CURRICULUM PROPOSAL COVER SHEET
University-Wide Undergraduate Curriculum Committee

LSC Use Only	UWUCC Use Only
Number _____	Number _____
Action _____	Action _____
Date _____	Date _____

I. TITLE/AUTHOR OF CHANGE
COURSE/PROGRAM TITLE MA 171 - Introduction to Linear Algebra
DEPARTMENT MATHEMATICS
CONTACT PERSON JOHN BROUGHTON

II. THIS COURSE IS BEING PROPOSED FOR:
_____ Course Approval Only
_____ Course Approval and Liberal Studies Approval
✓ Liberal Studies Approval only (course previously has been approved by the University Senate)

III. APPROVALS

Ronald L McBride
Department Curriculum Committee

J Roy Broughton
Department Chairperson

College Curriculum Committee

College Dean*

Director of Liberal Studies
(where applicable)

Provost
(where applicable)

*College Dean must consult with Provost before approving curriculum changes. Approval by College Dean indicates that the proposed change is consistent with long range planning documents, that all requests for resources made as part of the proposal can be met, and that the proposal has the support of the university administration.

IV. TIMETABLE

Date Submitted to LSC _____ to UWUCC _____

Semester/Year to be implemented _____

Date to be published in Catalog _____

Revised 5/88

[Attach remaining parts of proposal to this form.]

INDIANA UNIVERSITY OF PENNSYLVANIA
MATHEMATICS DEPARTMENT

COURSE NUMBER: MA 171

COURSE TITLE: Introduction to Linear Algebra

CREDITS: 3 Semester Hours

CATALOG DESCRIPTION:

Introduction to vector spaces, linear transformations, determinants, and matrix algebra. Topics are presented in a direct and intuitive approach.

PRESENT TEXT: Introduction to Linear Algebra with Applications
Fourth Edition
by Bernard Kolman

COURSE OUTLINE:

I. Linear Equations and Matrices
   A. Linear Systems
   B. Matrices
   C. Properties of Matrix Operations
   D. Solutions of Equations
   E. The Inverse of a Matrix

II. Determinants
   A. Definitions and Properties
   B. Cofactor Expansion and Applications
   C. Determinants from a Computational Point of View

III. Vectors and Vector Spaces
   A. Vectors in the Plane
   B. n-Vectors
   C. Cross Product in R^3
   D. Vector Spaces and Subspaces
   E. Linear Independence
   F. Basis and Dimension
   G. The Rank of a Matrix and Applications
   H. Orthonormal Bases in Real n-Space

IV. Linear Transformations and Matrices
   A. Definition and Examples
   B. The Kernel and Range of a Linear Transformation
   C. The Matrix of a Linear Transformation

V. Eigenvalues and Eigenvectors
   A. Diagonalization
   B. Diagonalization of Symmetrix Matrices

Assignments - Ma 171
R. McBride, Fall 87

NOTE: This was the assignment list for Fall, 87 when the Third Edition was in use. There may be changes in the Fourth Edition.

Page 9 - 1.1 - 1, 2, 3, 7, 11, 13, 15, 17. Use the three types of steps discussed in class.

Page 21 - 1.2 - 1, 2a, 3, 5, 8-10, odd 11-21, T3, read and look at examples of T4 and T6.

Page 32 - 1.3 - Odd 1-13, Hand in T1, work but do not hand in T2, T3, T9.

Page 47 - 1.4 - Odd 1-13, 15, 19, 21, T2, (think about T4), T5, T6, T8

Page 62 - 1.5 - 1,3,4,(5 find and check), 7c, 9(a,c), 11, T1, Prove: If a homogeneous system AX=0 has a nontrivial solution then the system has infinitely many different solutions. Do this by proving that if S is a nontrivial solution then for any real number r then rS is also a solution.

Page 64 - Chapter Review - 1-3, 4a, 5-7, 9, 12, 13, 15, 17.

Page 66 - Chapter Test - All

Page 76 - 2.1 - 1-5, 8-14, 15, 17, 19a, 20, 21, T3, T4, T5, T6, T9.

Page 89 - 2.2 - Odd 3-23, T5.

Page 94 - Chapter Review - Odd 1-13.

Page 95 - Chapter Test - All

Page 109 - 3.1 - Write all problems and answers in vector notation. 3, 5, 9, 13, 17, 19-22, T4, T5,T6, T8, (think through T7)

Page 123 - 3.2 - Use all vector notation. 1, 5, 7, 11, 15-17, 19-21, T2, T4, T5, T8, T9.

Page 130 - 3.3 - Omit this section.

Page 139 - 3.4 - (Think about #1), 3, 5, 7-12, 14-17, 19, 21-13, T2, T4, T5, T8, T9.

Page 149 - 3.5 - 1, 3-5, 7, 9, 11, 13, 15, T1, T2, T3, T4, T5, (think about T6 and T7), T8, T9.

Page 159 - 3.6 - 1, 3ab, 5cd, 6, 8, 9, 11, 13, 15, 17, 19, 21, T8, T10, T11.

Page 168 - 3.7 - Odd 1-17, 18, 19, 21, 22.

Page 179 - 3.8 - 1, 3, 5, 7, 11, 12, 13.

Page 181 - Chapter Review - All

Page 182 - Chapter Test - All except 6b.

Page 190 - Section 4.1 - Problems: 1,3,5-8,T_2,T_3,T_4.

Page 200 - Section 4.2 - Problems: 1,3,4,5,7,9,11,15.

Page 212 - Section 4.3 - Problems: odd 1-9.

Page 215 - Review 4 - Problems: 1-9.

Page 216 - Chapter Test - All

Page 234 - Section 5.1 - Problems: 1,5,7,13,15,17,19,23,T_1,T_3.

Page 245 - Section 5.2 - Problems: 1,5,7,9,

LIBERAL STUDIES COURSE APPROVAL FORM

About this form: Use this form only if you wish to have a course included for Liberal Studies credit. The form is intended to assist you in developing your course to meet the university's Criteria for Liberal Studies, and to arrange your proposal in a standard order for consideration by the LSC and the UWUCC. If you have questions, contact the Liberal Studies Office, 353 Sutton Hall; telephone, 357-5715.

Do not use this form for technical, professional, or pre-professional courses or for remedial courses, none of which is eligible for Liberal Studies. **Do not** use this form for sections of the synthesis course or for writing-intensive sections; different forms will be available for those.

PART I. BASIC INFORMATION

A. For which category(ies) are you proposing the course? Check all that apply.

LEARNING SKILLS

_____ First English Composition Course
_____ Second English Composition Course
__✓__ Mathematics

KNOWLEDGE AREAS

_____ Humanities: History
_____ Humanities: Philosophy/Religious Studies
_____ Humanities: Literature
_____ Fine Arts
_____ Natural Sciences: Laboratory Course
__✓__ Natural Sciences: Non-laboratory Course
_____ Social Sciences
_____ Health and Wellness
_____ Non-Western Cultures
_____ Liberal Studies Elective

B. Are you requesting regular or provisional approval for this course?

_____ **Regular** _____ **Provisional** (limitations apply, see instructions)

New course

C. During the transition from General Education to Liberal Studies, should this course be listed as an approved substitute for a current General Education course, thus allowing it to meet any remaining General Education needs? ✓ **yes** _____ **no**

If so, which General Education course(s)? _____

PART II. WHICH LIBERAL STUDIES GOALS WILL YOUR COURSE MEET? Check all that apply and attach an explanation.

All Liberal Studies courses must contribute to at least one of these goals; most will meet more than one. As you check them off, please indicate whether you consider them to be primary or secondary goals of the course. [For example, a history course might assume "historical consciousness" and "acquiring a body of knowledge" as its primary goals, but it might also enhance inquiry skills or literacy or library skills.] Keep in mind that no single course is expected to shoulder all by itself the responsibility for meeting these goals; our work is supported and enhanced by that of our colleagues teaching other courses.

	Primary	Secondary
A. Intellectual Skills and Modes of Thinking:		
1. Inquiry, abstract logical thinking, critical analysis, synthesis, decision making, and other aspects of the critical process.	✓	
2. Literacy--writing, reading, speaking, listening		✓
3. Understanding numerical data	✓	
4. Historical consciousness		✓
5. Scientific inquiry	✓	
6. Values (ethical mode of thinking or application of ethical perception)		✓
7. Aesthetic mode of thinking	✓	
B. Acquiring a Body of Knowledge or Understanding Essential to an Educated Person	✓	
C. Understanding the Physical Nature of Human Beings		
D. Certain Collateral Skills:		
1. Use of the library		✓
2. Use of computing technology		✓

PART III. DOES YOUR COURSE MEET THE GENERAL CRITERIA FOR LIBERAL STUDIES? Please attach answers to these questions.

A. If this is a multiple-section, multiple-instructor course, there should be a basic equivalency (though not necessarily uniformity) among the sections in such things as objectives, content, assignments, and evaluation. Note: this should not be interpreted to mean that all professors must make the same assignments or teach the same way; departments are encouraged to develop their courses to allow the flexibility which contributes to imaginative, committed teaching and capitalizes on the streangths of individual faculty.

What are the strategies that your department will use to assure that basic equivalency exists? Examples might be the establishment of departmental guidelines, assignment of repsonsibility to a coordinating committee, exchange and discussion of individual instructor syllabi, periodic meetings among instructors, etc.

B. Liberal Studies courses must include the perspectives and contributions of ethnic and racial minorities and of women wherever appropriate to the subject matter. **If your attached syllabus does not make explicit that the course meets this criterion, please append an explanation of how it will.**

C. Liberal Studies courses must require the reading and use by students of at least one, but preferably more, substantial works of fiction or nonfiction (as distinguished from textbooks, anthologies, workbooks, or manuals). **Your attached syllabus must make explicit that the course meets this criterion.**

[The only exception is for courses whose primary purpose is the development of higher level quantitative skills; such courses are encouraged to include such reading, but are not expected to do so at the expense of other course objectives. **If you are exercising this exception, please justify here.**]

D. If this is an introductory course intended for a general student audience, it should be designed to reflect the reality that it may well be the only formal college instruction these students will have in that discipline, instead of being designed as the first course in a major sequence. That is, it should introduce the discipline to students rather than introduce students into the discipline. **If this is such an introductory course, how is it different from what is provided for beginning majors?**

E. The Liberal Studies Criteria indicate six ways in which all courses should contribute to students' abilities. **To which of the six will your course contribute? Check all that apply and attach an explanation.**

____ 1. Confront the major ethical issues which pertain to the subject matter; realize that although "suspended judgment" is a necessity of intellectual inquiry, one cannot live forever in suspension; and make ethical choices and take responsibility for them.

✓ 2. Define and analyze problems, frame questions, evaluate available solutions, and make choices

____ 3. Communicate knowledge and exchange ideas by various forms of expression, in most cases writing and speaking.

✓ 4. Recognize creativity and engage in creative thinking.

✓ 5. Continue learning even after the completion of their formal education.

✓ 6. Recognize relationships between what is being studied and current issues, thoughts, institutions, and/or events.

PART IV. DOES YOUR COURSE MEET THE CRITERIA FOR THE CURRICULUM CATEGORY IN WHICH IT IS TO BE LISTED?

Each curriculum category has its own set of specific criteria in addition to those generally applicable. The LSC provides copies of these criteria arranged in a convenient, check-list format which you can mark off appropriately and include with your proposal. **The attached syllabus should indicate how your course meets each criterion you check. If it does not do so explicitly, please attach an explanation.**

PART III (MA 171)

A. There will be a common syllabi of topics that should be covered by each of the individual instructors teaching this course. Such common syllabi should include but not be limited to topics which introduce the student to deductive reasoning, develop in the student problem solving skills, and enable the student not only to understand the underlying principles of formulae but also to have the ability to use and interpret numerical data.

B. Whenever appropriate, information will be introduced into the classroom discussion which will reflect the contributions made to mathematics by women and by racial minorities.

C. All students will be required to read a minimum of three major articles from issues of "Scientific American". For each article read, a written report must be submitted by the student for evaluation. The Liberal Arts Curriculum Committee of the Mathematics Department will be responsible for maintaining a current minimum reading list for this course. Instructors will be encouraged to create expanded reading lists of appropriate magazine/journal/etc. articles pertinent to the mathematics material discussed in this course. Additionally, instructors could require the students to report in writing on articles they have discovered through their own reading which pertain to mathematics and/or applications of mathematics.

D. The thrust of MA 171 is to develop in the student, both mathematics and non-mathematics major, an awareness of and an appreciation for the power and usefulness of introductory linear algebra and its important role both in the history of mathematics and in a technological society, In particular, it should prepare the student for the further study of other mathematics courses. A partial list of topics that would be appropriate for this course would include linear equations and matrices; determinants; vector and vector spaces; linear transformations and matrices; and eigenvalues and eigenvectors. These topics would provide the course with a suitable mathematical strata that would improve the mathematical maturity of students to the point where they would be prepared to enroll in other mathematics courses which require calculus as a prerequisite. Additionally, this course would enable the student to develop confidence in handling numerical problems, would present the student with an opportunity to develop an appreciation for mathematics, and would allow the introduction to students of hand held calculators and possibly computers.

E. #2.- The very nature of mathematical study requires that problems be clearly analyzed and defined, that solutions be generated for such problems, and that an interpretation be assigned to each possible solution in order that a correct choice may be made.

#4.- Mathematics is exactly the art of creative thinking. One moves from the collection of data to the definition of the problem to the abstract generalization in which a solution or solutions are constructed to the interpretation of the solution or solutions to the application of the solution(s). This process requires one

to recognize creativity and to engage in creative thinking.

#5.- One is constantly exposed to information which needs the principles of mathematics for proper interpretation. Skills mastered in this course can last one a life time.

#6.- The student of linear algebra will be able to use the concepts learned in this course in the solution construction to problems in many other areas.

CHECK LIST -- MATHEMATICS
(Learning Skills Area)

Mathematics Criteria which the Course must meet:

✓ Introduce students to deductive reasoning

✓ Develop in the student problem solving techniques appropriate for the course.

✓ Enable the student to understand the underlying principles of formulas.

✓ Enable the student to use and interpret numerical information.

Courses appropriate to the Mathematics Learning Skills Area must be either:

✓ **A.** Mathematics courses that develop signficant mathematical skills required by a major discipline.

____ **B.** Mathematics courses designed for Liberal Studies.

Additional criteria which courses in Category B must meet:

____ Develop the student's confidence in handling numerical problems and data.

____ Be sensitive to the diverse background characteristics of the student.

____ Include elements on the history or appreciation of mathematics.

____ Introduce the hand-held calculator or the computer as a tool.