

University of Puerto Rico  
 Mayagüez Campus  
 College of Engineering  
 Department of Electrical and Computer Engineering  
 Graduate Program in Electrical Engineering

**Course Syllabus**

<b>1. General Information:</b>	
Alpha-numeric codification: INEL 6050 Course Title: ADVANCED DIGITAL SIGNAL PROCESSING ALGORITHMS Number of credits: 3 Contact Period: 3 hours of lecture per week	
<b>2. Course Description:</b>	
English: Theoretical foundations, fast algorithms for the Discrete Fourier Transform. Fast convolution algorithms, multidimensional techniques, fast filtering computations, architecture of filters and transforms, fast algorithms in VLSI. Application studies in transmission error controlling codes, sonar, radar, speech, image processing, and other engineering areas. Study of software implementations on vector and parallel architectures. Algorithms and symbolic computation.	
Spanish: Fundamentos Teóricos, Algoritmos Rápidos Para la Transformada Discreta de Fourier, Algoritmos Para Convoluciones Rápidas, Técnicas Multidimensionales, Computaciones Rápidas de Filtrado, Arquitecturas de Filtros y Transformadas, Algoritmos Rápidos en VLSI. Estudio de Aplicaciones en Códigos Para Controlar Errores de Transmisión, Procesamiento de Señales de Sonar, Radar, el Habla, Imágenes, y Otras Áreas de Ingeniería. Estudio de Implantaciones en Programados en Arquitecturas Vectoriales y Paralelas. Algoritmos y la Computación Simbólica.	
<b>3. Pre/Co-requisites and other requirements:</b>	
<b>4. Course Objectives:</b>	
The student will be able to apply advanced mathematical techniques and a theoretical framework for the analysis, design, and implementation of signal processing algorithms for diverse applications and to develop system-level algorithm with the assistance of MATLAB	
<b>5. Instructional Strategies:</b>	
<input checked="" type="checkbox"/> conference <input checked="" type="checkbox"/> discussion <input type="checkbox"/> computation <input type="checkbox"/> laboratory  <input type="checkbox"/> seminar with formal presentation <input type="checkbox"/> seminar without formal presentation <input type="checkbox"/> workshop  <input type="checkbox"/> art workshop <input type="checkbox"/> practice <input type="checkbox"/> trip <input type="checkbox"/> thesis <input checked="" type="checkbox"/> special problems <input type="checkbox"/> tutoring  <input type="checkbox"/> research <input type="checkbox"/> other, please specify:	
<b>6. Minimum or Required Resources Available:</b>	
MATLAB software and standard lecturing facilities.	
<b>7. Course time frame and thematic outline</b>	
<b>Outline</b>	<b>Contact Hours</b>
1. Introduction to Digital Signal Processing and Digital	6

Communications a. Digital Signals and Systems b. Fundamental Concepts of Analog and Digital Communications Systems c. Fundamental Concepts of Discrete-time Signal Processing d. Cyclic Convolution Operations and Fast Unitary Transforms	
2. Fundamental Algebraic Structures a. Sets, Relations, Cartesian Products, Number Functions b. Semi-groups, Groups, Fields, Vector Spaces, Linear Algebras	6
3. Finite Dimensional Linear Operators and Signal Algebras a. Matrix Representations b. Algorithm Implementations	3
4. Finite Impulse Response Filters and the Discrete Fourier Transform a. Linear and Cyclic Arithmetic Complexities b. Algorithm Implementations	6
5. Cyclic Codes a. Linear Codes vs. Convolutional Codes b. Algorithm Implementations	3
6. Fast Algorithms for Multidimensional Applications a. Fourier Transform b. Block Convolutions and Toeplitz Systems	6
7. Software and Hardware Algorithm Design and Development Techniques a. Source and Channel Coding Applications b. Digital Modulation Applications c. Time-frequency Signal Analysis Algorithm Applications d. Space-time Adaptive Processing Algorithm Applications	12
Exams	3
<b>Total hours: (equivalent to contact period)</b>	

### 8. Grading System

Quantifiable (letters)  Not Quantifiable

### 9. Evaluation Strategies

	Quantity	Percent
<input checked="" type="checkbox"/> Exams	1	10
<input checked="" type="checkbox"/> Final Exam	1	20
<input checked="" type="checkbox"/> Short Quizzes	2	10
<input type="checkbox"/> Oral Reports	2	10
<input type="checkbox"/> Monographies		
<input type="checkbox"/> Portfolio		
<input checked="" type="checkbox"/> Projects	2	30
<input type="checkbox"/> Journals		
<input checked="" type="checkbox"/> Other, specify: homework	10	20
<b>TOTAL:</b>		<b>100%</b>

### 10. Bibliography:

1. Guoan Bi and Yonghong Zeng (2004), Transforms and Fast Algorithms for Signal Analysis and Representations, Birkhäuser

2. Richard E. Blahut (1992), Algebraic Methods for Signal Processing and Communications, Springer-Verlag. (Classic textbook in the subject)
3. Richard E. Blahut (2002), Algebraic Codes for Data Transmission, Cambridge Press University
4. S. Lin and D. Costello (2004), Error Control Coding, Second Edition, Prentice Hall
5. R.L. Allen and D. Mills (2004), Signal Analysis: Time, Frequency, Scale, and Structure, Wiley - IEEE Press
6. J. F. Humphreys and M. Y. Prest (2004), Numbers, Groups and Codes, Cambridge University Press

**11. According to Law 51**

Students will identify themselves with the Institution and the instructor of the course for purposes of assessment (exams) accommodations. For more information please call the Student with Disabilities Office which is part of the Dean of Students office (Chemistry Building, room 019) at (787)265-3862 or (787)832-4040 extensions 3250 or 3258.

**Person who prepared this description and date of preparation:**

Domingo Rodríguez, August 2007