UNIVERSITY COLLEGE OF THE FRASER VALLEY

COURSE INFORMATION

DEPARTMENT: **Mathematics** **DATE:** **July 1994**

Mathematics 438	**Advanced Linear Algebra**	**3**
NAME & NUMBER OF COURSE	**DESCRIPTIVE TITLE**	**UCFV CREDIT**

CATALOGUE DESCRIPTION: **Techniques and applications of linear algebra. Vector spaces; linear functionals; the singular value decomposition; the generalized inverse; canonical forms; the spectral decomposition.**

COURSE PREREQUISITES: **Math 221 and at least two upper-level Math courses.**

COURSE COREQUISITES: **None**

HOURS PER TERM FOR EACH STUDENT	**Lecture**	**52 hrs**	**Student Directed Learning**		**hrs**
	Laboratory	**hrs**	**Other - specify:**		
	Seminar	**hrs**	______________		**hrs**
	Field Experience	**hrs**	**TOTAL**	**52**	**HRS**

☐ **UCFV CREDIT TRANSFER**	**UCFV CREDIT NON-TRANSFER**	**NON-CREDIT**

TRANSFER STATUS **(Equivalent, Unassigned, Other Details)**

UBC credits

SFU credits **Math 438**

UVIC units

Other

Math Curriculum Committee — **COURSE DESIGNER**

J.D. TUNSTALL Ph.D. — **DEAN OF ACADEMIC STUDIES**

OUTLN93/10/DD

Math 438
NAME & NUMBER OF COURSE

COURSES FOR WHICH THIS IS A PREREQUISITE:	RELATED COURSES
None	Math 439

TEXTBOOKS, REFERENCES, MATERIALS **(List reading resources elsewhere)**

TEXTS: **Material selected from:**

Linear Algebra - Hoffman & Kunze, Prentice Hall
Matrix Computations - Golub & Van Loan, North Oxford

OBJECTIVES: Students will be introduced to central ideas and methods of linear algebra as they are applied in modern mathematics. A symbolic manipulation package (e.g., Maple) will be employed throughout.

Upon completion of the course, students should:

1. **have a basic but broad knowledge of the fundamental ideas and techniques of modern linear algebra,**
2. **be able to recognize the many guises of projection in situations of approximation, and carry out the necessary computations,**
3. **be able to understand and apply the spectral theorem,**
4. **be able to employ canonical form decompositions, and**
5. **be able to employ efficient techniques of analyzing and solving linear systems.**

STUDENT EVALUATION PROCEDURE:

Students will be given 2 to 3 midterm exams during the semester, as well as a final exam. They will also be expected to turn in assignments approximately biweekly. The weighting will be as follows:

Midterm exams	40%
Final exam	40%
Assignments	20%

Math 438
NAME & NUMBER OF COURSE

COURSE CONTENT

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Topics covered will include:

1. **Review of Matrix Algebra (matrix arithmetic over the complex numbers.)**

2. **Review of Vector spaces (basis, dimension, coordinates, subspaces.)**

3. **Linear transformations and linear functionals.**
   - a. **Kernel, range, isomorphisms**
   - b. **Matrix representation**
   - c. **Dual spaces and dual bases**

4. **Brief review of determinants.**

5. **Inner Product Spaces**
   - a. **General inner products and norms**
   - b. **Generalized Gram-Schmidt process**
   - c. **Orthogonal complements and projection matrices**
   - d. **Least squares approximation (multiple regression, orthogonal polynomials, finite Fourier series)**
   - e. **If time permits: positive, unitary and normal operators**

6. **Canonical forms**
   - a. **Eigenvalues and diagonalizability**
   - b. **The spectral theorem (applications to optimization)**
   - c. **Direct sum decompositions**
   - d. **Jordan canonical form (applications of systems of differential equations)**
   - e. **If time permits: positive, unitary and normal operators**

7. **Computational linear algebra**
   - a. **Orthogonal transformations (Householder, Givens)**
   - b. **QR factorization**
   - c. **Singular value decomposition**
   - d. **Generalized inverses**