KINGSBOROUGH COMMUNITY COLLEGE
The City University of New York

CURRICULUM DATA TRANSMITTAL SHEET

DEPARTMENT Mathematics & Computer Science **DATE** February 2, 2015

Title of Course or Degree Change: MAT 76: Applications of Linear Algebra & Vector Analysis

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 02/02/2015 **Signature, Committee Chairperson:** [signature]

Signature, Department Chair: [signature]

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: This is an elective course for mathematics majors, and will serve to satisfy a major requirement in the category "choose two of the following" in the curricular specifications AS degree in Mathematics.

The addition of MAT 71 to the current list will broaden students' choices and will provide excellent preparation for continued study of the subject matter in a baccalaureate program.

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COURSE SYLLABUS

1. Department, Course number, Course Title : Department of Mathematics and Computer Science, **Mat 71** , Applications of Linear Algebra & Vector Analysis

2. Does this course meet a general education/CUNY core category? No

3. Transferability of this course? This course will help to prepare students for the introductory Biomedical Engineering Course at Stony Brook University (SUNY).
MAT 71 is equivalent to:
MTH 320 (Vector Analysis) at Medgar Evers
MAT 39200 (Linear Algebra and Vector Analysis for Engineers) at City College
MTH 44 (Vector Analysis) at Bronx Community College
MATH 25500 (Vector Analysis) at Hunter College
MAT 212 (Linear Algebra & Vector Analysis for Engineers) at LaGuardia Community College

4. Bulletin Description of Course: This course presents the theory of linear systems and vector analysis and their applications through two mutually reinforcing components. The first is modeling, the derivation of governing equations from physical principles. The second is solution techniques and algorithms for solving such equations. The course will illustrate and explain basic techniques – including dynamical systems modeled by linear differential equations, image processing, boundary value problems, and solution techniques such as Fourier Transform and Laplace Transform – that are used in *real-world* problems of the type encountered in applied mathematics, engineering, and science. The course will also explain how these mathematical techniques are derived from basic mathematical principles.

5. Number of weekly class hours: 4

6. Number of Credits: 4

7. Course pre or co-requisites: MAT 16 (Calculus II) and MAT 56 (Linear Algebra),

8. Brief rationale to justify proposed course: Linear Algebra and Vector Analysis play a central role in applied mathematics, as well as in science, engineering, computer science, probability and statistics, economics, numerical analysis, mathematical biology, and many other disciplines. A background in both calculus and linear algebra as applied to real-world scenarios is an essential tool for all these areas of study.

9. List of courses to be withdrawn when course is adopted: none

10. Field work, Internship, or Independent Study: N/A

11. Proposed text books:
a) Applied Linear Algebra, by Peter J. Olver & Chehrzad Shakiban. Published by Prentice Hall,

Upper Saddle River, N. J. 2006 ISBN: 0-13-147382-4
b) Calculus, by Roland E. Larson, Robert P.Hostetler, and Bruce H. Edwards. Published by Houghton Mifflin Co. , New York1998 ISBN:0-395-88902-2
c) In addition, lecture notes will be available to students on the website:
http://www.math.umn.edu/~olver/appl.html

12. Required course for majors or area of concentration:
This course will fulfill one elective requirement for math majors

13.. If open only to selected students:
Open to all students who satisfy the co-requisite requirements

14.Course Goals:

I Linear Algebra

The student will learn the standard techniques in solving systems of linear equations arising in applied mathematics.

II Vector Analysis

The student will be introduced to the basic concepts of vector analysis and their physical interpretations. The student will also learn how these concepts are applied to such problems that arise in engineering and physical science as fluid mechanics and the theory of electromagnetism, with an emphasis on Maxwell's equations.

15. Method of Teaching: Classroom lecture presentation of the application of the theory of linear algebra and vector analysis in the context applied mathematics, science, and engineering.

16. Assignments to students: Daily homework exercises and regular assigned projects. The homework exercises will call for finding solutions to specific problems related to the lectures. The projects will involve applications of the analyses and techniques discussed in the lectures.

17. Describe method of evaluating learning specified in 15: Classroom tests, quizzes, homework, projects, and a comprehensive final examination. Final Exam will weigh a minimum of 40%, with the remaining 60% distributed between classroom tests, quizzes and projects.

18. Topical Course Outline:			**Lesson**
Topic		Book/Section/pages	
Calculus		**Larson, et. al.**	
Differential Equations	Ch. 18	18.1: pp. 1076-1081	1
Applied Linear Algebra		**Olver and Shakiban**	
Vector Spaces and Bases		Ch. 2	
Real Vector Spaces		2.1: pp.78-82	2

Subspaces	2.2: pp.83-88	3
Span & Linear Independence	2.3: pp. 89-99	4
Bases & Dimension	2.4 pp.100-106	5
Fundamental Matrix Subspace	2.5 pp.107-121	6
<u>Inner Products & Norms</u>	<u>Ch. 3</u>	
Inner Products	3.1: pp. 131-136	7
Inequalities	3.2: pp. 137-143	8
Positive Definite Matrices	3.4: pp. 153-162	9
Complex Vector Spaces	3.6: pp. 169-179	10, 11
<u>Orthogonality</u>	<u>Ch. 5</u>	
Orthogonal Bases	5.1: pp. 217-226	12
Gram-Shmidt Process	5.2: pp. 227-234	13
Orthogonal Projections	5.5: pp. 256-259	14
Exam I		15
<u>Eigenvalues</u>	<u>Ch. 8</u>	
Eigenvalues and Eigenvectors	8.2: pp. 395-405	16, 17
Diagonalization	8.3: pp. 406-412	18
Spectral Theorem	8.4: pp. 413-421	19
<u>Linear Dynamical Systems</u>	<u>Ch. 8, 9</u>	
Simple Dynamical Systems	8.1: pp. 391-394	20
Basic Solution Techniques	9.1: pp. 445-458	21, 22
Stability of Linear Systems	9.2: pp. 459-464	23
Two-Dimensional Systems	9.3: pp. 465-471	24
Midterm (ExamII)		25
<u>Vector Analysis</u>	**<u>Larson, et. al.</u>**	

Topic	Reading	Lecture
Volume Integrals	Ch. 16	
Triple Integrals & Applications	16.6: pp. 966-975	26
Line & Surface Integrals	Ch.17	
Gradient, Divergence, Curl of a Vector Field, & Laplacian Operator	17.1: pp. 1000-10011	27, 28
Line Integrals & Vector Functions	17.2: pp. 1012-1023	29,30
Work by a Vector Field, Line Integrals Independent of Path, Conservative Vector Fields	17.3: pp. 1024-1032	31, 32
Surface Integrals	17.6: pp. 1052-1060	33, 34
Integral Theorems	Ch. 17	
Greens Theorem	17.4: pp. 1033-1041	35-37
Divergence Theorem	17.7: pp. 1061-1067	38-40
Stokes Theorem	17.8: pp. 1068-1072	41-43
Applications		
Continuity Equation of Fluid Flow		
Maxwell's Equations		44
Exam III		45
OptionalTopics		
Fourier Series and Transforms		
Lecture Notes & http://www.math.umn.edu/~olver/appl.html		
Simple Harmonic Motion	Lecture Notes & Web site	46
Larson, et. al		
Discrete Fourier Series	5.7: pp. 277-292	47
Review		48
Final Exam		

19. References

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

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

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