

Polytechnic University of Puerto Rico
Department of Electrical Engineering
Master in Electrical Engineering

Course Syllabus

Course Title : Mathematical Methods for Signal Processing

Course Code : [EE 6010](#)

Credits : Three (3) credits

Duration : One academic quarter.

Schedule : Forty-five credit hours per course.

Prerequisites : Undergraduate Calculus and Undergraduate Diff. Equations.

Course Description

This course provides part of the extensive mathematical background needed for contemporary signal processing, practice and research. It emphasizes several linear algebra topics. Some of the topics covered are: Vector Spaces and Linear Algebra including Linear Operators, Inverse Matrices, Matrix Factorizations, Eigenvalues and Eigenvectors, Singular Value Decomposition, Some Special Matrices and their Application, Kronecker Products. The connection of these topics with signal processing is emphasized.

Justification

Topics such as Digital Signal Processing and Digital Communication require the students to have adequate background in Vector Spaces and Linear Algebra. The material selected for this class will provide a foundation for future courses in Communication Theory, Signal Processing and Controls, as well as solid grounding for students wishing to pursue Doctoral studies.

Objectives

To provide the mathematical background needed for practice and research in contemporary signal processing.

Textbook

Mathematical Methods and Algorithms for Signal Processing (2000)

By T. K. Moon and W. C. Stirling

Prentice Hall

Upper Saddle River, NJ

ISBN: 0-201-36186-8

Topics Covered

1. Signal Spaces.
2. Representation and Approximation in Vector Spaces.
3. Applications of Orthogonality.
4. Linear Operators and Matrix Inverses.
5. Some Important Matrix Factorizations (LU, Cholesky, QR)
6. Eigenvalues and Eigenvectors.
7. Applications of Eigen-decomposition methods.
8. The Singular Value Decomposition.
9. Some Special Matrices (Toeplitz, Circulant, Vandermonde, etc) and their Application.
10. The Kronecker Product and some of its Applications.
11. Summary and compendium of applications to signal processing of the topics studied in class.

Evaluation Criteria

Final course grade will be determined, unless otherwise accorded in class, based on the following scale:

| | |
|--------|---|
| 100-90 | A |
| 89-80 | B |
| 79-70 | C |
| 69-60 | D |
| 59- 0 | F |

Homework is suggested to be 0% to 10% of the final grade. Three exams and a final exam are given to the students.

Course History

April, 2002; prepared by Pedro Torres, Ph.D. Candidate, P. E.

May 2002; revised by Marvi Teixeira Ph.D., P.E.

Bibliography

Advanced Engineering Mathematics (2003)

Peter V. O'Neil

5th Edition

Brooks/Cole

ISBN: 0534400779

Communication System Engineering (2002)

By J. G. Proakis and M. Salehi.

2nd Edition

Prentice Hall

ISBN: 0-13-061793-8

Probability, Random Variables and Stochastic Processes. (2001)

By A. Papoulis

4th Edition

Prentice Hall.

Applied Numerical Methods for Engineers Using MATLAB® and C (2000)

Robert A. Schilling, Sandra L. Harris

1st Edition

Brooks/Cole

ISBN: 0534370144

Linear Algebra and its Applications. (1998)

By G. Strang.

3rd Edition

Academic Press

ISBN: 0155510053

Algorithms for Discrete Fourier Transforms and Convolution. (1997)

By R. Tolimieri, M. An and C. Lu.

2nd Edition

Springer Verlag

ISBN: 0387982612

Wavelets and Filter Banks. (1996)

By G. Strang and T. Nguyen

1st Edition

Wellesley-Cambridge Press

Circulant Matrices. (1994)

By P. J. Davis

1st Edition
Chelsea Publishing

Advanced Linear Algebra. (1992)
By *S. Roman*
1st Edition
Springer Verlag
ISBN: 0-387-97837-2

Linear Operator Theory. (1971)
By A. W. Naylor and G. R. Sell.
1st Edition
Holt Rinehart Winston
ISBN: 0 -03-079390-4