KINGSBOROUGH COMMUNITY COLLEGE
The City University of New York

CURRICULUM TRANSMITTAL COVER PAGE

Department: Math and Computer Science **Date:** 01/14/2019

Title Of Course/Degree/Concentration/Certificate: Discrete Structures (CS 3500)

Change(s) Initiated: (Please check)

- ☐ Closing of Degree
- ☐ Closing of Certificate
- ☐ New Certificate Proposal
- ☐ New Degree Proposal
- ☐ New Course
- ☐ New 82 Course (Pilot Course)
- ☐ Deletion of Course(s)
- ☐ Change in Degree or Certificate
- ☐ Change in Degree: Adding Concentration
- ☐ Change in Degree: Deleting Concentration
- ☐ Change in Prerequisite, Corequisite, and/or Pre/Co-requisite
- ☐ Change in Course Designation
- ☐ Change in Course Description
- ■ Change in Course Title, Number, Credits and/or Hours
- ☐ 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
- ☐ Change in Program Learning Outcomes
- ☐ 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: _____ **Signature, Committee Chairperson:** _____

If submitted Curriculum Action affects another Department, signature of the affected Department(s) is required:

Date Approved: _____ **Signature, Department Chairperson:** _____

Date Approved: _____ **Signature, Department Chairperson:** _____

I have reviewed the attached material/proposal

Signature, Department Chairperson: R Yan 1/14/2019

Revised/Augl.2018/AK

Kingsborough Community College
The City University of New York

Modifications in Credits/Hours for an Existing Course Form

1. Course Number and Title:
   Mathematics and Computer Science
   CS 3500 - Discrete Structures

2. This Course is **currently** listed as:

   ___4___ Credits ___5___ Hours (include break-down of lecture, lab, or gym)
   5 Lecture Hours

3. **Proposed** Change in Credits/Hours (Please check **ONE** appropriate box below based on credits):

   It is recommended that you refer to the "College Credits Assigned for Instructional Hours" PDF at **http://kingsborough.edu/aa/Pages/forms.aspx**

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

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:_____

4. Rationale/Justification for the change in credits/hours for this course:

   The change in number of credits reflects curricular adjustments to allow for 2 lab hours and 2 lecture hours, as reflected in the course syllabus.

5. Include the **Current** Syllabus/Topical Course Outline and the **Proposed** Syllabus/Topical Course Outline for the course. **Highlight** areas that have been modified and serve as the justification for the proposed change in credits/hours for the course.

   See attachments.

KINGSBOROUGH
COMMUNITY COLLEGE
DREAMS BEGIN HERE

TO: Spring 2019 Curriculum Committee

FROM: Department of Mathematics & Computer Science

DATE: 01/14/2019

RE: Change in Number of Course Credits for Discrete Structures (CS 3500)

The Department of Mathematics & Computer Science is proposing a change in number of Course Credits for Discrete Structures (CS 3500):

FROM:

4 credits, 5 hrs.

TO:

3 credits, 4 hrs. (2 lecture hrs., 2 hr. lab)

Rationale for Change: The change in number of credits reflects curricular adjustments to allow for 2 lab hours and 2 lecture hours, as reflected in the course syllabus.

CURRENT

Kingsborough Community College

Of the City University of New York

Department of Mathematics & Computer Science

1. **Department, Course Number and Title**
   Department of Mathematics & Computer Science, CS 35, Discrete Structures

2. **Distribution Requirements for Groups I-V**
   This course satisfies the Group V requirement.

3. **Demonstration of Course Transferability**
   <go to TIPS web site> http://student.cuny.edu

4. **Bulletin Description of Course**
   Logic and Proofs, Sets, Functions, Sequences and Summations, Matrices, Divisibility, Mathematical Induction, Counting, Discrete Probability, Order Relations and Structures, Graphs, Trees, Boolean Algebra

5. **Number of Weekly Class Hours**
   Five hours per week

6. **Number of Credits**
   Five credits

7. **Prerequisite**
   Mat15

8. **Justification for Course and Expected Enrollment**
   Discrete Mathematics supplies the theoretical foundation for much of todays advanced technology. To understand modern computer hardware or software, communication systems, digital signal processing, information theory, neural networks, control systems, and operations research, a student must know discrete mathematics.

9. **Course Withdrawals**
   None

10. **Field Work, Internship or Independent Study**
    N/A

11. **Textbook**
    Discrete Mathematics and its Applications (Seventh Edition)
    by Kenneth Rosen (McGraw-Hill: ISBN-10: 978-0-07-338309-5)

12. **Required Course for Majors**

This is a required course for Computer Science majors

13. **Specify If Courses Is Open to Only Selected Students**

All who have fulfilled prerequisites

Intended primarily for Computer Science majors

14. **What Will Student Know and Be Able To Do Upon Completion of Course**

Students will develop mathematical maturity and be able to apply basic mathematical principles.

15. **Method of Teaching**

Classroom lectures

16. **Assignments to Students**

Pertinent problems taken from the text.

17. **Method of Evaluating Learning**

Class tests and final exam; computer projects optional at the discretion of the instructor

18. **Topical Course Outline**

Chapter 1. The Foundations: Logic and Proofs (9 hours)

1.1 Propositional Logic
1.3 Propositional Equivalencies
1.4 Predicates and Quantifiers
1.5 Nested Quantifiers
1.6 Rules of Inference
1.7 Introduction to Proofs
1.8 Proof Methods and Strategy

Review and Exam 1 (2 hours)

Chapter 2. Basic Structures: Sets, Functions, Sequences, Sums, and Matrices (8 hours)

2.1 Sets
2.2 Set Operations
2.3 Functions
2.4 Sequences and Summations
2.5 Cardinality
2.6 Matrices

Chapter 4. Number Theory and Cryptography (2 hours)

4.1 Divisibility
4.3 Primes and Greatest Common Divisors

Chapter 5. Induction and Recursion (2 hours)

5.1 Mathematical Induction

Review and Exam 2 (2 hours)

Chapter 6. Counting (6 hours)

6.1 Basics of Counting
6.2 Pigeonhole Principle
6.3 Permutations and Combinations
6.4 Binomial Coefficients and Identities
6.5 Generalized Permutations and Combinations

Chapter 7. Discrete Probability (1 hour)

7.1 Introduction to Discrete Probability

Chapter 9. Relations (7 hours)

9.1 Relations and Their Properties
9.3 Representing Relations
9.4 Closures of Relations
9.5 Equivalence Relations
9.6 Partial Orderings

Review and Exam 3 (2 hours)

Chapter 10. Graphs (6 hours)

10.1 Graphs and Graph Models
10.2 Graph Terminology and Special Types of Graphs
10.3 Representing Graphs and Graph Isomorphism
10.4 Connectivity
10.5 Euler and Hamiltonian Paths
10.6 Shortest-Path Problems

Chapter 11. Trees (5 hours)

11.1 Introduction to Trees
11.3 Tree Transversals
11.4 Spanning Trees
11.5 Minimum Spanning Trees

Chapter 12. Boolean Algebra (4 hours)

12.1 Boolean Functions
12.2 Representing Boolean Functions

12.3 Logic Gates

Review and Exam 4 (2 hours)

Review for Final Exam (2 hours)

19. Selected Bibliography and Source Materials

Updated by Professor Stephen Majewicz, Fall 2014

KINGSBOROUGH COMMUNITY COLLEGE
THE CITY UNIVERSITY OF NEW YORK

Proposed

COURSE SYLLABUS: CS 3500

1. **DEPARTMENT, COURSE NUMBER, AND TITLE (SPEAK TO ACADEMIC SCHEDULING FOR NEW COURSE NUMBER ASSIGNMENT):**
   Department of Mathematics and Computer Science,
   CS 3500 - Discrete Structures

2. **DOES THIS COURSE MEET A GENERAL EDUCATION/CUNY CORE CATEGORY?**
   - ☐ **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:**

   Course CS 3500 (Discrete Structures) is equivalent to:
   LaGuardia Community College – MAC 281 - Discrete Structures (3 credits)
   York College – MATH 141 Discrete Mathematics (3 credits)
   Queens College – CSCI 220 Discrete Structures (3 credits)
   NYC College of Technology – MAT 2440 - Discrete Structures and Algorithms I (3 credits)
   Brooklyn College – CISC 2210 Introduction to Discrete Structures (3 credits)

4. **BULLETIN DESCRIPTION OF COURSE:**
   This course is designed to equip the computer scientist with various mathematical tools. Topics include logic and proofs, sets, functions, sequences and summations, zero-one matrices, mathematical induction, counting, discrete probability, relations, equivalence relations and partial orderings, graphs, and boolean algebra.

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:**____

7. **COURSE PREREQUISITES AND COREQUISITES (IF NONE PLEASE INDICATE FOR EACH)**
   A. PREREQUISITE(S): MAT 1500
   B. COREQUISITE(S): N/A
   C. PRE/COREQUISITE(S): N/A

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)
   B. PROJECTED ENROLLMENT: 28-56
   C. SUGGESTED CLASS LIMITS : 28
   D. FREQUENCY COURSE IS LIKELY TO BE OFFERED: Class is offered every Fall and Spring semesters
   E. ROLE OF COURSE IN DEPARTMENT'S CURRICULUM AND COLLEGE'S MISSION:
   Key in adding value to Kingsborough Community College's A.S. Computer Science and A.S. Mathematics degrees; introduces vital topics in logic and proofs, sets, functions, sequences and summations, zero-one matrices, mathematical induction, counting, discrete probability, relations, equivalence relations and partial orderings, graphs, and boolean algebra.

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):**

Discrete Mathematics and its Applications (Seventh Edition), by Kenneth Rosen, McGraw-Hill, ISBN 978-0-07-338309-5

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.

Required for the A.S. Mathematics, and A.S. Computer Science degrees.

13. IF OPEN ONLY TO SELECTED STUDENTS SPECIFY POPULATION:

Open to students who satisfy the prerequisite (See Question #7A above)

14. EXPLAIN WHAT STUDENTS WILL KNOW AND BE ABLE TO DO UPON COMPLETION OF COURSE:

Students will understand how to solve problems involving:

- Propositional logic, predicates and quantifiers, and rules of inference
- Proof methods - direct, contraposition, contradiction, induction, etc.
- Basic set theory
- Sequences and sums
- Basic number theory - divisibility, modular arithmetic, primes, GCD and LCM
- Techniques in counting - permutations and combinations, the pigeonhole principle, the Binomial Theorem
- Introduction to discrete probability
- Relations, representing relations via graphs and matrices, equivalence relations, and partial orderings
- Graph theory - representing graphs, graph isomorphisms, connectivity, Euler and Hamilton paths and circuits, shortest-path problems
- Boolean algebra and boolean functions

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.:

This a course structured around a combination of class lectures (2 hours per week) and lab

learning (2 hours per week). Students are expected to attend all lectures, do homework assignments regularly, complete quizzes, and participate in group work.

16. ASSIGNMENTS TO STUDENTS:

In-class assignments are taken from the textbook, and are chosen at the discretion of the instructor. Lab assignments consist of independent study and quizzes, along with group work participation.

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.

- Four exams are to be administered in class to weigh approximately 70% in total at the discretion of the instructor.
- A final exam will be given at the end of the semester. This is worth 30% of the grade at the discretion of the instructor.
- Lab work, including out of class quizzes and participation on the discussions board, may be considered.

18. TOPICAL COURSE OUTLINE FOR THE 12 WEEK SEMESTER (WHICH SHOULD BE SPECIFIC REGARDING TOPICS COVERED, LEARNING ACTIVITIES, AND ASSIGNMENTS):

2	Propositional Logic	1.1	Page 12 1, 3, 9, 11, 15 (omit Problem E), 27, 31, 35, 37, 43 Lab
1.5	Propositional Equivalencies	1.3	Page 34 5, 9, 11 (use Tables 6-8), 17, 23, 29, 31 Lab
1.5	Predicates and Quantifiers	1.4	Page 53 1, 5 - 11 odd, 15, 19, 25, 39 Lab
1	Nested Quantifiers	1.5	Page 64 1, 2, 3, 7, 9, 25, 27
1	Rules of Inference	1.6	Lab
1.5	Introduction to Proofs	1.7	Page 91 1, 5 ,7, 9, 13, 15, 17, 27, 31, 33
1	Sets	2.1	Page 125 1, 7, 11, 27, 33, 41
1	Set Operations	2.2	Page 136 3, 7, 13, 19, 25, 31, 47
2	Functions	2.3	Lab
2	Sequences and Series	2.4	Page 329 3 - 9 odd, 13, 21, 31, 35, 37, 57 Lab
1	Matrices	2.6	Page 183 1 - 3 all, 15, 26 - 29 all
2	Divisibility and Modular Arithmetic	4.1	Page 244 7, 9, 21 - 29 odd, 35, 3
1	Primes and Greatest Common Divisors	4.3	Page 272 3, 11, 15, 19, 25, 27, 33
2	Mathematical Induction	5.1	Page 329 3 - 9 odd, 13, 21, 31, 35, 37, 57 Lab
1	Basics of Counting	6.1	Lab

1	Pigeonhole Principle	6.2	Lab
2	Permutations and Combinations	6.3	Lab
1	Binomial Coefficients and Identities	6.4	Lab
1	Introduction to Discrete Probability	7.1	Lab
1.5	Relations and their Properties	9.1	Page 581 1, 3, 7, 11, 27, 35, 37, 49 Lab
1.5	Representing Relations	9.3	Page 596 1, 3, 7, 9, 14, 15, 19, 23, 25, 27 Lab
1.5	Equivalence Relations	9.5	Page 615 1, 3, 9, 15, 17, 21, 23, 35, 37, 41, 47, 49 Lab
1.5	Partial Orderings	9.6	Page 630 1, 5 - 9 odd, 14, 21 - 25 odd Lab
0.5	Graphs and Graph Models	10.1	Page 650 3 - 9 odd
1.5	Graph Terminology and Special Types of Graphs	10.2	Page 665 1 - 5 odd Lab
1.5	Representing Graphs and Graph Isomorphisms	10.3	Page 665 7, 9, 19 - 25 odd, 35, 53 (a,b,c) Lab
1.5	Connectivity	10.4	Page 689 1 - 5 odd, 11, 19 - 25 odd, 29 - 33 odd, 39 Lab
1	Euler and Hamilton Paths	10.5	Page 703 1 - 7 odd, 10, 19 - 23 odd, 31 - 39 odd, 47
1	Shortest Path Problems	10.6	Page 716 3, 6 - 8 all, 11, 17, 25, 27
1	Boolean Functions	12.1	Lab)
1	Representing Boolean Functions	12.2	Lab
6.5	Class Examinations and Reviews		Lab

19. SELECTED BIBLIOGRAPHY AND SOURCE MATERIALS:

1. Discrete Mathematics with Applications (Fourth Edition), by S. S. Epp, Brooks/Cole Cengage Learning, ISBN-13: 978-0495391326
2. Introductory Discrete Mathematics by V. K. Balakrishnan, Dover Publications Inc. (New York), ISBN-13: 978-0-486-14038-4
3. Discrete Mathematics (First Edition) by G. Chartrand and P. Zhang, Waveland Press Inc., ISBN-13: 978-1577667308
4. Discrete Mathematics (Eighth Edition) by R. Johnsonbaugh, Pearson, ISBN-13: 978-0321964687
5. Discrete Mathematics (Third Edition) by S. Lipschutz and M. Lipson, Schaum's Outline, ISBN-13: 978-0071615860
6. Discrete Mathematics for Computer Science by D. Liben-Nowell, Wiley, ISBN: 978-1-118-06553-2
7. Essentials of Discrete Mathematics (Third Edition) by D. Hunter, John and Barlett Learning, ISBN-13: 978-1284056242

8. Discrete Mathematics with Graph Theory (Classic Version) (Third Edition) by E. Goodaire and M. Parmenter, Pearson Modern Classics for Advanced Mathematics Series, ISBN-13: 978-0134689555
9. Mathematics: A Discrete Introduction (Third Edition) by E. Scheinerman, Brooks/Cole Cengage Learning, ISBN-13: 978-0840048421
10. Discrete Mathematics: Mathematical Reasoning and Proof with Puzzles, Patterns, and Games (First Edition) by D. E. Ensley and J. W. Crawley, Wiley, ISBN-13: 978-0-471-47602-3
11. Discrete Structures by H. Fell and J. A. Aslam, Cognella Academic Publishing, ISBN-13: 978-1634876469
12. Discrete Structures, Logic, and Computability by J. L. Hein, Jones and Barlett Learning, ISBN-13: 978-1284070408
13. Fundamentals of Discrete Structures (Second Edition) by G. M. Weiss, D. M. Lyons, C. Papadakis-Kanaris, and A. G. Werschulz, Pearson Learning Solutions, ISBN-13: 978-1256389217
14. Discrete Mathematical Structures (Sixth Edition) by B. Kolman, Prentice Hall, ISBN-13: 978-8120336896

Revised/Jan.2019/SM