learning beyond the freshman and sophomore years in each area as defined by some general criteria, and students would be required to take one course from each category at Tier 1, and a choice of four at the Tier 2 level as determined by each program; 2) that there be one common interdisciplinary course that would satisfy the Tier 1 requirement in the Critical Thinking & Problem Solving competency, and that a pilot version of this course would be given in the Fall of 2013. A revised proposal containing these suggestions was presented to the Faculty Senate at the end of the Spring of 2013. Unfortunately, the lack of direct consultation with the chairs of Arts and Sciences was not acceptable, and the UUCC was told to meet with the chairs and revise the plan as needed to incorporate their feedback, and to return to the Senate for a final approval after that.

Year 7: 2013-14
In the Fall of 2014 the chairs of Arts and Sciences rewrote much of the existing learning outcomes for each competency. The UUCC and the chairs then began a refinement process which culminated in the development of new explicit learning outcomes for both Tier 1 and Tier 2. Although the 9 competencies themselves did not change, the revision to the outcomes was large enough that it was decided that the general faculty needed to weigh in again on them. During the Spring of 2014 all faculty were presented with the updated learning outcomes and the proposed process for going forward, especially emphasizing the importance of approving something soon or risk the wrath of NEASC. This report can be read here. While there were still minor issues with the wording of this or that outcome, the Faculty Senate finally blessed the new set of learning outcomes and approved of the formation of a task force that would report to the UUCC as it oversaw the implementation of the process going forward.

Year 8: 2014-15
So we now find ourselves perched and ready to begin the next phase of our journey. Phase 1, generating learning outcomes, is complete. Phase 2, creating a course inventory, is about to begin. An interim report for NEASC is due next summer, and the two year plan sets the Fall of 2016 as the start date of the new core.
1.2 Learning Outcomes

Tier I classes should fit the CC3.1 Mathematical & Quantitative Literacy outcomes:

- [1] Apply mathematical concepts and principles to solve problems.

Tier II classes should fit the CC3.2 Mathematical & Quantitative Literacy outcomes:


OR

- [3] Draw appropriate conclusions as the result of performing quantitative data analysis based on sound assumptions regarding estimation and modeling.

In creating the learning outcomes for the proposed courses, we elected to use the action verbs from Bloom’s Taxonomy to fit the appropriate Tier. We attach the list of these verbs in what follows.
### Appendix F

*Bloom’s Taxonomy of Educational Objectives*

<table>
<thead>
<tr>
<th>1. KNOWLEDGE</th>
<th>2. COMPREHEND</th>
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<tbody>
<tr>
<td>Count</td>
<td>Read</td>
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<td>Define</td>
<td>Recall</td>
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<td>Describe</td>
<td>Recite</td>
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<td>Draw</td>
<td>Record</td>
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<td>Enumerate</td>
<td>Reproduce</td>
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<td>Identify</td>
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<td>Tell</td>
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<td>View</td>
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<tr>
<td>Name</td>
<td>Write</td>
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<tr>
<th>3. APPLY</th>
<th>4. ANALYZE</th>
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<tbody>
<tr>
<td>Act</td>
<td>Imitate</td>
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<tr>
<td>Administer</td>
<td>Implement</td>
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<td>Articulate</td>
<td>Interview</td>
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<td>Assess</td>
<td>Include</td>
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<td>Change</td>
<td>Inform</td>
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<td>Chart</td>
<td>Instruct</td>
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<td>Choose</td>
<td>Paint</td>
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<td>Collect</td>
<td>Participate</td>
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<td>Compute</td>
<td>Predict</td>
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<td>Contribute</td>
<td>Produce</td>
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<td>Control</td>
<td>Provide</td>
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<td>Demonstrate</td>
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<td>Determine</td>
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<td>Develop</td>
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<td>Discover</td>
<td>Show</td>
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<td>Dramatize</td>
<td>Solve</td>
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<td>Draw</td>
<td>Transfer</td>
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<td>Establish</td>
<td>Use</td>
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<td>Extend</td>
<td>Utilize</td>
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<tr>
<th>5. SYNTHESIZE</th>
<th>6. EVALUATE</th>
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<tr>
<td>Adapt</td>
<td>Intervene</td>
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<tr>
<td>Anticipate</td>
<td>Invent</td>
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<tr>
<td>Categorize</td>
<td>Make up</td>
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<td>Collaborate</td>
<td>Model</td>
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<td>Combine</td>
<td>Modify</td>
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<td>Communicate</td>
<td>Negotiate</td>
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<td>Compare</td>
<td>Organize</td>
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<td>Compile</td>
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<td>Compose</td>
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<td>Construct</td>
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<td>Contrast</td>
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<td>Create</td>
<td>Progress</td>
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<td>Design</td>
<td>Propose</td>
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<td>Develop</td>
<td>Rearrange</td>
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<td>Devise</td>
<td>Reconstruct</td>
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<td>Express</td>
<td>Reinforce</td>
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<td>Facilitate</td>
<td>Reorganize</td>
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<td>Formulate</td>
<td>Revise</td>
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<td>Generate</td>
<td>Rewrite</td>
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<td>Incorporate</td>
<td>Structure</td>
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<td>Individualize</td>
<td>Substitute</td>
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<tr>
<td>Initiate</td>
<td>Validate</td>
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*Taken from: http://www.teachervision.com, © Pearson Education, Inc. 2007.*
2 TIER I CLASSES

For Tier I, we propose the following courses:

- MATH 1104-Quantitative-Reasoning
- MATH 1108-College-Mathematics
- MATH 1110-College-Algebra
Course Prefix/Number: MATH1104  
Course Title: Quantitative Reasoning  
[Cross-Listed as: ______] Credits: 3
Prerequisite(s): placement into MATH 1104 or higher or completion of MATH 1103 with a grade of C or higher.
Corequisite(s): ______
Concurrent requisites: ______
Core Curriculum Category Certification: 3.1
Grading Scheme: A-F ☒  S/U ☐  P/F ☐

Catalog Description:
Prerequisite: placement into MATH 1104 or higher or completion of MATH 1103 with a grade of C or higher. Topics include: sets; logic;elementary functions; number systems; functions and graphs; enumeration; and elementary probability. This course serves as an appropriate pre-requisite in place of MATH 1108 for non-calculus track math and physics courses. Students needing to take any of the courses in the sequence MATH 1110, MATH 1115, MATH 1117 should consider MATH 1108 instead as MATH1104 is not a prerequisite for MATH 1110. 3 credits.

Learning Outcomes:
At the end of the course the student can:
1) Describe errors and fallacies in a logical statement
2) Transfer a verbal statement into a symbolic logical statement
3) Describe sets using their different representations
4) Compute different operations on sets  CC3.1.1
5) Identify patterns in elementary mathematical problems
6) Write truth tables  CC3.1.3
7) Compute numerical quantities with algebraic operations
8) Describe properties of number systems
9) Solve systems of linear equations in two variables  CC3.1.1
10) Find measures of basic physical quantities  CC3.1.1
11) Solve problems involving basic geometric concepts  CC3.1.1
12) Solve basic counting problems  CC3.1.1

Is this course part of the assessment plan for:
  Major ☐  Core Curriculum ☒  Agency Accreditation ☐

If so, please identify any required assignments or assessment methods:
a Cumulative final

If the course is cross-listed grad/UG, please describe the additional expectations for the graduate course:

Topic List: (Please present as a pro forma 15-week semester calendar that reflects the relative emphasis on component topic areas)
Topics for MATH 1104

Week 1:
Inductive and Deductive Reasoning: Introduce the inductive and deductive reasoning arguments as general techniques for problem solving and critical thinking. In addition, introduce the concept of approximation in mathematical models
Week 2:
Sets: Give the different representations of sets such as the symbolic notation and Venn diagrams.

Week 3:
Sets: Provide the definitions of set operations such as union, intersection, and complement, and some related rules.

Week 4:
Logic: Discuss logical statements and how to symbolize them mathematically. Discuss negations of statements and connectives in compound statements.

Week 5:
Logic: Discuss truth tables together with negation, conjunction, disjunction of statements, and discuss truth tables for conditional and biconditional statements. Discuss the equivalence of statements.

Week 6:
Logic: Introduce DeMorgan’s Law for the negations of conditional statements and discuss validity of arguments using truth tables.

Week 7:
Number Systems: Introduce natural numbers, prime and composite numbers, divisibility tests, and the order of operations.

Week 8:
Number Systems: Provide a review of rational, irrational, and real numbers followed by the various properties of the real number system such as closure, associativity of operations, commutativity, and having an identity element.

Week 9:
Exponents/Sequences: Provide rules of exponents and introduce scientific notation. Introduce the concept of sequences, in particular arithmetic and geometric sequences, and give the general pattern for these types of sequences.

Week 10:
Functions: Introduce functions and their graphical representations, in particular linear functions. In addition, introduce the methods of solving systems of linear equations in two variables.

Week 11:
Measurement: Introduce the concept of measuring the length, area, volume, weight, temperature using different measurement systems.

Week 12:
Geometry: Discuss basic geometric concepts such as points, lines, planes, angles, triangles, polygons, volumes, areas, surface areas.

Week 13:
Counting: Introduce the fundamental counting principle, permutations.

Week 14:
Introduce combinations as techniques of counting and fundamentals of probability.

Week 15:
Review and final.

Required Library resources and acquisitions:

Comments (by committees):

Instructions for Use:
1. Please review the distinction between a syllabus and a course outline—see Curriculum Guide 7.9 and deans’ guiding documents.
2. LOs—please reference instructions for CCAP plans provided by the University Assessment Committee [http://newhaven.edu/academics/academic-administration/provost/CCAP]
I. General Information

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<td>2039321209</td>
<td>4/7/15</td>
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<td>A&amp;S</td>
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II. Course Information

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<th>Course Prefix/Number</th>
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<td>Quantitative Reasoning</td>
<td>MATH 1104</td>
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<th>Course Credit Hours</th>
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<tr>
<td>Existing course not requiring substantive change</td>
<td>3</td>
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<table>
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<td>Prerequisite: placement into MATH 1104 or higher or completion of MATH 1103 with a grade of C or higher. Topics include: sets; logic; elementary functions; number systems; functions and graphs; enumeration; and elementary probability. This course serves as an appropriate pre-requisite in place of MATH 1108 for non-calculus track math and physics courses. Students needing to take any of the courses in the sequence MATH 1110, MATH 1115, MATH 1117 should consider MATH 1108 instead as MATH1104 is not a prerequisite for MATH 1110. 3 credits.</td>
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<td>Placement into MATH 1104 or higher, or having completed MATH 1103 or equivalent with a C or higher.</td>
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If this course has prerequisites, are they also being proposed for core certification? **No**

If you did not answer Yes, please justify:

III. Review Decision

Recommended Action: **Select ...**

Task Force Chair Signature:  
Date:  

Committee comments (if request remanded):

Please attach Curriculum Change Form A6 – Course Syllabus to this proposal.
The student can:

1. Apply mathematical concepts and principles to solve problems.
   - 70% of Course Emphasizing Outcome
   - Support Competency Outcome: a) Compute different operations on sets, b) Solve systems of linear equations in two variables, c) Find measures of basic physical quantities, d) Solve problems involving basic geometric concepts, e) Solve basic counting problems
   - Likely Assessment Instruments for Course Outcome(s): a) Cumulative final exam, b) Same as above

2. Differentiate among multiple representations of mathematical information.
   - Support Competency Outcome: a)
   - Likely Assessment Instruments for Course Outcome(s): a) Same as above

3. Assess mathematical reasonableness and consistency
   - Support Competency Outcome: a) Write truth tables
   - Likely Assessment Instruments for Course Outcome(s): a) Same as above

Total: 75%

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1 This percentage is a combination of the effort spent on instruction plus reinforcement through activities outside of class such as homework.
### Course Prefix/Number: MATH 1108  
**Course Title:** College Mathematics  

**[Cross-Listed as: ____]**  
**Credits:** 3

**Prerequisite(s):** MATH 1103 or MATH 1104 C or higher or Math Placement exam  
**Corequisite(s):**  
**Concurrent requisites:**  
**Core Curriculum Category Certification:** 3.1

**Grading Scheme:**  
- A-F (X)  
- S/U (□)  
- P/F (□)

**Catalog Description:**  
Prerequisite: placement into MATH 1108, or completion of MATH 1103 or MATH 1104 with a grade of C or higher.  
Topics include: algebraic expressions and equations; functions and graphs; linear inequalities; polynomials and rational functions; an introduction to exponential and logarithmic functions; systems of two linear equations; and basic elements of probability. 3 credits.

**Learning Outcomes:**  
- At the end of the course the student can:  
  1. Solve equations of various types (CC3.1.1)  
  2. Explain linear models and graphs  
  3. Describe basic functions such as polynomials and rational functions (CC3.1.1)  
  4. Solve systems of linear equations  
  5. Identify operations on sets (CC3.1.2)  
  6. Make sense of elementary probability problems (CC3.1.3)  
  7. Calculate elementary statistical concepts (CC3.1.1)

**Is this course part of the assessment plan for:**  
- Major (□)  
- Core Curriculum (X)  
- Agency Accreditation (□)

**If so, please identify any required assignments or assessment methods:**  
Cumulative final

**If the course is cross-listed grad/UG, please describe the additional expectations for the graduate course:**

**Topic List:**  
(Please present as a pro forma 15-week semester calendar that reflects the relative emphasis on component topic areas)  
Topics for MATH 1108

**Week 1:**  
Exponents: Review rules of exponents and how to simplify algebraic expressions

**Week 2:**  
Polynomials: Introduce the definition and give examples of polynomials. Discuss the various components of polynomials such as degree, leading coefficient, and constant term, etc.

**Week 3:**  
Factoring: Factor quadratic expressions.  
Solve Equations: Solve linear and quadratic equations, applying factoring where appropriate.

**Week 4:**  
Graphs and Inequalities: Introduce graphs of lines and solve linear inequalities.
Week 5: Functions: Introduce the notion of functions together with their graphs.
Week 6: Family of functions: Give examples of functions such as linear, quadratic, and rational functions.
Week 7: Applications: Utilize linear and quadratic functions to solve application problems.
Week 8: Polynomial and Rational Functions: Provide a deeper look into polynomials and rational expressions using the notion of functions.
Week 9: Exponential Functions: establish a basic background on exponential functions and utilize those to solve related equations.
Week 10: Logarithmic Functions: establish a basic background on logarithmic functions and utilize those to solve related equations.
Week 11: Explain the methods of solving systems of linear equations.
Week 12: Sets: Give a quick introduction to set notation and its possible representation by Venn diagrams.
Week 13: Probability: Define the basic concepts of probability and apply them to solving problems using their connection to sets.
Week 14: Statistics: Define the basic concepts of statistics such as mean, median, frequency, distribution, and measures of center.
Week 15: Review and final.

Required Library resources and acquisitions:

Comments (by committees):

Instructions for Use:
1. Please review the distinction between a syllabus and a course outline—see Curriculum Guide 7.9 and deans’ guiding documents.
2. LOs—please reference instructions for CCAP plans provided by the University Assessment Committee [http://newhaven.edu/academics/academic-administration/provost/CCAP/]
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<tr>
<td>Catalog Description: Placement into MATH 1108 or higher or having completed MATH 1103 or equivalent with a C or higher</td>
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Prerequisite: placement into MATH 1108, or completion of MATH 1103 or MATH 1104 with a grade of C or higher. Topics include: algebraic expressions and equations; functions and graphs; linear inequalities; polynomials and rational functions; an introduction to exponential and logarithmic functions; systems of two linear equations; and basic elements of probability. 3 credits.

If this course has prerequisites, are they also being proposed for core certification? No
If you did not answer Yes, please justify:

III. Review Decision

<table>
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<th>Recommended Action: Select ...</th>
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<th>Task Force Chair Signature:</th>
<th>Date:</th>
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Committee comments (if request remanded):

Please attach Curriculum Change Form A6 – Course Syllabus to this proposal.
## MAPPING OF COMPETENCY LEARNING OUTCOMES TO COURSE LEARNING OUTCOMES

<table>
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<th>CC3.1 – Mathematical &amp; Quantitative Literacy Tier 1 Learning Outcomes</th>
<th>% Of Course Emphasizing Outcome(^1)</th>
<th>Course Learning Outcome(s) That Support Competency Outcome</th>
<th>Likely Assessment Instruments for Course Outcome(s)</th>
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<td>The student can:</td>
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</table>
| 1. Apply mathematical concepts and principles to solve problems. | 90 | a) Solve equations of various types  
b) Describe basic functions such as polynomials and rational functions  
c) Calculate elementary statistical concepts | a) Cumulative final exam |
| 2. Differentiate among multiple representations of mathematical information. | 5 | a) Identify operations on sets | a) same as above |
| 3. Assess mathematical reasonableness and consistency | 5 | a) Make sense of elementary probability problems | a) same as above |
| **Total:** | **100%** | | |

\(^1\) This percentage is a combination of the effort spent on instruction plus reinforcement through activities outside of class such as homework.
# Course Information

**Course Prefix/Number:** MATH 1110  
**Course Title:** College Algebra  
**[Cross-Listed as: ____]**  
**Credits:** 3

**Prerequisite(s):** MATH 1108 C or higher Math Placement Exam  
**Corequisite(s):**  
**Concurrent requisites:**

**Core Curriculum Category Certification:** 3.1  
**Grading Scheme:** A-F ☑  
S/U ☐  
P/F ☐

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## Catalog Description

Prerequisites: placement into MATH 1110, or completion of MATH 1108 with a grade of C or higher. Topics include: a review of the fundamental algebraic operations; a study of functions including transformations and function composition; linear and quadratic equations; quadratic functions and models; synthetic division; zeros of polynomials and rational functions; inverse functions and a study of the exponential and logarithmic functions; and solving systems of linear equations. This course is intended primarily for students whose program of study requires calculus based math classes. 3 credits.

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## Learning Outcomes

At the end of the course the student can:

1. Simplify algebraic expressions
2. Solve for the unknown variable in equations using various manipulations CC3.1.1
3. Construct the equation of a circle
4. Identify the properties of functions
5. Compute different operations on functions CC3.1.1
6. Compute the inverse of a function
7. Sketch the graph of functions CC3.1.2
8. Solve systems of linear equations
9. Create algebraic equations from a word problem CC3.1.1
10. Apply the concepts of ratio, proportion, and variation to solve word problems
11. Verify reasonableness of solutions to word problems CC3.1.3

---

## Is this course part of the assessment plan for:

- Major ☐  
- Core Curriculum ☑  
- Agency Accreditation ☐

If so, please identify any required assignments or assessment methods:

a) Cumulative final exam

---

If the course is cross-listed grad/UG, please describe the additional expectations for the graduate course:

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## Topic List

(Please present as a *pro forma* 15-week semester calendar that reflects the relative emphasis on component topic areas)

### Topics for MATH 1110

**Week 1:**  
Review: Give a review of basic algebraic operations, powers, simplifications of algebraic functions, factoring, solving for the unknown in linear, quadratic, radical equations
Week 2:  
Rectangular Coordinates and Graphs: Introduce the students to the coordinate system and how to plot points on this system

Week 3:  
Circles: Introduce the students to the definition of a circle, its equation, and its graph
Functions: Define a function and give examples, then introduce the graph of a function

Week 4:  
Linear Functions: Give their properties and the connection between the slope and the graph

Week 5:  
Equations of Lines and Linear Models: Introduce some applications of linear functions
Graphs of Basic Functions (Functions Library): Introduce a variety of basic functions

Week 6  
Graphing Techniques and Transformations: How to use the function library to graph more complicated functions

Week 7:  
Function Operations and Composition: introduce combinations of functions to form complicated ones such as addition, subtraction, product, division, and composition of functions

Week 8:  
Quadratic Functions and Models: Give the definition, examples, and applications

Week 9:  
Synthetic Division and Long Division: Introduce this method of division to divide a polynomial by another (quotient and remainder)
Zeroes of Polynomial Functions: Introduce the definition of the roots(zeroes) of a plynomial and some methods to find them

Week 10:  
Polynomial Functions: Give an overview of their graphs, applications, and models
Rational Functions: Introduce their graphs (asymptotes), applications, and models
Variation: Discussion of word problems, how to translate a word problem into an equation

Week 11:  
Inverse Functions: Give the definition, some examples, and introduce their graphs and the concept of symmetry with the original function

Week 12:  
Exponential Functions: Give the definition, their properties, some examples, and their graphs
Logarithmic Functions: Give the definition, their properties, some examples, and their graphs

Week 13:  
Systems of Linear Equations: Solving systems of equations algebraically and geometrically

Week 15:  
Review

Required Library resources and acquisitions:
Management of free online mathematics course materials using College Algebra, 11th ed. by Lial, Hornsby, Schneider, and Daniels, Pearson (2013).

Comments (by committees):
### I. General Information

<table>
<thead>
<tr>
<th>Proposing Faculty Member</th>
<th>Contact Person’s E-mail</th>
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<td><a href="mailto:helturkey.efiorillo@newhaven.edu">helturkey.efiorillo@newhaven.edu</a></td>
<td>2039321209</td>
<td>1/20/15</td>
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<td>A&amp;S</td>
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### II. Course Information

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<th>Course Prefix/Number</th>
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<tr>
<td>College Algebra</td>
<td>MATH 1110</td>
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<table>
<thead>
<tr>
<th>Nature of Course: Existing course not requiring substantive change</th>
<th>Course Credit Hours: 3</th>
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<table>
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<tr>
<th>Catalog Description</th>
<th>Pre/Co-requisites</th>
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<td>Prerequisites: placement into MATH 1110, or completion of MATH 1108 with a grade of C or higher. Topics include: a review of the fundamental algebraic operations; a study of functions including transformations and function composition; linear and quadratic equations; quadratic functions and models; synthetic division; zeros of polynomials and rational functions; inverse functions and a study of the exponential and logarithmic functions; and solving systems of linear equations. This course is intended primarily for students whose program of study requires calculus based math classes. 3 credits.</td>
<td>MATH 1108 or placement by the Math Placement Exam</td>
</tr>
</tbody>
</table>

If this course has prerequisites, are they also being proposed for core certification? **No**

If you did not answer Yes, please justify:

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### III. Review Decision

**Recommended Action:** Select ...

<table>
<thead>
<tr>
<th>Task Force Chair Signature:</th>
<th>Date:</th>
</tr>
</thead>
</table>

**Committee comments (if request remanded):**

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Please attach Curriculum Change Form A6 – Course Syllabus to this proposal.
## MAPPING OF COMPETENCY LEARNING OUTCOMES TO COURSE LEARNING OUTCOMES

<table>
<thead>
<tr>
<th>CC3.1 – Mathematical &amp; Quantitative Literacy Tier 1 Learning Outcomes</th>
<th>% Of Course Emphasizing Outcome(^1)</th>
<th>Course Learning Outcome(s) That Support Competency Outcome</th>
<th>Likely Assessment Instruments for Course Outcome(s)</th>
</tr>
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<tbody>
<tr>
<td>The student can:</td>
<td></td>
<td></td>
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</table>
| 1. Apply mathematical concepts and principles to solve problems. | 50 | a) Solve for the unknown variable(s) in equations using various manipulations  
 b) Compute different operations on functions  
 c) Create algebraic equations from a word problem | a) Cumulative final exam |
| 2. Differentiate among multiple representations of mathematical information. | 10 | a) Sketch the graph of functions | a) same as above |
| 3. Assess mathematical reasonableness and consistency | 5 | a) Verify reasonableness of solutions to word problems | a) Same as above |
| **Total:** 65% | | | |

\(^1\) This percentage is a combination of the effort spent on instruction plus reinforcement through activities outside of class such as homework.
3 TIER II CLASSES

For Tier II, we propose the following courses:

- MATH 1115-Precalculus
- MATH 1117-Calculus I
- MATH 1118-Calculus II
- MATH 2203-Calculus III
- MATH 2228-Elementary-Statistics
- MATH 1121-Foundations-of-Mathematics
**Course Prefix/Number:** MATH 1115  
**Course Title:** Pre-Calculus  
**[Cross-Listed as: ____]**  
**Credits:** 3

**Prerequisite(s):** MATH 1110 C or higher or Math Placement exam  
**Corequisite(s):** ____  
**Concurrent requisites:** ____

**Core Curriculum Category Certification:** 3.2

**Grading Scheme:** A-F ☒  
S/U ☐  
P/F ☐

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**Catalog Description:**
Prerequisite: placement into MATH 1115, or completion of MATH 1110 with a grade of C or higher. Topics include: polynomials; algebraic functions; plane analytic trigonometry; and properties of exponential and logarithmic functions. This course offers the foundation needed for the study of calculus. 3 credits

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**Learning Outcomes:**
At the end of the course the student can:
1) Graph polynomial functions using transformations  
2) Recognize the real and complex zeros of a polynomial and their multiplicity  
3) Examine the graph of parent functions  
4) Generate equations and models of applied problems  CC3.2.1  
5) Verify reasonableness of solutions to applied problems CC3.2.2  
6) Solve algebraic, exponential, logarithmic and trigonometric equations  CC3.2.3  
7) Create exponential growth and decay models  
8) Integrate fundamental identities of trigonometric functions for equation solving  CC3.2.3  
9) Generate equations of conic sections  CC3.2.1  
10) Analyze the graph of polynomial, rational, exponential, logarithmic, and trigonometric functions and their inverses CC3.2.3

---

**Is this course part of the assessment plan for:**
- Major ☐  
- Core Curriculum ☒  
- Agency Accreditation ☐

If so, please identify any required assignments or assessment methods:
- a) Cumulative online final

If the course is cross-listed grad/UG, please describe the additional expectations for the graduate course:

---

**Topic List:** (Please present as a pro forma 15-week semester calendar that reflects the relative emphasis on component topic areas)  
Topics for MATH 1115

**Week 1:**
Polynomials: Introduce polynomial functions, determine end behavior, x and y intercepts, zeros and multiplicity of the functions.

**Week 2:**
Rational Functions: Find domain, range, key points and asymptotes for rational functions. Apply to word problems involving rational functions.
Remainder/Factor Theorem: Use the remainder and factor theorem, find the real zeros of polynomial functions and solve polynomial equations.

Week 4:
Zeros of Polynomials: Find the complex zeros of a polynomial function using the conjugate pairs theorem.

Week 5:
Composite Functions: Form the composite functions and identify the domain, determine whether a function is one-to-one. Construct the inverse of a function algebraically and graphically.

Week 6:
Exponential Functions: Evaluate and graph exponential functions. Define the number e and solve exponential equations.

Week 7:
Logarithmic Functions: Evaluate logarithmic expressions, review properties of logs, graph logarithmic functions, and solve logarithmic equations. Use exponential and logarithmic models to solve word problems.

Week 8:
Angles: Convert degrees to radians and vice versa, find the area of a sector of a circle and find linear speed in circular motion. Find the six trig functions using a point on the unit circle.

Week 9:
Trigonometric Functions: Determine the domain and range of the trigonometric functions. Determine the period of the function, the signs of the trigonometric in a given quadrant, use even-odd properties to find the exact values.

Week 10:
Graphing Trigonometric Functions: Graph sinusoidal functions using key points, amplitude and period. Find the equation for the sinusoidal graph. Find the model to represent the data.

Week 11:
Inverse Trigonometric Functions: Discuss the domain and range of the inverse trigonometric functions. Use properties of Inverse functions to find exact values. Write a trigonometric expression as an algebraic expression.

Week 12:
Trigonometric Equations: Solve equations involving trigonometric functions. Use sum, difference, double and half angle formulas to solve equations.

Week 13:
Applications of Trigonometric Functions: Solve right triangle and applied problems. Apply the law of sines and cosines to solve applied problems.

Week 14:
Analytic Geometry: Analyze parabolas, ellipses, and hyperbolas, construct their equations and graphs. Solve applied problems involving conic sections.

Week 15:
Review and final.

Required Library resources and acquisitions:

Comments (by committees):

Instructions for Use:
1. Please review the distinction between a syllabus and a course outline—see Curriculum Guide 7.9 and deans’ guiding documents.
2. LOs—please reference instructions for CCAP plans provided by the University Assessment Committee [http://newhaven.edu/academics/academic-administration/provost/CCAP]
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<td>Pre-Calculus</td>
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<td>Prerequisite: placement into MATH 1115, or completion of MATH 1110 with a grade of C or higher. Topics include: polynomials; algebraic functions; plane analytic trigonometry; and properties of exponential and logarithmic functions. This course offers the foundation needed for the study of calculus. 3 credits</td>
<td>a grade of C or higher in MATH 1110 or Mathematics Placement</td>
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III. Review Decision

| Recommended Action: Select ... |
|------------------------------|----------------|----------------|
| Task Force Chair Signature: | Date:       |

| Committee comments (if request remanded): | |

Please attach Curriculum Change Form A6 – Course Syllabus to this proposal.
MAPPING OF COMPETENCY LEARNING OUTCOMES TO COURSE LEARNING OUTCOMES

<table>
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<tr>
<th>CC3.2 – Mathematical &amp; Quantitative Literacy Tier 2 Learning Outcomes</th>
<th>% Of Course Emphasizing Outcome(^1)</th>
<th>Course Learning Outcome(s) That Support Competency Outcome</th>
<th>Likely Assessment Instruments for Course Outcome(s)</th>
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</table>
| The student can:  
  1. Generate mathematical models based on abstract concepts. | 10 | a) Generate equations of conic section  
b) Generate equations and models to applied problems | a) Cumulative online final |
| 2. Justify the correctness of a solution based on assumptions made and known limitations of methods used. | 2 | a) Verify reasonableness of solutions to applied problems | a) same as above |
| 3. Solve complex mathematical problems involving multiple mathematical forms and techniques. | 80 | a) Analyze the graph of polynomial, rational, exponential, logarithmic, and trigonometric functions and their inverses  
b) Integrate fundamental identities of trigonometric functions for equation solving  
c) Solve algebraic, exponential, logarithmic and trigonometric equations | a) same as above |
| OR | | | |
| 3. Draw appropriate conclusions as the result of performing quantitative data analysis based on sound assumptions regarding estimation and modeling. | | a) | a) |

**Total: 92%**

\(^1\) This percentage is a combination of the effort spent on instruction plus reinforcement through activities outside of class such as homework.
CURRICULUM CHANGE FORM
FORM A6 – COURSE SYLLABUS TEMPLATE

Standard Course Syllabus

Course Prefix/Number: MAT 1117  
Course Title: Calculus I
[Cross-Listed as: ]  Credits: 4
Prerequisite(s): MATH 1115 C or better or Math Placement exam
Corequisite(s): 
Concurrent requisites: 
Core Curriculum Category Certification: 3.2
Grading Scheme: A-F ☑  S/U ☐  P/F ☐

Catalog Description:
Prerequisite: a grade of C (not C-) or higher in MATH 1115, or placement by the department. The first year college course for majors in mathematics, science and engineering; and the basic prerequisite for all advanced mathematics. Introduces differential and integral calculus for functions of one variable, including algebraic and transcendental functions and culminates in the fundamental theorem of calculus. Includes basic rules and properties of limits and derivatives and applications of derivatives. Studies the plane analytic geometry needed for calculus. 4 credits

Learning Outcomes:
At the end of the course the student can:
1) Evaluate limits and the common exceptions where limits do not exist  CC3.2.3
2) Calculate derivatives using a variety of tools  CC3.2.3
3) Analyze the connection between derivatives and tangent lines CC3.2.1
4) Interpret derivatives across several fields of physical sciences CC3.2.1
5) Justify the inverse relationship between derivatives and integrals CC3.2.2
6) Evaluate integrals of functions CC3.2.3

Is this course part of the assessment plan for:
Major ☑  Core Curriculum ☑  Agency Accreditation ☐

If so, please identify any required assignments or assessment methods:
a) Cumulative final exam

If the course is cross-listed grad/UG, please describe the additional expectations for the graduate course:

Topic List:  (Please present as a pro forma 15-week semester calendar that reflects the relative emphasis on component topic areas)
Topics for MATH 1117
Week 1:
Review functions and representing functions using verbal, tabular, symbolic, and graphical representations.
Week 2:
PreCalculus review: Define inverse, exponential, logarithmic and trigonometric functions and their inverses describing their domain and range and special conditions
Week 3:
Limits: Introduce limits and develop methods to evaluate limits
Week 4:
Limits: Interpret infinite limits and limits at infinity and how they relate to their graphs
Limits: Generate the definition of continuity and its relationship with limits and defined function as well as the precise definition of a limit.

Week 6:
Derivatives: Introduce derivatives using limits and begin with some basic rules of differentiation, example constant rule, power rule

Week 7:
Derivatives: Various rules of differentiation such as product, quotient, and chain rule

Week 8:
Derivatives: Introduce the derivatives of trigonometric functions and rates of change

Week 9:
Derivatives: Introduce implicit differentiation and differentiation of logarithmic and exponential functions

Week 10:
Derivatives: Introduce differentiation of inverse trigonometric functions and related rate word problems applying implicit differentiation

Week 11:
Derivatives with respect to graphing: Apply derivative techniques for graphing, example max and min, concavity and optimization problems

Week 12:
Introduce and apply the Mean value theorem and L'Hopital's Rule

Week 13:
Antiderivative: Introduce antiderivative, approximating under the curve and definite integrals

Week 14:
Inverse relationship of Differentiation and Integration: Introduce the Fundamental theorem of Calculus and substitution method of integration

Week 15:
Review and final.

Required Library resources and acquisitions:

Instructions for Use:
1. Please review the distinction between a syllabus and a course outline—see Curriculum Guide 7.9 and deans’ guiding documents.
2. LOs—please reference instructions for CCAP plans provided by the University Assessment Committee [http://newhaven.edu/academics/academic-administration/provost/CCAP/]}
CORE CURRICULUM TASK FORCE FORM
CERTIFICATION OF COURSE REQUEST
CC3.2 – MATHEMATICAL & QUANTITATIVE LITERACY: TIER 2

I. General Information

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<td>2039321146</td>
<td>3/25/15</td>
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Department/Program: Mathematics and Physics/ Mathematics
College: A&S

II. Course Information

<table>
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<th>Title of Course</th>
<th>Course Prefix/Number</th>
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<tr>
<td>Calculus I</td>
<td>MATH 1117</td>
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Nature of Course: Existing course not requiring substantive change

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<th>Catalog Description</th>
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<td>Prerequisite: a grade of C (not C-) or higher in MATH 1115, or placement by the department. The first year college course for majors in mathematics, science and engineering; and the basic prerequisite for all advanced mathematics. Introduces differential and integral calculus for functions of one variable, including algebraic and transcendental functions and culminates in the fundamental theorem of calculus. Includes basic rules and properties of limits and derivatives and applications of derivatives. Studies the plane analytic geometry needed for calculus. 4 credits</td>
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If this course has prerequisites, are they also being proposed for core certification? Yes

If you did not answer Yes, please justify:

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<th>Course Credit Hours:</th>
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Pre/Co-requisites

C or higher in PreCalculus Math 1115 or placement by the department.

III. Review Decision

Recommended Action: Select ...

Task Force Chair Signature: 
Date:

Committee comments (if request remanded):

Please attach Curriculum Change Form A6 – Course Syllabus to this proposal.
### MAPPING OF COMPETENCY LEARNING OUTCOMES TO COURSE LEARNING OUTCOMES

<table>
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</table>
| 1. Generate mathematical models based on abstract concepts. | 18 | a) Analyze the connection between derivatives and tangent lines  
b) Interpret derivatives across several fields of physical science | a) Cumulative final exam |
| 2. Justify the correctness of a solution based on assumptions made and known limitations of methods used. | 2 | a) Justify the inverse relationship between derivatives and integrals | a) same as above |
| 3. Solve complex mathematical problems involving multiple mathematical forms and techniques. | 75 | a) Evaluate limits and the common exceptions where limits do not exist  
b) Calculate derivatives using a variety of tools  
c) Evaluate integrals of functions | a) same as above |
| OR | | | |
| 3. Draw appropriate conclusions as the result of performing quantitative data analysis based on sound assumptions regarding estimation and modeling. | | a) | a) |

Total: 95%

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<sup>1</sup> This percentage is a combination of the effort spent on instruction plus reinforcement through activities outside of class such as homework.
Course Prefix/Number: __________ Course Title: Calculus II
[Cross-Listed as: __________] Credits: 4
Prerequisite(s): completion of MATH 1117 with a grade of C or higher.
Corequisite(s): ______
Concurrent requisites: ______
Core Curriculum Category Certification: 3.2
Grading Scheme: A-F ☑ S/U □ P/F ☐

Catalog Description:
Prerequisite: a grade of C (not C-) or higher in MATH 1117. Continuation of first year calculus, including the fundamental theorem of calculus, methods of integration, applications of the integral, improper integrals, infinite series, and introduction to differential equations. 4 credits

Learning Outcomes:
At the end of the course the student can:
  1) Examine physical and geometric applications of definite integrals CC3.2.3
  2) Recognize the appropriate integration technique
  3) Generate the required steps in evaluating an integral CC3.2.1
  4) Solve basic differential equations
  5) Assess convergence and divergence of sequences and series CC3.2.2
  6) Create the Taylor Series of basic functions CC3.2.1

Is this course part of the assessment plan for:
   Major ☑ Core Curriculum ☑ Agency Accreditation ☐

If so, please identify any required assignments or assessment methods:
a) Cumulative final exam

If the course is cross-listed grad/UG, please describe the additional expectations for the graduate course:

Topic List: (Please present as a pro forma 15-week semester calendar that reflects the relative emphasis on component topic areas)
Topics for MATH 1118

Week 1:
Review basic antiderivatives.
Integrals: Define and give examples of definite and indefinite integrals. Discuss the geometric connection with areas under the curves of functions.

Week 2:
Integration Technique 1: Introduce the Substitution Rule
Motion: Introduce the first application of definite integrals in computing the position, velocity, and acceleration functions of a moving object.

Week 3:
Areas: Explain how to apply definite integrals to compute areas under one curve or the area between two curves.
Volumes: Explain how to apply definite integrals to compute volumes of solids using the slicing method, the disk method, and the shell method.
Week 4:
Arc Length and Surface Area: Apply definite integrals to compute the arc length of a curve and to compute the surface area of a solid generated from a curve.

Week 5:
Exponential, Logarithmic, Hyperbolic Functions: Introduce the notion of these functions, their inverses, derivatives, and their integrals together with their graphs.

Week 6:
Tools: Introduce some subtle substitutions and unusual methods that are not covered by procedural integration techniques.
Integration Technique 2: Give a detailed explanation of Integration By Parts to integrate products of functions and inverse functions.

Week 7:
Integration Technique 3: Give a detailed explanation of Trigonometric Integrals to compute integrals that involve the trigonometric functions.
Integration Technique 4: Give a detailed explanation of Trigonometric Substitutions that transform special types of integrals into trigonometric integrals.

Week 8:
Integration Technique 5: Give a detailed explanation of Integration By Partial Fractions that decompose rational functions into simpler fractions that can be integrated using basic rules or by substitution rule.
Improper Integrals: Introduce and solve the two types of improper integrals that involve Infinity as a bound or a point of discontinuity.

Week 9:
Numerical Integration: Implement the midpoint rule, the trapezoidal rule, and the Simpson's rule to approximate integrals that cannot be integrated using the previous techniques.
Differential Equations: Provide a quick introduction to basic differential equations.

Week 10:
Sequences: Introduce sequences, their connection to patterns, the concept of convergence and divergence, and how to utilize limits in examining their behavior.
Series 1: Make the transition from sequences to infinite series and establishing the connection between the two concepts through the usage of the sequence of partial sums to study the behavior of series in a broader sense.
Week 11:
Series 2: Examine the convergence and divergence of series using a variety of tests such as the divergence, integral, root, ratio tests.
Week 12:
Series 3: Examine the convergence and divergence of series using comparison and the alternating series tests.
Week 13:
Power Series: Introduce the notion of power sets and how they can be used to approximate a function by a series. Then discuss their interval and radius of convergence using the previously developed tests.
Week 14:
Taylor Series: Continue the discussion on writing functions as series but using a specific method referred to as the Taylor series of a function. Discuss these types of series for most of the basic functions.

Week 15:
Review and final.

Required Library resources and acquisitions:

Comments (by committees):

Instructions for Use:
1. Please review the distinction between a syllabus and a course outline—see Curriculum Guide 7.9 and deans’ guiding documents.
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CC3.2 – MATHEMATICAL & QUANTITATIVE LITERACY: TIER 2

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<td>2039321209</td>
<td>3/24/15</td>
</tr>
</tbody>
</table>

Department/Program: Mathematics and Physics/ Mathematics

College: A&S

II. Course Information

<table>
<thead>
<tr>
<th>Title of Course</th>
<th>Course Prefix/Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Calculus II</td>
<td>MATH 1118</td>
</tr>
</tbody>
</table>

Nature of Course: Existing course not requiring substantive change

Catalog Description

Prerequisite: a grade of C (not C-) or higher in MATH 1117.
Continuation of first year calculus, including the fundamental theorem of calculus, methods of integration, applications of the integral, improper integrals, infinite series, and introduction to differential equations. 4 credits

<table>
<thead>
<tr>
<th>Pre/Co-requisites</th>
</tr>
</thead>
<tbody>
<tr>
<td>a grade of C or higher in MATH 1117</td>
</tr>
</tbody>
</table>

If this course has prerequisites, are they also being proposed for core certification? Yes
If you did not answer Yes, please justify:

III. Review Decision

Recommended Action: Select ...

Task Force Chair Signature: Date:

Committee comments (if request remanded):

Please attach Curriculum Change Form A6 – Course Syllabus to this proposal.
<table>
<thead>
<tr>
<th>CC3.2 – Mathematical &amp; Quantitative Literacy Tier 2 Learning Outcomes</th>
<th>% Of Course Emphasizing Outcome(^1)</th>
<th>Course Learning Outcome(s) That Support Competency Outcome</th>
<th>Likely Assessment Instruments for Course Outcome(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>The student can:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Generate mathematical models based on abstract concepts.</td>
<td>50</td>
<td>a) Create the Taylor Series of functions b) Generate the required steps in evaluating an integral</td>
<td>a) Cumulative final</td>
</tr>
<tr>
<td>2. Justify the correctness of a solution based on assumptions made and known limitations of methods used.</td>
<td>25</td>
<td>a) Assess convergence and divergence of sequences and series</td>
<td>a) same as above</td>
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<tr>
<td>3. Solve complex mathematical problems involving multiple mathematical forms and techniques.</td>
<td>25</td>
<td>a) Examine physical and geometric applications of definite integrals</td>
<td>a) same as above</td>
</tr>
<tr>
<td>OR</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>3. Draw appropriate conclusions as the result of performing quantitative data analysis based on sound assumptions regarding estimation and modeling.</td>
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<td>a)</td>
<td>a)</td>
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**Total: 100%**

\(^1\) This percentage is a combination of the effort spent on instruction plus reinforcement through activities outside of class such as homework.
CURRICULUM CHANGE FORM
FORM A6 – COURSE SYLLABUS TEMPLATE
Standard Course Syllabus

Course Prefix/Number: MATH2203  Course Title: Calculus III
[Cross-Listed as: ____]  Credits: 4
Prerequisite(s): completion of MATH 1118 with a grade of C or higher.
Corequisite(s): ____
Concurrent requisites: ____
Core Curriculum Category Certification: 3.2
Grading Scheme:  A-F  S/U  P/F

Catalog Description:
Prerequisite: a grade of C (not C-) or higher in MATH 1118. The calculus of multiple variables, covering three
dimensional topics in analysis, linear algebra, and vector analysis, partial differentiation, maxima and minima for
functions of several variables, line integrals, multiple integrals, spherical and cylindrical polar coordinates. 4 credits

Learning Outcomes:
At the end of the course the student can:
1) Formulate parametric and polar equations for curves CC3.2.1
2) Analyze Calculus concepts for parametric, polar, and vector-valued functions CC3.2.3
3) Combine vector operations to curves in space CC3.2.2
4) Justify the correlation partial derivatives to maximum/minimum problems CC3.2.2
5) Construct tangent planes and linear approximations to surfaces CC3.2.1
6) Evaluate iterated integrals CC3.2.3

Is this course part of the assessment plan for:
Major  ☒  Core Curriculum  ☒  Agency Accreditation  ☒

If so, please identify any required assignments or assessment methods:
a) Cumulative final

If the course is cross-listed grad/UG, please describe the additional expectations for the graduate course:

Topic List: (Please present as a pro forma 15-week semester calendar that reflects the relative emphasis on component topic areas)

Week 1: Parametric Equations and Polar Coordinates: Introduce these two concepts and show the conversion back
and forth to cartesian coordinates.
Week 2: Calculus in Polar Coordinates: Find tangent lines for parametric and polar curves, solve arc length
problems, and find areas between curves
Week 3: Conic Sections: Introduce parabolas, ellipses, hyperbolas in both cartesian and polar forms.
Vectors in the Plane and Three Dimensions: Introduction to vectors and show arithmetic operations on vectors.
Week 4: Dot & Cross Product: Introduce dot and cross product of vectors and interpret them geometrically.
Week 5: Lines and Curves in Space, Calculus of Vector Valued Functions: Study Calculus concepts of vector valued
functions such as derivatives, integrals, tangent vectors.
Week 6: Motion in Space Section, Length of Curves, Curvature and Normal Vectors: Introduce different the
components of motion such as position, velocity, speed, acceleration, and curvature of trajectories.
Week 7: Surfaces: Introduce surfaces including planes and study their level curves and sketch some of the well known surfaces.
Week 8: Limits and Continuity, Partial Derivatives: Introduce Calculus concepts is multiple dimensions. This includes limits, continuous functions, partial derivatives.  
Week 9: Chain Rule and Directional Derivatives: Introduce the chain rule in multiple dimensions, and introduce directional derivatives and the gradient vector.  
Week 10: Tangent Planes and Linear Approximation, Maximum/Minumum Problems: solve these Calculus problems in 2-D and 3-D.  
Week 11: Lagrange Multipliers: Introduce optimization problems under a constraint. 
Double Integrals: Introduce double integrals together with their geometric interpretation.  
Week 12: Compute double integrals in cartesian and polar coordinates.  
Week 13: Triple Integrals: Learn how to compute triple integrals in cartesian, cylindrical, and spherical coordinates.  
Week 14: Change of Variables: Utilize change of variables in multiple integrals.  
Week 15: Review and final.

Required Library resources and acquisitions:

Comments (by committees):

Instructions for Use:  
1. Please review the distinction between a syllabus and a course outline—see Curriculum Guide 7.9 and deans’ guiding documents.  
2. LOs—please reference instructions for CCAP plans provided by the University Assessment Committee (http://newhaven.edu/academics/academic-administration/provost/CCAP/)
# CORE CURRICULUM TASK FORCE FORM  
**CERTIFICATION OF COURSE REQUEST**  
**CC3.2 – MATHEMATICAL & QUANTITATIVE LITERACY: TIER 2**

## I. General Information

<table>
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<tr>
<td>Calculus III</td>
<td>MATH 2203</td>
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<table>
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<tr>
<th>Nature of Course:</th>
<th>Course Credit Hours:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Existing course not requiring substantive change</td>
<td>4</td>
</tr>
</tbody>
</table>

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<td>Prerequisite: a grade of C (not C-) or higher in MATH 1118. The calculus of multiple variables, covering three dimensional topics in analysis, linear algebra, and vector analysis, partial differentiation, maxima and minima for functions of several variables, line integrals, multiple integrals, spherical and cylindrical polar coordinates. 4 credits</td>
<td>a grade of C or higher in MATH 1118</td>
</tr>
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</table>

If this course has prerequisites, are they also being proposed for core certification? **Yes**  
If you did not answer Yes, please justify:  

## III. Review Decision

<table>
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<tr>
<th>Recommended Action:</th>
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<td>Select ...</td>
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<th>Task Force Chair Signature:</th>
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Committee comments (if request remanded):  

Please attach Curriculum Change Form A6 – Course Syllabus to this proposal.
### MAPPING OF COMPETENCY LEARNING OUTCOMES TO COURSE LEARNING OUTCOMES

<table>
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<tr>
<th>CC3.2 – Mathematical &amp; Quantitative Literacy Tier 2 Learning Outcomes</th>
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<td>The student can:</td>
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</table>
| 1. Generate mathematical models based on abstract concepts. | 20 | a) Formulate parametric and polar equations for curves  
b) Construct tangent planes and linear approximations to surfaces | a) Cumulative final |
| 2. Justify the correctness of a solution based on assumptions made and known limitations of methods used. | 20 | a) Justify the correlation between partial derivatives to maximum/minimum problems | a) same as above |
| 3. Solve complex mathematical problems involving multiple mathematical forms and techniques. | 40 | a) Analyze Calculus concepts for parametric, polar, and vector-valued functions  
b) Evaluate iterated integrals | a) same as above |
| OR | | | |
| 3. Draw appropriate conclusions as the result of performing quantitative data analysis based on sound assumptions regarding estimation and modeling. | | a) | a) |

**Total: 80%**

---

$^1$ This percentage is a combination of the effort spent on instruction plus reinforcement through activities outside of class such as homework.
Course Prefix/Number: MAT1121  Course Title: Foundations of Mathematics

[Cross-Listed as: _____]  Credits: 4

Prerequisite(s): placement in MATH 1121 or completion of MATH 1117 with a grade of C or higher.

Corequisite(s): ______

Concurrent requisites: _____

Core Curriculum Category Certification: 3.2

Grading Scheme: A-F ☒ S/U ☐ P/F ☐

Catalog Description:
Prerequisite: placement in MATH 1121 or completion of MATH 1117 with a grade of C or higher. Set theory, logic, counting and the pigeonhole principle, mathematical induction and the well ordering principle, different methods of proofs (including direct and indirect proof, proof by contrapositive and contradiction, and mathematical induction), relations and equivalence relations, functions (injective, surjective, bijective, composition and inverse), infinite sets and cardinality, and the Cantor-Bernstein-Schroeder theorem. 4 credits

Learning Outcomes:
At the end of the course the student can:
1) Show the connection between different representations and operations of sets CC3.2.1
2) Generate mathematical expressions for logical statements
3) Construct truth tables CC3.2.2, CC3.2.1
4) Solve counting problems CC3.2.1
5) Decide the appropriate method of rigorous proofs and reasoning CC3.2.2
6) Examine equivalence relations and classes CC3.2.1
7) Examine properties of functions CC3.2.3
8) Correlate the concept of infinite sets and cardinality.

Is this course part of the assessment plan for:
Major ☒ Core Curriculum ☒ Agency Accreditation ☐

If so, please identify any required assignments or assessment methods:
a) Cumulative final

If the course is cross-listed grad/UG, please describe the additional expectations for the graduate course:

Topic List: (Please present as a pro forma 15-week semester calendar that reflects the relative emphasis on component topic areas)
Topics for MATH 1121

Week 1:
Sets: Introduce the definition of sets, the set notation, examples, Venn diagrams.

Week 2:
Sets: Demonstrate all the possible set operations such as union, intersection, complement. Show DeMorgan's Law for set operations.

Week 3:
Logic: Communicate to students the translation of logical statements into a mathematical context using symbolic representations of these statements. Construct examples of truth tables to validate the truth of a statement.
Week 4: Counting: Develop the counting techniques and formulas to count how many ways a certain task can be completed.
Week 5: Direct proof: Demonstrate the first proof technique to reason a conclusion. Explain how to decompose a statement into a hypothesis and a conclusion, and how to unpack the hypothesis and the conclusion into related definitions and theorems.
Week 6: Proof by Contrapositive: Show the equivalence of a statement and its contrapositive. Introduce the second proof technique that uses the negation of the conclusion to show the negation of the hypothesis.
Week 7: Proof by Contradiction: Introduce the third proof technique which assumes the conclusion to be false and get a contradiction to the given statement.
Week 8: Proofs involving sets: Examine proofs that involve sets, set notations, and set operations.
Week 9: Disproof: Introduce the concept of counter examples to disprove a statement.
Week 10: Mathematical induction: Develop this proof technique that involves statements depending on natural numbers.
Week 11: Relations: Provide an introduction into relations and equivalence relations, and how to examine if a relation is an equivalence relation.
Week 12: Functions: Correlate the concept of relations to the concept of functions and show the connection with the calculus definition of a function.
Week 13: Functions: Elaborate on showing whether a function is one-to-one and/or onto. Introduce the Image and Pre-image sets.
Week 14: Cardinalities: Introduce the concept of cardinalities for infinite sets together with the Cantor-Bernstein-Schröder theorem.
Week 15: Review and final.

Required Library resources and acquisitions:

Comments (by committees):
Instructions for Use:
1. Please review the distinction between a syllabus and a course outline—see Curriculum Guide 7.9 and deans’ guiding documents.
2. LOs—please reference instructions for CCAP plans provided by the University Assessment Committee [http://newhaven.edu/academics/academic-administration/provost/CCAP]
CORE CURRICULUM TASK FORCE FORM  
CERTIFICATION OF COURSE REQUEST  
CC3.2 – MATHEMATICAL & QUANTITATIVE LITERACY: TIER 2

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<th>Title of Course</th>
<th>Course Prefix/Number</th>
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</thead>
<tbody>
<tr>
<td>Foundations of Mathematics</td>
<td>MATH 1121</td>
</tr>
</tbody>
</table>

**Nature of Course:** Existing course not requiring substantive change

<table>
<thead>
<tr>
<th>Catalog Description</th>
<th>Pre/Co-requisites</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prerequisite: placement in MATH 1121 or completion of MATH 1117 with a grade of C or higher. Set theory, logic, counting and the pigeonhole principle, mathematical induction and the well ordering principle, different methods of proofs (including direct and indirect proof, proof by contrapositive and contradiction, and mathematical induction), relations and equivalence relations, functions (injective, surjective, bijective, composition and inverse), infinite sets and cardinality, and the Cantor-Bernstein-Schroeder theorem. 4 credit</td>
<td>a grade of C or higher in MATH 1117 or Mathematics Placement</td>
</tr>
</tbody>
</table>

If this course has prerequisites, are they also being proposed for core certification? Yes

If you did not answer Yes, please justify:

III. Review Decision

<table>
<thead>
<tr>
<th>Recommended Action:</th>
<th>Select ...</th>
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<tr>
<th>Task Force Chair Signature:</th>
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| Committee comments (if request remanded): |

Please attach Curriculum Change Form A6 – Course Syllabus to this proposal.
<table>
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<tr>
<th>CC3.2 – Mathematical &amp; Quantitative Literacy Tier 2 Learning Outcomes</th>
<th>% Of Course Emphasizing Outcome¹</th>
<th>Course Learning Outcome(s) That Support Competency Outcome</th>
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<td>The student can:</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>1. Generate mathematical models based on abstract concepts.</td>
<td>25</td>
<td>a) Show the connection between different representations and operations of sets b) Examine equivalence relations and classes c) Construct truth tables</td>
<td>a) Cumulative final</td>
</tr>
<tr>
<td>2. Justify the correctness of a solution based on assumptions made and known limitations of methods used.</td>
<td>50</td>
<td>a) Construct truth tables b) Decide the appropriate method of rigorous proofs and reasoning</td>
<td>a) same as above</td>
</tr>
<tr>
<td>3. Solve complex mathematical problems involving multiple mathematical forms and techniques.</td>
<td>10</td>
<td>a) Solve counting problems b) Examine properties of functions</td>
<td>a) same as above</td>
</tr>
<tr>
<td>OR</td>
<td></td>
<td></td>
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<td>3. Draw appropriate conclusions as the result of performing quantitative data analysis based on sound assumptions regarding estimation and modeling.</td>
<td></td>
<td>a)</td>
<td>a)</td>
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</table>

Total: 85%

¹ This percentage is a combination of the effort spent on instruction plus reinforcement through activities outside of class such as homework.
Course Prefix/Number: MATH 2228  
Course Title: Elementary statistics

[Cross-Listed as: _____] Credits: 4
Prerequisite(s): MATH 1104 or higher or placement in MATH 1110 or higher or permission of the department.
Corequisite(s): _____
Concurrent requisites: _____

Core Curriculum Category Certification: 3.2

Grading Scheme: A-F ☒  S/U ☐  P/F ☐

Catalog Description:
Prerequisite: MATH 1104 or higher or placement into MATH 1110 or higher, or permission of the department. Topics include: basic probability theory; random variables and their distributions; estimation and hypothesis testing; regression; and correlation. The course is not calculus-based, and places an emphasis on an applied approach to statistical theory with applications chosen from the biological sciences and other fields of study. Students will be introduced to and make use of a computer package for data analysis. 4 credits

Learning Outcomes:
At the end of the course the student can:
1) Analyze data using different representations
2) Compute probability of various events
3) Examine probability distributions CC3.2.2
4) Generate confidence intervals for population means, proportions, and their differences CC3.2.1
5) Choose appropriate hypothesis tests for population means, proportions, and their differences CC3.2.2
6) Investigate the relationship between two quantitative variables using regression and correlation methods CC3.2.3

Is this course part of the assessment plan for:
Major ☐  Core Curriculum ☒  Agency Accreditation ☐

If so, please identify any required assignments or assessment methods:
a) Cumulative final

If the course is cross-listed grad/UG, please describe the additional expectations for the graduate course:

Topic List: (Please present as a pro forma 15-week semester calendar that reflects the relative emphasis on component topic areas)
Week 1: Introduction to displaying and describing data distributions
Week 2: Introduce density curves and normal distributions, how to use a statistical software, analyzing scatterplots,
Week 3: Introduce least-squares regression, correlation and regression
Week 4: Introduce how to analyze data for two-way tables
Week 5: Study statistical inference randomness
Week 6: Examine probability models, random variables, means and variances of random variables
Week 7: Explain general probability rules/ Baye's rule and introduce sampling distribution of the sample Mean, and extend to sampling distribution for proportions
Week 8: Elaborate on estimating with confidence tests of significance, cases of use and abuse of tests
Week 9: Introduce inference for a population mean together with comparing two means and comparing distributions
Week 10: Introduce inference for a single proportion together with comparing two proportions
Week 11: Introduce inference for two-way tables and explain the Chi-Square test
Week 12: Introduce inference for simple linear regression
Week 13: Introduce Inference for multiple regression
Week 14: Explain ANOVA, and introduce inference for ANOVA and for two-way ANOVA
Week 15: Summary and Review

Required Library resources and acquisitions:

Comments (by committees):

Instructions for Use:
1. Please review the distinction between a syllabus and a course outline—see Curriculum Guide 7.9 and deans’ guiding documents.
2. LOs—please reference instructions for CCAP plans provided by the University Assessment Committee [http://newhaven.edu/academics/academic-administration/provost/CCAP]
# CORE CURRICULUM TASK FORCE FORM

## CERTIFICATION OF COURSE REQUEST

### CC3.2 – MATHEMATICAL & QUANTITATIVE LITERACY: TIER 2

---

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<tr>
<td>Elementary Statistics</td>
<td>Math 2228</td>
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<tr>
<th>Nature of Course: Existing course not requiring substantive change</th>
<th>Course Credit Hours: 4</th>
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**Catalog Description**

Prerequisite: MATH 1104 or higher or placement into MATH 1110 or higher, or permission of the department. Topics include: basic probability theory; random variables and their distributions; estimation and hypothesis testing; regression; and correlation. The course is not calculus-based, and places an emphasis on an applied approach to statistical theory with applications chosen from the biological sciences and other fields of study. Students will be introduced to and make use of a computer package for data analysis. 4 credits

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<td>If you did not answer Yes, please justify:</td>
<td>MATH 1104 or MATH 1108</td>
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<td>Prerequisite: MATH 1104 or higher or or placement in MATH 1108 or higher or permission of the department.</td>
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**Committee comments (if request remanded):**

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Please attach Curriculum Change Form A6 – Course Syllabus to this proposal.
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<td>a) Generate confidence intervals for population means, proportions, and their differences</td>
<td>a) Cumulative final</td>
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<tr>
<td>2. Justify the correctness of a solution based on assumptions made and known limitations of methods used.</td>
<td>40</td>
<td>a) Examine probability distributions b) Choose appropriate hypothesis tests for population means, proportions, and their differences</td>
<td>a) same as above</td>
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<tr>
<td>3. Solve complex mathematical problems involving multiple mathematical forms and techniques.</td>
<td></td>
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**OR**

| 3. Draw appropriate conclusions as the result of performing quantitative data analysis based on sound assumptions regarding estimation and modeling. | 20 | a) Investigate the relationship between two quantitative variables using regression and correlation methods | a) same as above |

**Total: 70%**

---

\(^1\) This percentage is a combination of the effort spent on instruction plus reinforcement through activities outside of class such as homework.