

## SECRETARÍA ACADÉMICA



## DIRECCIÓN DE EDUCACIÓN SUPERIOR

### SYNTHESIZED SCHOOL PROGRAM

ACADEMIC UNIT:	Escuela Superior de Cómputo	
ACADEMIC PROGRAM:	Ingeniería en Sistemas Computacionales.	
LEARNING UNIT:	Basic Signal Processing	LEVEL: III

#### AIM OF THE LEARNING UNIT:

The student solves signal processing problems based on spectral analysis and digital filter design.

#### CONTENTS:

- I. Signals and discrete-time systems
- II. Wavelet Transform
- III. Digital Signal Processors

#### **TEACHING PRINCIPLES:**

In this unit a project-oriented learning strategy will be used. The teacher will apply a heuristic method, in order to carry out learning activities that will contribute to the development of skills such as abstraction, analysis, design and evaluation of effective methods to resolve signal processing problems. Class work will consist of activities to develop students' attitudes like collaboration and skills such as brainstorming, graphic organizers, documentary research, discussion and the implementation of a software-hardware project.

#### **EVALUATION AND PASSING REQUIREMENTS:**

This learning unit will be evaluated from the portfolio of evidence, which is made up of: formative assessment, summative and self-assessment and peer assessment rubrics.

Some additional criteria will be used to evaluate the student; among these we have participation in the classroom, problem-solving, learning evidences and the implementation of a software-hardware project.

Other means to pass this Learning Unit is as follows:

- Evaluation of previously acquired knowledge, based on the guidelines established by the academy.
- Official recognition either by an Academic Unit of the IPN or by other national or international educational institution.

#### **REFERENCES:**

- Oppenheim, A.V. Willsky, A.S. Nawab, S.H. (1996). *Signals and Systems*. (2nd Edition). Upper Saddle River, NJ, USA. Prentice-Hall, Inc. ISBN: 0-13-814757-4.
- Oppenheim, A.V. Schafer, R.W. (2009). *Discrete-Time Signal Processing*. (3rd Edition). Upper Saddle River, NJ, USA. Prentice-Hall, Inc. ISBN: 0-13-198842-5.
- Porat, B. (1996). A Course in Digital Signal Processing. New York, NY, USA. John Wiley & Sons, Inc. ISBN:0-47-114961-6.
- Proakis, J.G. Manolakis, D.K. (2006). *Digital Signal Processing* (4th Edition). Upper Saddle River, NJ, USA: Prentice-Hall, Inc. ISBN: 0-13-187374-1.
- Walker, J.S. (2008). A Primer on Wavelets and Their Scientific Applications. University of Wisconsin, Eau Claire, USA: Chapman and Hall/CRC. ISBN: 1-58-488745-1.



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### **DIRECCIÓN DE EDUCACIÓN SUPERIOR**

ACADEMIC UNIT: Escuela Superior de Cómputo. ACADEMIC PROGRAM: Ingeniería en Sistemas Computacionales LATERAL OUTPUT: Analista Programador de Sistemas de Información. FORMATION AREA: Professional. MODALITY: Presence. LEARNING UNIT: Basic Signal Processing. TYPE OF LEARNING UNIT: Theorical - Practical, Optative. USE: August, 2011 LEVEL: III. CREDITS: 7.5 Tepic, 4.39 SATCA

#### ACADEMIC AIM:

This learning unit contributes to the profile of graduates in Computer Systems Engineering by developing the skills of abstraction, analysis, design and evaluation of effective methods for solving signal processing. It also develops creative thinking, promotes research capacity, and encourages student participation and collaboration.

This learning unit requires the aptitude to represent signals in time domain and frequency domain, as well as the ability to use visualization tools for spectral components of a signal. All of the above mentioned skills are learned in a previous course named Communications and Signal Theory.

#### AIM OF THE LEARNING UNIT:

The student solves signal processing problems based on spectral analysis and digital filter design.

CREDITS HOURS	LEARNING UNIT DESIGNED BY: Academia de Sistemas Digitales	AUTHORIZED BY: Comisión de Programas Académicos del Conseio General
THEORETICAL CREDITS / WEEK: 3.0		Consultivo del IPN. 2011
PRACTICAL CREDITS / WEEK: 1.5	REVISED BT:	
HOURS THEORETICAL /TERM: 54	Dr. Flavio Arturo Sánchez Garfias Subdirección Académica	
HOURS PRACTICAL / SEMESTER: 27		Ing Rodrigo de Jesús Serrano
HOURS AUTONOMOUS LEARNING: 54		Domínguez
CREDITS HOURS / SEMESTER: 81	Ing. Apolinar Francisco Cruz Lázaro Presidente del CTCE.	Programas Académicos



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**Basic Signal Processing** 

LEARNING UNIT:

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No.	CONTENTS		Teacher led- instruction HOURS		omous ming URS	REFERENCES KEY
		т	Р	т	Р	
1.1	Signals, Systems and Signal Processing	0.5			2.0	1B,2B,3B,4C,
1.2	Discrete-time systems	0.5	0.5	3.0	2.0	50,70
1.3	Analysis of linear discrete time invariant (LTI)	0.5			1.0	
1.4	Discrete-time systems described by difference equations	3.0	0.5	3.0	2.0	
1.5	Correlation and autocorrelation				1.0	
1.6	Fourier transform and Z transform	3.0	0.5	3.0	2.0	
1.7	Digital filters	1.0		1.0	1.0	
	Subtotal:	8.5	1.5	10.0	11.0	

#### LEARNING EVALUATION

Diagnostic Evaluation	
Portfolio of evidence:	
Solved exercises	20%
Practice Reports	30%
Project Proposal	15%
Self-assessment rubrics	2%
Co-evaluation rubric	3%
Evidence of learning	30%



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### **DIRECCIÓN DE EDUCACIÓN SUPERIOR**

**LEARNING UNIT:** 

N° THEMATIC UNIT: ||

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TITLE: Wavelet Transform

#### UNIT OF COMPETENCE

The student decomposes signals in terms relocated and enlarged version of a finite wave, based on Wavelet Transform.

**Basic Signal Processing** 

No.	CONTENTS	Teach instru HO	er led- uction URS	Autonomous Learning HOURS		REFERENCES KEY
		т	Р	т	Р	
2.1 2.1.1 2.1.2	Introduction to Wavelet Transform Linearity Fourier Transform window	2.0	0.5	3.0	2.0	1B,2B,3B,6C
2.2 2.2.1	Haar Wavelet Transform Scaling function	2.0	0.5	3.0	2.0	
2.2.2 2.2.3 2.2.4	Properties of the scaling function Decomposition algorithm Reconstruction algorithm	0.5		1.0		
2.3 2.3.1	Daubechies Wavelet Transform Vanishing Moments	2.0	0.5	3.0	2.0	
2.3.2 2.3.3	Classification of the Daubechies wavelets Properties of Daubechies wavelets			0.5 0.5		
	Subtotal:	6.5	1.5	11.0	6.0	
			S		0.0	

This unit will be addressed from the learning strategy and project-oriented method heuristics, which allow the consolidation of the following learning techniques: documentary research, discussion, problem solving and practical work.

LEARNING EVALUATION					
Portfolio of evidence:					
Solved exercises	20%				
Practice Reports	30%				
Progress Project	15%				
Self-assessment rubrics	2%				
Co-evaluation rubric	3%				
Evidence of learning	30%				



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### DIRECCIÓN DE EDUCACIÓN SUPERIOR

LEARNING UNIT:

N° THEMATIC UNIT: III

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**TITLE:** Digital Signal Processors

## UNIT OF COMPETENCE

**Basic Signal Processing** 

The student designs digital filters from analog filters, based on the use of windows and design techniques of poles and zeros.

No.	CONTENTS	Teacher led- instruction HOURS		Teacher led- instruction HOURS		Auton Lear HOI	omous ning JRS	REFERENCES KEY	
		т	Р	т	Р				
3.1 3.1.1	Digital Signal Processors Block Diagram Coperal Features	1.0				1B,2B,3B,5C, 6C,7C			
3.1.3	Instruction set of a particular DSP	1.5	0.5		2.0				
3.2 3.2.1	Implementation of DSP algorithms FFT	1.5	0.5	3.0 2.0	2.0				
3.2.2	Digital filters		1.0	1.0					
3.2.3	Recursive Filters			1.0					
3.2.4	Nonrecursive filters			1.0					
3.2.5	Applications	3.0		3.0	1.0				
	Subtotal:	7.0	2.0	11.0	5.0				
	TEACHING PRINCIPLES								

This unit will be addressed from the learning strategy and project-oriented method heuristics, which allow the consolidation of the following learning techniques: documentary research, discussion, problem solving and practical work.

#### LEARNING EVALUATION

15%
30%
50%
2%
3%



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## DIRECCIÓN DE EDUCACIÓN SUPERIOR

LEARNING UNIT:

Basic Signal Processing

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### LIST OF PRACTICES

PRACTICE No.	NAME	THEMATIC UNITS	DURATION	ACOMPLISHMENT LOCATION
1	Outlining of continuous signals.	I	3.0	Lab. E4 Laboratory of ESCOM.
2	Discretized continuous signals classification.	I	3.0	
3	Implementation of a uniform sampling algorithm, Natural and flat roofs.	I	3.0	
4	Implementation of the convolution algorithm to determine the response of LTI systems.	I	3.5	
5	Implementation of a FIR filter with hardware programming.	II	3.5	
6	Implementation of an IIR filter using hardware programming.	II	4.0	
7	DSP implementation of a discrete signal.	Ш	2.5	
8	Implementation of the FFT algorithm on a DSP.	Ш	2.5	
9	Implementation of a digital filter in a DSP.	Ш	2.0	
		TOTAL DE HORAS	27.0	
EVALUATION	AND VALIDATION:			

Practices contribute 30% of the grade of each unit.

Practices are considered a prerequisite for this learning unit to be approved.



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LEARNING UNIT:		T:	Basic Signal Processing			PAGE:	7	OU.	T OF	8
	PERÍOD	UNIT		EVALUATION	N TERMS					
	1	I	Continuous evaluation 70% Learning evidence 30%							
	2	II	Continuous evaluation70%Learning evidence30%							
	3	Ш	Continuous evaluation 100%							
			Unit I contributes 30% of the fi Unit II contributes 30% of the f Unit III contributes 40% of the	nal grade. inal grade. final grade.						
			Other means to pass this Lear • Evaluation of previous established by the aca • Official recognition eits or international educated If accredited by Special Assess on guidelines established by the	ning Unit is as f usly acquired demy. her by an Acad ional institution. ssment or a cert he academy on	ollows: knowledge, lemic Unit of tificate of prof a previous n	based the IPN of ficiency, t neeting fo	on or b his ' or th	the y oth will b is pu	guide lier nat lie base rpose.	iines tional ed

KEY	В	С	REFERENCES
1	Х		Burrus, C.S. Gopinath, R.A. Guo, H. (1997). <i>Introduction to Wavelets and Wavelet Transforms: A Primer</i> . Upper Saddle River, NJ, USA. Prentice-Hall, Inc. ISBN: 0-13-489600-9.
2	Х		Mallat, S. (1999). <i>A Wavelet Tour of Signal Processing</i> . Academic Press. ISBN: 0-12-466606-X.
3	Х		Oppenheim, A.V. Willsky, A.S. Nawab, S.H. (1996). <i>Signals and Systems</i> . (2nd Edition). Upper Saddle River, NJ, USA. Prentice-Hall, Inc. ISBN: 0-13-814757-4.
4		Х	Oppenheim, A.V. Schafer, R.W. (2009). <i>Discrete-Time Signal Processing</i> . (3rd Edition). Upper Saddle River, NJ, USA. Prentice-Hall, Inc. ISBN: 0-13-198842-5.
5		Х	Porat, B. (1996). <i>A Course in Digital Signal Processing</i> . New York, NY, USA. John Wiley & Sons, Inc. ISBN:0-47-114961-6.
6		Х	Proakis, J.G. Manolakis, D.K. (2006). <i>Digital Signal Processing</i> . (4th Edition). Upper Saddle River, NJ, USA. Prentice-Hall, Inc. ISBN: 0-13-187374-1.
7		X	Walker, J.S. (2008). <i>A Primer on Wavelets and Their Scientific Applications</i> . University of Wisconsin, Eau Claire, USA. Chapman and Hall/CRC. ISBN: 1-58-488745-1.

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### TEACHER EDUCATIONAL PROFILE PERR LEARNING UNIT

#### 1. GENERAL INFORMATION

ACADEMIC U	NIT:	Escuela Superior de Cón	nputo			
ACADEMIC PI	ROGRAM:	Ingeniería en Sistemas Computacionales		LEVEL:		
FORMATION	AREA:	Institutional	Basic Scientific	Profe	ssional	Terminal and Integration
ACADEMY:	Academia d	le Sistemas Digitales			AJE: Basic	Signal Processing
SPECIALTY A	ND ACADE	MIC REQUIRED LEVEL:	Master in Science.	Computer Sci	ence or Doct	tor in Computer

#### 2. AIM OF THE LEARNING UNIT:

The student solves signal processing problems based on spectral analysis and digital filter design.

#### 3. PROFESSOR EDUCATIONAL PROFILE:

KNOWLEDGE	PROFESSIONAL EXPERIENCE	ABILITIES	APTITUDES
<ul> <li>Signal analysis methods.</li> <li>Techniques for digital filter design.</li> <li>Wavelet Transform.</li> <li>DSP programming.</li> <li>Developing applications using DSPs.</li> <li>IEM.</li> <li>English Language</li> </ul>	<ul> <li>One year of experience in signal analysis.</li> <li>One year of experience in design of digital filters.</li> <li>One year of experience in programming DSPs</li> <li>Two years of experience in handling groups and collaborative work.</li> <li>One year of experience as a Professor of Higher Education.</li> </ul>	<ul> <li>Analysis and synthesis.</li> <li>Leadership.</li> <li>Decision making.</li> <li>Conflict management.</li> <li>Group management.</li> <li>Verbal fluency.</li> <li>Teaching skills.</li> </ul>	<ul> <li>Responsable.</li> <li>Tolerant.</li> <li>Honest.</li> <li>Respectful.</li> <li>Collaborative.</li> <li>Participative.</li> <li>Interested in learning.</li> <li>Assertive.</li> </ul>

#### DESIGNED BY

**REVISED BY** 

#### AUTHORIZED BY

M en C. Mario Aldape Pérez M en C. Jacqueline Arzate Gordillo M en C. Iván Díaz Toalá Dr. Alfonso Fernández Vázquez Profesores Coordinadores Dr. Flavio Arturo Sánchez Garfias Subdirector Académico Ing. Apolinar Francisco Cruz Lázaro Director

Fecha: 2011