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: Calculus III (MAT 2100)

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: 1/16/19 **Signature, Department Chairperson:** I am aware of this submission

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

I have reviewed the attached material/proposal

Signature, Department Chairperson: TP Yousa 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
   MAT 2100 - Calculus III

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

   ___4__ Credits ___4___ Hours (include break-down of lecture, lab, or gym)
   4 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 Calculus III (MAT 2100)

The Department of Mathematics & Computer Science is proposing a change in number of Course Credits for Calculus III (MAT 2100).

FROM:

4 credits, 4 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 Math & Computer Science

1. **Department, Course Number and Title**
   Department of Mathematics and Computer Science, MAT 21, Calculus3

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

3. **Demonstration of Course Transferability**
   Course equivalencies for Kingsborough' s MAT 21 at Baruch College, Brooklyn College, City College, Queens College, and Staten Island College are as follows:
   Baruch College: MTH 3020, 4 credits;
   Brooklyn College: MAT 5.3, 4 credits;
   City College: MAT 20300, 4 credits;.
   Queens College: MAT 201 4 credits;
   Staten Island College: MTH 233, 3 credits, with the remaining credit transferred as an elective.

4. Bulletin Description
   Continuation of MAT 16 with emphasis on partial differentiation, polar coordinates, multiple integration, solid geometry, vectors, parametric representation of curves and functions, and infinite series.

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

6. Number of Credits
   Four credits

7. Prerequisites
   MAT 16 with "C" grade or better.

8. Justification for Course
   The objective of this course is to deepen and widen the student's understanding of the fundamental ideas of calculus. Knowledge of parametric equations, polar coordinate system, vectors, three-dimensional analytic geometry, functions of several variables, and series is necessary for students majoring in mathematics, science, engineering, and economics.

9. Course Withdrawals

None

10. CPI Requirements

Meets CPI requirements for a course in mathematics or as an elective.

11. Field Work, Internship, or Independent Study

N/A

12. Textbook

Larson, Hostetler, and Edwards. Calculus, Sixth Edition. Houghton Mifflin Co., Boston . ISBN 0-395-88902-2.

13. Required Course for Majors.

This is a required course for Mathematics, Physics, Engineering and Computer Science majors..

14. Course is open to:

This course is open to any who satisfies the prerequisites..

15. What Students Will Know and be Able to Do Upon Completion of Course

Students will know:

- how to investigate properties of plane and space curves using parametric equations, vectors and vector-valued functions;
- polar coordinates;
- how to investigate properties of functions of several variables using partial derivatives, directional derivatives, the total differential, and the gradient;
- double integrals; and
- infinite series and their properties.

Students will be ready:

- to study ordinary and partial differential equations;
- to study mechanics, theory of electromagnetic field, quantum theory, and other parts of modern calculus-based physics;
- to study engineering sciences.

16. Method of Teaching

Classroom lectures

17. Assignments to Students

The assignments will be taken primarily from the text.

18. Method of Evaluation

Class examinations and a final examination.

19. Topical Course Outline:

WEEK	TOPIC	PAGES
1	Polar coordinates. Polar- rectangular transformation.	694-700
	Graphs of polar equations. The equations of conic sections.	701-707, 716-723
2	Calculation of area using polar coordinates.	708-716
	Parametric equations and curves on plane.	679-686
	Differentiation in parametric form.	687-690
3	Integration. Arc length and areas in parametric form	690-694
	Two-dimensional vectors. The dot product and its uses.	727-745
4	Vector- valued functions.	746-757
	Review	
	Class exam	
	Solid analytic geometry. Three-dimensional vectors. The dot-product.	785-794
5,6	The cross product and its properties.	795-802
	Planes and lines in space.	803-812
	Surfaces in space. Surfaces of the second order	812-822
	Space curves	822-830
	Functions of several variables. Graphs. Level curves. Limits and continuity.	841-862
7	Partial derivatives, differentials, chain rules, directional derivatives and gradient, and extrema of functions of several variables.	863-905
a.	Iterated integrals.	931-938
	Double integrals and volume.	938-954
	Review.	

8	Class exam.	

WEEK	TOPIC	PAGES
10, 11	Infinite sequences. Convergence and divergence	559-572
	Infinite series. Convergence. Telescoping series. Geometric progression. The n^{th} term test. The integral test and p-series	581-586
	The direct comparison and limit comparison tests. The ratio and root tests.	586-589
	Alternating series. Absolute and conditional convergence.	599-605
12	Power series. The radius of convergence. Maclauren and Taylor series.	605-642
	Optional topics (Complex numbers and Euler's formulas for e^{ix}, cos x, sin x; cylindrical and spherical coordinates or other topics choosen by the instructor).	
	Review for final exam.	

20. Selected Bibliography

1. Gerald B. Folland. Advanced Calculus. 1st ed. Prentice Hall, 2002. ISBN 0-13-065265-2
2. C. Henry Edwards, David E. Penney Multivariable Calculus. 6th ed. Prentice Hall, 2002. ISBN 0-13-033967-9
3 Harold M. Edwards. Advanced Calculus: A Differential Form Approach. 4th ed. Birkhäuser, 1996. ISBN 0-8176-3707-9

KINGSBOROUGH COMMUNITY COLLEGE
THE CITY UNIVERSITY OF NEW YORK

Proposed

COURSE SYLLABUS: MAT 2100

1. **DEPARTMENT, COURSE NUMBER, AND TITLE (SPEAK TO ACADEMIC SCHEDULING FOR NEW COURSE NUMBER ASSIGNMENT):**
   Department of Mathematics and Computer Science,
   MAT 2100 - Calculus III

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: THIS COURSE TRANSFERS TO BARUCH COLLEGE:**
   Brooklyn College: MATH 2201 Multivariable Calculus, 4 credits
   College of Staten Island: MTH 233 Analytic Geometry and Calculus III, 3 credits
   John Jay College of Criminal Justice: MAT 243 Calculus III, 3 credits

4. **BULLETIN DESCRIPTION OF COURSE:** Continuation of MAT 16 with emphasis on partial differentiation, polar coordinates, multiple integration, solid geometry, vectors, parametric representation of curves and functions, and infinite series.

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 ☐3 hours lecture, 1 hour lab/field ☒ 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 1600 with a grade of "C" grade or better
   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: MAT 2100 will have an enrollment of approximately 70
   C. SUGGESTED CLASS LIMITS: 30
   D. FREQUENCY COURSE IS LIKELY TO BE OFFERED: Fall and Spring semesters.
   E. ROLE OF COURSE IN DEPARTMENT'S CURRICULUM AND COLLEGE'S MISSION
   This course has been offered during the Fall and Spring semesters (two sections). The suggested class limit is 30 students per section. The objective of this course is to deepen and widen the student's understanding of the fundamental ideas of calculus. Knowledge of parametric equations, polar coordinate system, vectors, three-dimensional analytic geometry, functions of several variables, and series is necessary for students majoring in mathematics, science, engineering, and economics.

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):**

    Larson, Hostetler, and Edwards. Calculus, Sixth Edition. Houghton Mifflin Co., Boston, New York. ISBN 0-395-88902-2

12. **REQUIRED COURSE FOR MAJOR OR AREA OF CONCENTRATION?**
    This is a required course for Mathematics, Physics, Computer Science, and Engineering majors

13. **IF OPEN ONLY TO SELECTED STUDENTS SPECIFY POPULATION:** N/A

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

Students will know:

a. How to investigate properties of plane and space curves using parametric equations, vectors and vector-valued functions; polar coordinates;
b. How to investigate properties of functions of several variables using partial derivatives, directional derivatives, the total differential, and the gradient;
c. How to do double integrals;
d. Infinite series and their properties.

Students will be able to study ordinary and partial differential equations with applications in mechanics, theory of electromagnetic field, quantum theory, and other parts of modern calculus-based physics and the engineering sciences.

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.:

Classroom lectures and labs. In the labs students will practice performing relevant skills described in question #14.

16. **ASSIGNMENTS TO STUDENTS:** Weekly homework. The homework will call for answers to specific questions relevant to the lectures and the recitation.

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.

Classroom tests, quizzes, homework, projects, class participation, and a comprehensive final examination. Final exam -30% , 3 exams -45%, quizzes, homework and projects- 25%

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

Topical Course Outline

A lesson number followed by an L indicates a lab

		Section(s)
Week 1		
1. Parametric Equations and Plane Curves		12.1
2. Parametric Equations and Calculus	L	12.2
3. Polar Coordinates and Polar Graphs		12.3, 12.4
Week 2		
4. Area and Arc Length in Polar Coordinates		12.5
5. Vectors in the Plane	L	13.1
6. The Dot Product of Two Vectors	L	13.2
7. Vector – Valued Functions	L	13.3
Week 3		
8. Space Coordinates and Vectors in Space		14.1
9. The Cross Product of Two Vectors in Space	L	14.2
10. Lines and Planes in Space		L14.3
Week 4		
11. Surfaces in Space		14.4
12. Review	L	

Examination #1		
13. Introduction to Functions of Several Variables		15.1
Week 5		
14. Limits and Continuity		15.2
15. Partial Derivatives	L	15.3
Week 6		
16. Differential	L	15.4
17. Chain Rules for Functions of Several Variables		15.5
Week 7		
18. Directional Derivatives and Gradients		15.6
19. Tangent Planes and Normal lines		15.7
20. Extrema of Functions of Two Variables	L	15.8
Week 8		
21. Iterated Integrals and Area in the Plane		16.1
22. Double Integrals and Volume		16.2
Week 9		
23. Change of Variables: Polar Coordinates		16.3
24. Review	L	
Examination #2		
25. Sequences	L	10.1
Week 10		
26. Series and Convergence		10.2
27. The Integral Test and p-Series	L	10.3
28. Comparisons of series	L	10.4
Week 11		
29. Alternating Series	L	10.5
30. The Ratio and Root Tests		10.6
31. Power Series	L	10.8
32. Representations of Functions by Power Series	L	10.9
Week 12		
33. Taylor and Maclaurin Series		10.10, 10.7
34. Review	L	
Examination #3		

19. SELECTED BIBLIOGRAPHY AND SOURCE MATERIALS:

1. G. Arfken, *Mathematical Methods for Physicists,* Academic Press, Inc., Orlando, 1985

2. M. L. Boas, *Mathematical Methods in the Physical Sciences*, third ed., John Wiley & Sons Inc., New York, 2006

3. W. E. Boyce and R. C. DiPrima, *Elementary Differential Equations and Boundary Value Problems*, 7 th ed. John Wiley & Sons, Inc. New York, 2001

4. E.O. Brigham, *The Fast Fourier Transform*, Prentice -Hall, Inc. Engelwood Cliffs, N. J. 1974

5. M. J. Crowe, *A History of Vector Analysis,* Dover Publ., New York, 1985

6. N. Curle and H. Davfies, *Modern Fluid Dynamics*, **vol. 1,** M Van Nostrand,

London, 1968

7. K. R. Davidson A. P. Dansig, *Real Analysis with Real Applications,* Pretnice-Hall, Inc. Engelwood Cliffs, N. J. 2002

8. F. Diacu, *An Introduction to Differential Equations,* W. H. Freeman, New York, 2000

9. G. B. Folland, *Fourier Analyis and its Applications*, Wadsworth & Brooks/Cole, Pacific Grove, CA., 1992

10. H. Goldstein, *Classical Mechanics,* second ed., Addison Wesley, Reading MA, 1980

11. M. W. Hirsch, *Differential Equations, Dynamical Systems, and Linear Algebra,* Academic Press, New York, 1974

12. J. P. Keener, *Principles of Applied Mathematics. Transformation and Approximation*, Addison-Wesley Publ. Co., New York, 1988

13. A. M. Krall, *Applied Analysis,* D. Reidel Publ. Co. Boston, 1986

14. P. E. Lewis and J. W. Ward, *Vector Analysis for Engineers and Scientists*, Addison-Wesley Publ. Co. New York, 1989

15. J. Lighthill, *An Informal Introduction to Theoretical Fluid Mechanics*, Oxford University Press, Oxford, 1986

16. J. E. Marsden and A. J. Tromba, *Vector Calculus*, W. H. Freeman and Co. , New York, 1988

17. P. C. Mathews, *Vector Calculus*, Springer-Verlag, London, 1998

18. F. W. Olver, *Asymptotics and Special Functions*, Academic Press, New York, 1974

19. M Rahman and I. Mulolani, *Applied Vector Analysis* CRC Press Taylor & Francis Group, New York 2008

20. M. Reed and B. Simon, *Methods of Modern Mathematical Physics,* Academic Press, New York, 1972

21. K. F. Riley, M. P. Hobson, and S. J. Bence, *Mathematical Methods for Physics and Engineering*, Cambridge University Press, U. K. , 1997

22. M. Schwartz, S. Green, and W. A. Rutledge, *Vector Analysis with Applications to Geometry and Physics,* Harper & Brothers, New York, 1960

23. G. Strang *Introduction to Applied Mathematics,* Wellesley-Cambridge Press, MA 1986

24. C. R. Wylie, *Advanced Engineering Mathematics,* McGraw-Hill Book Co., New York, 1975

25. D. G. Zill and M. R. Cullen, *Advanced Engineering Mathematics,* PWS-Kent Publ. Co. , Boston, 1992

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