KINGSBOROUGH COMMUNITY COLLEGE
The City University of New York

CURRICULUM DATA TRANSMITTAL SHEET

DEPARTMENT Mathematics & Computer Science **DATE** September 15, 2014

Title of Course or Degree Change: MAT 3200 – Introduction to Set Theory

Change(s) Initiated: (Please check)

- ☐ Letter of Intent
- ☐ Closing of Degree Program
- ☒ New Course*
- ☐ New 82 Course
- ☐ New Certificate Program
- ☐ Change in Pre/Co-Requisite
- ☐ Deletion of Course
- ☐ Other (please describe): _____
- ☐ Proposal
- ☐ Proposal (Letter of Intent sent previously)
- ☐ Change in Degree Requirements
- ☐ Change in Degree Requirements (adding concentration)
- ☐ Change in Discipline Code
- ☐ Change in Description
- ☐ Change in Course Titles, Numbers, Credits &/or Hours

PLEASE ATTACH PERTINENT MATERIAL TO ILLUSTRATE AND EXPLAIN ALL CHANGES

I. **DEPARTMENTAL ACTION**

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

Date approved 9/17/14 **Signature, Committee Chairperson:** _____

Signature, Department Chair: Rina Yarza

II. **PROVOST ACTION**

Provost to act within 30 days of receipt and forward to College-wide Curriculum Committee exercising one of the following options:

A. **Approved** ☐ B. **Returned to department with comments** ☐

Recommendations (if any): _____

Signature, Provost: _____ **Date:** _____

III. **CURRICULUM SUB-COMMITTEE RECOMMENDATIONS** (**FOR NEW COURSES ONLY*):

A. **Approved** ☐ B. **Tabled** ☐ **(no action to be taken by Curriculum Committee)**

Recommendations (if any): _____

Signature, Sub-Committee Chair: _____ **Date:** _____

IV. **COLLEGE-WIDE CURRICULUM COMMITTEE ACTION**

Committee to act within 30 days of receipt, exercising **one** of the following options:

A. **Approved** ☐ (forwarded to Steering Committee)
B. **Tabled** ☐ (Department notified)
C. **Not Approved** ☐ (Department notified)

Signature, Chairperson of Curriculum Committee _____ **Date:** _____

Revised/Winter 08

Rationale: MAT 3200 (proposed) will provide an excellent option for Mathematics majors in the section "Choose two courses from" in the Degree Requirements for the A.S. in Mathematics.

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FORMAT FOR PRESENTATION OF CURRICULUM PROPOSALS

1. **DEPARTMENT, COURSE NUMBER AND TITLE:**
   Department of Mathematics & Computer Science,
   Math 3200-Introduction to Set Theory

2. **DOES THIS COURSE MEET A GENERAL EDUCATION / CUNY CORE CATEGORY? IF YES, PLEASE COMPLETE AND SUBMIT WITH THIS PROPOSAL A CUNY COMMON CORE SUBMISSION FORM.**
   WILL APPLY FOR INCLUSION IN PATHWAYS FLEXIBLE CORE "SCIENTIFIC WORLD"

3. **TRANSFERABILITY OF THIS COURSE.**
   Lehman College: MAT 189 Course Title: Sets & Infinity, Credits: 1.0
   And MAT 340 Course Title: Foundations of Mathematics, Credits: 3.0

   City College: MAT 443 Course Title: Set Theory, Credits: 4.0

   College of Staten Island: MTH 245 Course Title: Set Theory OR
   MTH 440 Course Title: Foundations of Mathematics, Credits: 4.0

   Queens College: MATH 609, Course Title: Intro to Set Theory, Credits: 3.0

   Medgar Evers College MTH 306, Course Title: Set Theory, Credits 3.0

   Baruch College: MTH 4315 Course Title: Intro to Mathematical Logic, Credits 3.0

   York College; MATH 271, Course Title, Topics in Foundational Mathematics, Credits 4.0

4. **BULLETIN DESCRIPTION OF COURSE:**
   The course covers the discovery of basic properties of infinite sets and the historical development of Set Theory as the foundation of mathematics. Topics will include the foundational role of sets in mathematics, well-orderings, ordinals, cardinals, powersets and Cantor's theorem, Continuum Hypothesis, early set theoretic paradoxes, the Zermelo-Fraenkel axioms, Axiom of Choice, Von-Neumann's cumulative hierarchy of sets, and Gödel's first Incompleteness Theorem.

5. **NUMBER OF WEEKLY CLASS HOURS** 4
6. **NUMBER OF CREDITS: 4**

7. **COURSE PREREQUISITES AND COREQUISITES**
   A. **PREREQUISITES:** **MATH 14 WITH A GRADE OF "C" OR BETTER**
   B. **COREQUISITES:** NONE
   C. **PRE OR COREQ: None**

8. **BRIEF RATIONALE TO JUSTIFY PROPOSED COURSE TO INCLUDE:**
   This course would expand the available number of optional math courses offered by the Mathematics and Computer Science Department. It would also give students the opportunity to be exposed to a topic at an introductory level that they might only see in graduate school, while completing a Pathways core requirement.

9. **LIST OF COURSES, IF ANY, TO BE WITHDRAWN WHEN COURSE(S) IS (ARE) ADOPTED:** None

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

11. **PROPOSED TEXT BOOK(S) AND/OR OTHER REQUIRED INSTRUCTIONAL MATERIAL(S):**
Halmos, P. (1998). *Naïve Set Theory.* Springer-Verlag.

12. **REQUIRED COURSE FOR MAJORS AND/OR AREA OF CONCENTRATION?** Open to all students who have satisfied the prerequisites. Will be an option for Mathematics majors in the section "Choose two courses from" in the Degree Requirements for the A.S. in Mathematics.

13. **EXPLAIN WHAT STUDENTS WILL KNOW AND BE ABLE TO DO UPON COMPLETION OF COURSE:**
Upon completion of course, the main concepts students will learn are:
1. Students will be able to interpret and manipulate mathematical objects as sets
2. Students will understand and be able to motivate an axiomatic approach to set theory.
3. Students will understand and be able to motivate the ZFC axioms as the foundation of Set Theory.
4. Students will be able to perform ordinal/cardinal arithmetic, compare cardinalities of sets.
5. Students will be able to prove Cantor's theorem and Schroeder-Bernstein theorem.
6. Students will be able to construct the universe of sets as Von Neumann's cumulative hierarchy.
7. Students will be able to prove Gödel's first Incompleteness Theorem and understand its significance to the limitations of the axiomatic approach.

14. **METHODS OF TEACHING --eg., 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:**
1. Lecture and guided discussion
2. Use of online resources

15. **ASSIGNMENTS TO STUDENTS:**
1. Student presentations
2. Writing intensive assignments

16. **DESCRIBE METHOD OF EVALUATING LEARNING SPECIFIED IN #15:**
1. Homework assignments and oral presentations – 20%
2. Midterm – 30%
3. Term Paper – 15%
4. Final Exam – 35%

17. **TOPICAL COURSE OUTLINE (WHICH SHOULD BE AS SPECIFIC AS POSSIBLE REGARDING TOPICS COVERED, LEARNING ACTIVITIES AND ASSIGNMENTS):**
SEE NEXT PAGE

18. SELECTED BIBLIOGRAPHY AND SOURCE MATERIALS:

Schimmerling, Ernest, 2011, *A Course on Set Theory,* Cambridge University Press
ISBN-10: 1107008174, **ISBN-13:** 978-1107008175

Devlin, Keith, 1993. *The Joy of Sets* (2nd ed.). Springer Verlag, ISBN 0-387-94094-4

Ferreirós, Jose, 2007 (1999). *Labyrinth of Thought: A history of set theory and its role in modern mathematics*. Basel, Birkhäuser. ISBN 978-3-7643-8349-7

Johnson, Philip, 1972. *A History of Set Theory*. Prindle, Weber & Schmidt ISBN 0-87150-154-6

Kunen, Kenneth, 1980. *Set Theory: An Introduction to Independence Proofs*. North-Holland, ISBN 0-444-85401-0.

Potter, Michael, 2004. *Set Theory and Its Philosophy: A Critical Introduction.* Oxford University Press.

Tiles, Mary, 2004 (1989). *The Philosophy of Set Theory: An Historical Introduction to Cantor's Paradise*. Dover Publications.

Hazewinkel, Michiel, ed. (2001), "Set theory", *Encyclopedia of Mathematics*, Springer, ISBN 978-1-55608-010-4

Jech, Thomas (2002). "Set Theory", *Stanford Encyclopedia of Philosophy*.

Akihiro Kanamori, (2003) *The Higher Infinite*, Second edition, Springer-Verlag.

17.Topical Course Outline

WEEK	TOPIC	CHAPTERS/SECTIONS
1	Sets	Intuitive notion of set, examples of finite/infinite sets, set notation, Boolean operations, Russell's paradox, the need for an axiomatic approach
2	Infinite sets in mathematics	Discovery of irrational numbers, geometrical figures as sets of points, examples of sets: real numbers, complex numbers, collections of matrices
3	Cantor and the transfinite	Cantor's discovery of ordinal numbers and motivation, ordinal arithmetic
4	Cardinals	Bijections and the sizes of infinite sets, countable/ uncountable sets, uncountability of the reals Cantor's theorem, Schroeder-Bernstein theorem, Continuum Hypothesis, cardinal arithmetic

5	Paradoxes in set theory	Cantor's paradox, Hilbert's Hotel, Russell's Paradox revisited, the need for an axiomatic approach
6	Midterm Review of first order logic	Logical notation, connectives, quantifiers, formulas, evaluating truth of formulas
7	Zermelo-Fraenkel Axioms (ZF)	Axioms of emptyset, pairing, extensionality, separation, infinity, motivation for axioms, construction of natural numbers and induction
8	ZF (continued)	Axioms of union, powerset, motivation for axioms, construction of real numbers
9	ZF (continued)	Axioms of replacement, foundation, motivation for axioms
10	Axiom of Choice	Definition and motivation, Zorn's lemma
11	Von Neumann's cumulative hierarchy of sets	Iteratively building the universe of sets
12	Gödel's incompleteness theorem	Coding formulas into sets, definability of truth

Please contact your Department Chairperson or Associate Dean Stanley Bazile at the Office of Academic Affairs x5328, if you require any assistance completing a course proposal according to this format. Copies of this format are available electronically.