KINGSBOROUGH COMMUNITY COLLEGE
The City University of New York

CURRICULUM TRANSMITTAL COVER PAGE

Department: Mathematics and Computer Science **Date:** 3/5/2018

Title Of Course Or Degree: Introduction to Mathematical Concepts in Proof

Change(s) Initiated: (Please check)

- ☐ Closing of Degree
- ☐ Closing of Certificate
- ☐ New Certificate Proposal
- ☐ New Degree Proposal
- ☑ New Course
- ☐ New 82 Course
- ☐ Deletion of Course
- ☐ Change in Degree or Certificate Requirements
- ☐ Change in Degree Requirements (adding concentration)
- ☐ Change in Pre/Co-Requisite
- ☐ Change in Course Designation
- ☐ Change in Course Description
- ☐ Change in Course Title, Numbers Credit and/or Hour
- ☐ Change in Academic Policy
- ☐ Pathways Submission:
  - ☐ Life and Physical Science
  - ☐ Math and Quantitative Reasoning
  - ☐ A. World Cultures and Global Issues
  - ☐ B. U.S. Experience in its Diversity
  - ☐ C. Creative Expression
  - ☐ D. Individual and Society
  - ☐ E. Scientific World

☐ Other (please describe): _____

PLEASE ATTACH MATERIAL TO ILLUSTRATE AND EXPLAIN ALL CHANGES

DEPARTMENTAL ACTION

Action by Department and/or Departmental Committee, if required:

Date Approved: 3/5/18 **Signature, Committee Chairperson:** _____

I have reviewed the attached material/proposal

Signature, Department Chairperson: _____

Revised/Dec.2015/AK

KINGSBOROUGH
COMMUNITY COLLEGE
★ DREAMS BEGIN HERE ★

TO: Spring 2018 Curriculum Committee

FROM: Department of Mathematics & Computer Science

DATE: March 6, 2018

RE: New Course Introduction to Mathematical Concepts in Proof (MAT 3000)

The Department of Mathematics & Computer Science is proposing to change one of the requirements for the A.S. Mathematics degree in the following manner:

ADD:
MAT 3000 - Introduction to Mathematical Concepts in Proof

Rationale for Change: Program assessment in A.S. Mathematics has for several years observed one notable weak spot for terminal students: reading and writing mathematical proofs. Arguably, this is the essential skill for any math program (re: A.S. Mathematics Program Objective #2, "Give proofs by direct and inductive methods"), and we would like to bolster our students' chance for success in the next step of their careers.

KINGSBOROUGH COMMUNITY COLLEGE
THE CITY UNIVERSITY OF NEW YORK

NEW COURSE PROPOSAL FORM

1. **DEPARTMENT, COURSE NUMBER, AND TITLE (SPEAK TO ACADEMIC SCHEDULING FOR NEW COURSE NUMBER ASSIGNMENT):**
   Department of Mathematics & Computer Science,
   MAT 3000 – Introduction to Mathematical Concepts in Proof

2. **DOES THIS COURSE MEET A GENERAL EDUCATION/CUNY CORE CATEGORY?** No.
   - ☐ **Life and Physical Science**
   - ☐ **Math and Quantitative Reasoning**
   - ☐ **A. World Cultures and Global Issues**
   - ☐ **B. U.S. Experience in its Diversity**
   - ☐ **C. Creative Expression**
   - ☐ **D. Individual and Society**
   - ☐ **E. Scientific World**

   IF YES, COMPLETE AND SUBMIT WITH THIS PROPOSAL A CUNY COMMON CORE SUBMISSION FORM.

3. **DESCRIBE HOW THIS COURSE TRANSFERS (REQUIRED FOR A.S. DEGREE COURSE). IF A.A.S. DEGREE COURSE AND DOES NOT TRANSFER, JUSTIFY ROLE OF COURSE, E.G. DESCRIBE OTHER LEARNING OBJECTIVES MET:**

   Hunter College: MATH 156: Introduction to Mathematical Proof Workshop (2 hrs, 1 cr.)

   In other cases, without directly transferring, this course can prepare students for the following critical courses in the mathematical discipline (usually in the sophomore year):

   Brooklyn College: MATH 2001 Transition to Advanced Mathematics (3 cr)
   City Tech: MAT 2071: Introduction to Proofs and Logic (4 cr)
   CCNY: MATH 30800: Bridge to Advanced Mathematics (3 cr)
   Medgar Evers College: MTH 206: Introduction to Mathematical Proof (4 cr)

4. **BULLETIN DESCRIPTION OF COURSE:**
   This course introduces majors in mathematics to the critical skill of reading and writing formal proofs; and serves as a bridge to the more advanced mathematics they will study at the baccalaureate level and beyond. Expected topics include: Basic set theory, logic, counting principles, direct proof, contrapositives, contradictions, non-conditionals, counterexamples, induction, relations, functions, and cardinality.

5. **CREDITS AND HOURS* (PLEASE CHECK ONE APPROPRIATE BOX BELOW BASED ON CREDITS):**

1-credit:	☐ 1 hour lecture ☒ 2 hours lab/field/gym
2-credits:	☐ 2 hours lecture ☐ 1 hour lecture, 2 hours lab/field ☐ 4 hours lab/field
3-credits:	☐ 3 hours lecture ☐ 2 hours lecture, 2 hours lab/field

	☐ 1 hour lecture, 4 hours lab/field ☐ 6 hours lab/field
4-credits:	☐ 4 hours lecture ☐ 3 hours lecture, 2 hours lab/field ☐ 2 hours lecture, 4 hours lab/field ☐ 1 hour lecture, 6 hours lab/field ☐ 8 hours lab/field
More than 4-credits:	☐ Number of credits: ____ (explain mix lecture/lab below) ___ Lecture ____Lab Explanation:_____

***Hours are hours per week in a typical 12-week semester**

6. **NUMBER OF EQUATED CREDITS IN ITEM #5:** N/A.

7. **COURSE PREREQUISITES AND COREQUISITES (IF NONE PLEASE INDICATE FOR EACH)**
   A. PREREQUISITE(S): MAT 14 OR MAT 9900
   B. COREQUISITE(S): NONE
   C. PRE/COREQUISITE(S): None

8. **BRIEF RATIONALE TO JUSTIFY PROPOSED COURSE TO INCLUDE:**
   A. ENROLLMENT SUMMARY IF PREVIOUSLY OFFERED AS AN 82 (INCLUDE COMPLETE 4-DIGIT 82 COURSE NUMBER)
   N/A.

   B. PROJECTED ENROLLMENT
   Expect roughly 15 students in the math major to take this course each year (based on 50 students in math major each year, and prerequisite of MAT 14, as informed by the Office of Research, Planning, and Assessment).

   C. SUGGESTED CLASS LIMITS: 25

   D. FREQUENCY COURSE IS LIKELY TO BE OFFERED:
   Expect the course to be offered at least once each academic year.

   E. ROLE OF COURSE IN DEPARTMENT'S CURRICULUM AND COLLEGE'S MISSION:
   Deductive mathematical proof is the primary skill and tool used in the mathematical discipline from at least the sophomore year onward. Whereas Kingsborough currently has no course aimed specifically at math majors in the subject, prior assessment of program learning objectives (PLOs) have shown a recurring weakness in this area for students in the years 2014-2017. In order that our math majors should be aware and prepared for transfer to a baccalaureate degree program, we seek to remedy this gap with a short course specifically in the topic of proof.

9. **LIST COURSE(S), IF ANY, TO BE WITHDRAWN WHEN COURSE IS ADOPTED (NOTE THIS IS NOT THE SAME AS DELETING A COURSE):**
   None.

10. **IF COURSE IS AN INTERNSHIP, INDEPENDENT STUDY, OR THE LIKE, PROVIDE AN EXPLANATION AS TO HOW THE STUDENT WILL EARN THE CREDITS AWARDED. THE CREDITS AWARDED SHOULD BE CONSISTENT WITH STUDENT EFFORTS REQUIRED IN A TRADITIONAL CLASSROOM SETTING:**
N/A.

11. **PROPOSED TEXT BOOK(S) AND/OR OTHER REQUIRED INSTRUCTIONAL MATERIAL(S):**
Hammack, Richard H. *Book of proof.* Richard Hammack, 2013.
[Open Educational Resource, CC BY-ND 3.0 License]

12. **REQUIRED COURSE FOR MAJOR OR AREA OF CONCENTRATION?**
Yes.

IF YES, COURSE IS REQUIRED, SUBMIT A SEPARATE CURRICULUM TRANSMITTAL COVER PAGE INDICATING A "CHANGE IN DEGREE OR CERTIFICATE REQUIREMENTS" AS WELL AS A PROPOSAL THAT MUST INCLUDE A RATIONALE AND THE FOLLOWING ADDITIONAL PAGES: A "CURRENT" DEGREE WITH ALL PROPOSED DELETIONS (STRIKEOUTS) AND ADDITIONS (BOLDED TEXT) CLEARLY INDICATED, AND A "PROPOSED" DEGREE, WHICH DISPLAYS THE DEGREE AS IT WILL APPEAR IN THE CATALOG (FOR A COPY OF THE MOST UP-TO-DATE DEGREE/CERTIFICATE REQUIREMENTS CONTACT AMANDA KALIN, EXT. 4611).

NYSED GUIDELINES OF 45 CREDITS OF LIBERAL ARTS COURSE WORK FOR AN ASSOCIATE OF ARTS DEGREE (A.A.), 30 CREDITS FOR AND ASSOCIATE OF SCIENCE DEGREE (A.S.), AND 20 CREDITS FOR AN APPLIED ASSOCIATE OF SCIENCE DEGREE (A.A.S.) MUST BE ADHERED TO FOR ALL 60 CREDIT PROGRAMS.

13. **IF OPEN ONLY TO SELECTED STUDENTS SPECIFY POPULATION:**
Registration restricted to Mathematics majors.

14. **EXPLAIN WHAT STUDENTS WILL KNOW AND BE ABLE TO DO UPON COMPLETION OF COURSE:**
1. Read and write formal mathematical proofs.
2. Correctly use symbolic set notation.
3. Establish valid explanations for basic facts of number-theory.
4. Identify congruence classes of integers modulo n.
5. Use the principle of mathematical induction.
6. Succeed at future proof-based courses at the baccalaureate level.

15. **METHODS OF TEACHING –E.G. LECTURES, LABORATORIES, AND OTHER ASSIGNMENTS FOR STUDENTS, INCLUDING ANY OF THE FOLLOWING: DEMONSTRATIONS, GROUP WORK, WEBSITE OR E-MAIL INTERACTIONS AND/OR ASSIGNMENTS, PRACTICE IN APPLICATION OF SKILLS, ETC.:**
1. Lecture and guided discussion
2. Written and online assignments

16. **ASSIGNMENTS TO STUDENTS:**
Written mathematical proofs.

17. **DESCRIBE METHOD OF EVALUATING LEARNING SPECIFIED IN #15 - INCLUDE PERCENTAGE BREAKDOWN FOR GRADING. IF A DEVELOPMENTAL COURSE INCLUDE HOW THE NEXT LEVEL COURSE IS DETERMINED AS WELL AS NEXT LEVEL PLACEMENT.**
1. Written homework: 25%
2. Midterm Exams (2): 40%
3. Final Exam: 35%

18. **TOPICAL COURSE OUTLINE FOR THE 12 WEEK SEMESTER (WHICH SHOULD BE SPECIFIC**

REGARDING TOPICS COVERED, LEARNING ACTIVITIES, AND ASSIGNMENTS):

Hour	Ch.	Topics	Lab
1	1.1-1.4	Sets, subsets, products, and power sets	
2	1.5-1.7	Union, intersection, difference, complement, and Venn diagrams	L
3	1.8-1.10	Indexed sets, number systems, and Russell's Paradox	
4	2.1-2.4	Statements, and-or-not, conditionals, and biconditionals	
5	2.5-2.8	Truth tables, equivalence, and quantifiers	L
6	2.9-2.12	Translating English to symbolic logic, negations, and logical inference	L
7	3.1-3.2	Counting lists; factorials	
8	3.3-3.4	Counting subsets; the binomial theorem	L
9	-	MIDTERM EXAM 1	L
10	4.1-4.2	Theorems and definitions	
11	4.3	Direct proof	
12	4.4-4.5	Using cases; similar cases	L
13	5.1-5.2	Contrapostives; congruence of integers	
14	5.3	Mathematical writing	L
15	6.1-6.2	Proving statements with contradiction	
16	6.3-6.4	Combining techniques; words of advice	L
17	-	MIDTERM EXAM 2	L
18	7.1-7.2	If-and-only-if; equivalent statements	
19	7.3-7.4	Existence proofs; non-constructive proofs	L
20	8.1-8.2	How to Prove a □ A; A □ B	
21	8.3-8.4	How to Prove A = B; Perfect Numbers	
22	9.1-9.4	Counterexamples and disproof	L
23	10.1-10.3	Mathematical induction	
24	-	Review for final	L

19. SELECTED BIBLIOGRAPHY AND SOURCE MATERIALS:

- Cupillari, Antonella. *The Nuts and bolts of proofs: An Introduction to mathematical proofs*. Academic Press, 2011.
- Gilbert, William J., and Scott A. Vanstone. *An introduction to mathematical thinking: algebra and number systems*. Pearson Prentice Hall, 2005.
- Lay, Steven R. *Analysis with an Introduction to Proof*. Pearson Education, 2013.
- Solow, Daniel. *How to Read and Do Proofs: an Introduction to Mathematical Thought Processes*. (2002).
- Sundstrom, Ted. *Mathematical Reasoning: Writing and Proof*. (2013). [OER]
- Velleman, Daniel J. *How to prove it: A structured approach*. Cambridge University Press, 2006.

Daniel R. Collins 01/2018
Revised/Dec.2015/AK

A.S. MATHEMATICS

College Requirements:

Successful completion of CUNY Tests in Reading and Writing and the COMPASS Math Skills Test with passing examination scores, unless otherwise exempt, or developmental courses may be required.

Civic Engagement Experiences:

Two (2) Civic Engagement experiences satisfied by Civic Engagement Certified or Civic Engagement Component courses or approved outside activity.

Writing Intensive Requirement:

One (1) Writing Intensive course in any discipline from any category below is required. Participation in a Learning Community that includes ENG 1200 or ENG 2400 also satisfies this requirement.

Refer to course descriptions for prerequisite, corequisite and/or pre-corequisite requirements

Required Core (4 Courses, 12 Credits):

When Required or Flexible Core Courses are specified for a category, they are required for the major.

ENG 1200 Freshman English I (3 crs.)

ENG 2400 Freshman English II (3 crs.)

Mathematical & Quantitative Reasoning Course – MAT 1500 – Calculus I ~~(4 crs.)~~ (3 crs.)* ^

Life & Physical Sciences Course (3 crs.)

*This program has a waiver to require particular courses in the Common Core, otherwise more than the minimum credits for the degree may be necessary.

Flexible Core (6 Courses, 19 Credits):

One course from each Group A to E.

A. World Cultures and Global Issues Designated Course

B. U.S. Experience in its Diversity Designated Course

C. Creative Expression Designated Course

D. Individual and Society Designated Course

E. Scientific World Designated Course, if not taken for Required Core*

1. MAT 1600 – Calculus II ~~(4 crs.)~~ (3 crs.)* **or**
2. CS 1200 – Introduction to Computing (4 crs.)* **or**

*This program has a waiver to require particular courses in the Common Core, otherwise more than the minimum credits for the degree may be necessary.

No more than two courses can be selected from the same discipline

Major Requirements (8 Courses, 25 Credits):

If not taken for the CUNY Required or Flexible Core, the following are required:

MAT 2100 – Calculus III ~~(4 crs.)~~ (3 crs.)

MAT 5500 – Differential Equations (3 crs.)

MAT 5600 – Linear Algebra (3 crs.)

MAT/BIO 9100 – Biostatistics (4 crs.) **or** MAT/BA 2200 – Business Statistics ~~(4 crs.)~~ (3 crs.)

CS 3500 – Discrete Structures (4 crs.)

MAT 3000 – Introduction to Mathematical Concepts in Proof (1 cr.)

~~HE 1400 – Critical Issues in Personal Health (1 cr.)~~

AND

Select **two** (**2**) courses from the following:

CS 13A0 – Advanced Programming Techniques (4 crs.)
CS 1400 – Computer and Assembly Language Programming (4 crs.)
MAT 1100 – Finite Mathematics (4 crs.)
MAT 3200 – Introduction to Set Theory (4 crs.)
MAT 7100 – Applications of Linear Algebra and Vector Analysis (4 crs.)

Electives:

~~0 credits sufficient to meet required total of 60 credits~~ ^ Note that MAT 9900 is the prerequisite to MAT 1500. MAT 9900 (if required) and 0-1 credit elective; **or** 3-4 credit elective

TOTAL CREDITS: 60