INSTITUTO POLITÉCNICO NACIONAL

SECRETARÍA ACADÉMICA

DIRECCIÓN DE EDUCACIÓN SUPERIOR

SYNTHESIZED SCHOOL PROGRAM

ACADEMIC UNIT: Escuela Superior de Cómputo

ACADEMIC PROGRAM: Ingeniería en Sistemas Computacionales.

LEARNING UNIT: Advanced Signal Processing **LEVEL:** III

AIM OF THE LEARNING UNIT:
The student designs signal processing systems implemented in specialized hardware based on the device programming techniques.

CONTENTS:

I. Digital Signal Processors (DSP).
II. Peripheral interface controller for signal processing (dsPIC).
III. DSP and FPGAReal-time applications.

TEACHING PRINCIPLES:
The learning unit will be addressed from the project-oriented learning strategy, the teacher apply the heuristic method, with which it carried out learning activities that will guide the development of skills of abstraction, analysis and design of efficient algorithms, using theoretical and practical tools, such is the case for the implementation of computer programs that demonstrate the concepts of the unit. The activities done in class to encourage students some techniques, such as collaborative, participatory, brainstorming, graphic organizers, inquiry documents, worksheets, supplementary statement of issues, discussion and directed the execution of a project software. It is the responsibility of the teacher decide the features of the project and the programs implemented by fixing the time of preparation and delivery.

EVALUATION AND PASSING REQUIREMENTS:

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

Other means to pass this Unit of Learning:

- Evaluation of acknowledges previously acquired, with base in the issues defined by the academy.
- Official recognition by either another IPN Academic Unit of the IPN or by a national or international external academic institution besides IPN.

REFERENCES:

- Bremaud, P. (2010). *Mathematical Principles of Signal Processing: Fourier and Wavelet Analysis,* USA: Springer. ISBN: 1-44-192956-8.
- Kuo, SM, Woon-Seng S. Gan. (2004). *Digital Signal Processors: Architectures, Implementations, and Applications,* Prentice-Hall, USA, 2004. ISBN: 0-13-035214-4.
- Oppenheim, AV, Schafer, RW. (2009). *Discrete-Time Signal Processing* (3a. Ed.). USA: Pearson. ISBN: 0-13-198842-5.
- Usategui, A. Angulo-Martinez, JM, I.Mictocontroladores Avanzados: DsPic. Controladores Digitales de Señales. Madrid España: Ediciones Paraninfo S.A. ISBN:0-13-198842-5.
- 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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SECRETARÍA ACADÉMICA

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: Advanced Signal Processing
TYPE OF LEARNING UNIT: Theorical - Practical, Optative.
VALIDITY: August, 2011.
LEVEL: lll.
CREDITS: 7.5 Tepic, 4.39 SATCA

ACADEMIC AIM

This learning unit contributes to the profile of graduates in Computer Systems Engineering, to develop the skills of effective problem solving in complex dynamic systems modeling of practical problems. It also develops strategic thinking, creative thinking, collaborative and participatory and assertive communication.
Requires learning units Basic Signal Processing with the knowledge of specialized hardware implementation.

AIM OF THE LEARNING UNIT:

The student designs signal processing systems implemented in specialized hardware based on the device programming techniques.

CREDITS HOURS

THEORETICAL CREDITS / WEEK: 3.0

PRACTICAL CREDITS / WEEK: 1.5

THEORETICAL HOURS / SEMESTER: 54

PRACTICAL HOURS / SEMESTER: 27

AUTONOMOUS LEARNING HOURS: 54

CREDITS HOURS / SEMESTER: 81

LEARNING UNIT DESIGNED BY:
Academia de Sistemas Distribuidos

REVISED BY:
Dr. Flavio Arturo Sánchez Garfias.
Subdirección Académica

APPROVED BY:
Ing. Apolinar Francisco Cruz Lázaro.
Presidente del CTCE

AUTHORIZED BY: Comisión de Programas Académicos del Consejo General Consultivo del IPN

Ing. Rodrigo de Jesús Serrano Domínguez
Secretario Técnico de la Comisión de Programas Académicos

THEMATIC UNIT: I **TITLE:** Digital Signal Processors (DSP)

UNIT OF COMPETENCE

The student uses the DSP in the design of digital signal processing techniques based on hardware programming.

No.	CONTENTS	Teacher led-instruction HOURS		Autonomous Learning HOURS		REFERENCES KEY
		T	P	T	P	
1.1	Definition of a DSP	0.5		1.0		2B, 3C,5C
1.2	Basic structure of a DSP	0.5		1.0		
1.3	Architecture Features RISC architecture Harvard Architecture Segmentation (pipeline)	1.0 1.0		2.0 2.0		
1.4	Families and subfamilies of DSPs Program Memory Data Memory Peripheral resources					
1.5	Programming Model	0.5		1.0		
1.6	Instruction Set	0.5		1.0		
1.7	Circular Addressing Modes Bit Reversi	1.0		2.0		
1.8	Programming development environment Structure of a program in assembler Simulator Management Examples of programs	1.0	3.0	2.0	6.0	
	Subtotals:	6.0	3.0	12.0	6.0	

TEACHING PRINCIPLES

This Thematic Unit must begin with a framing of the course and the formation of teams. Will be Projects-Based learning strategy, trough inductive method, with the techniques of elaboration of charts, technical data and exercise-solving, exhibition in team, practical and production of learning evidence and the accomplishment of a project proposal.

LEARNING EVALUATION

Diagnostic Test
Project Portfolio:

Charts	5%
Technical data	5%
Exercise-solving	10%
Cooperative Presentation	10%
Report of Practicals	20%
Proposal of project	10%
Self-Evaluation Rubrics	5%
Cooperative Evaluation Rubrics	5%
Written Learning Evidence	30%

THEMATIC UNIT: II **TITLE:** Peripheral interface controller for signal processing (dsPIC)

UNIT OF COMPETENCE

The student uses dsPIC in the design of digital signal processing techniques based on hardware programming.

No.	CONTENTS	Teacher led-instruction HOURS		Autonomous Learning HOURS		REFERENCES KEY
		T	P	T	P	
2.1	DAC's settings using SPI	1.5	0.5	3.0	1.5	4B, 1C
2.2	CODEC's settings using the DCI module	1.5	1.0	3.0	1.5	
2.3	DMA Controller Configuration	1.5	1.0	3.0	1.5	
2.4	Image sensor settings using SPI	1.5	0.5	3.0	1.5	
	Subtotals:	6.0	3.0	12.0	6.0	

TEACHING PRINCIPLES

Will be projects-Based learning strategy, trough heuristic method, with the techniques of charts, exercise-solving, cooperative presentation, advance of the project, practical and the production of the learning evidences.

LEARNING EVALUATION

Project Portfolio:

Charts	5%
Technical data	5%
Computer programs w/report	10%
Cooperative Presentation	10%
Report of Practicals	10%
Advance of the Project	30%
Self-Evaluation Rubrics	5%
Rubric of Co-Evaluation	5%
Written Learning Evidence	20%

THEMATIC UNIT: III **TITLE:** DSP and FPGA Real-time applications

UNIT OF COMPETENCE

The student develops real-time applications in hardware devices based on the techniques of the DSP and FPGA.

No.	CONTENTS	Teacher led-instruction HOURS		Autonomous Learning HOURS		REFERENCES KEY
		T	P	T	P	
3.1	Qn format	1.0		2.0		3C, 1C, 2B, 4B
3.2	Convolution	1.0		2.0		
3.3	FFT	1.0		2.0		
3.4	FIR and IIR filters	1.0	1.0	2.0	2.0	
3.5	Voice Processing	1.0	1.0	2.0	2.0	
3.6	Image Processing	1.0	1.0	2.0	2.0	
	Subtotals:	6.0	3.0	12.0	6.0	

TEACHING PRINCIPLES

Will be projects-Based learning strategy, trough inductive and heuristic methods, with the techniques of elaboration of exercise-solving, cooperative presentation, practical and learning evidence, the production of the learning evidences and advance of the project.

LEARNING EVALUATION

Project Portfolio:

Charts	5%
Technical data	5%
Computer programs w/report	10%
Cooperative Presentation	10%
Report of Practicals	10%
Project Implementation	50%
Self-Evaluation Rubrics	5%
Rubric of Co-Evaluation	5%

RECORD OF PRACTICALS

No.	NAME OF THE PRACTICAL	THEMATIC UNITS	DURATION	ACCOMPLISHMENT LOCATION
1	DSP Programming.	I	9.0	Digital Electronics Lab.
2	dsPIC Programming.	II	9.0	
3	dsPIC and FPGAs Programming.	III	9.0	
		TOTAL OF HOURS	9.0	

EVALUATION AND PASSING REQUIREMENTS:

The practicals are considered mandatory to pass this learning unit.
The practicals worth 20% in thematic unit I.
The practicals worth 10% in thematic unit I.
The practicals worth 10% in thematic unit I.

PERIOD	UNIT	EVALUATION TERMS
1	I y II	Continuous evaluation 70% and written learning evidence 30%
2	III	Continuous evaluation 80% and written learning evidence 20%
3	IV	Continuous evaluation 100% The learning unit I and II is 30% worth of the final score The learning unit III is 30% worth of the final score The learning unit IV is 40% worth of the final score Other means to pass this Learning Unit: • Evaluation of acknowledges previously acquired, with base in the issues defined by the academy. • Official recognition by either another IPN Academic Unit of the IPN or by a national or international external academic institution besides IPN. If accredited by Special Assessment or a certificate of proficiency, this will be based on guidelines established by the academy on a previous meeting for this purpose.

KEY	B	C	REFERENCES
1		X	Bremaud, P. (2010). *Mathematical Principles of Signal Processing: Fourier and Wavelet Analysis,* USA: Springer. ISBN: 1-44-192956-8.
2	X		Kuo, SM, Woon-Seng S. Gan. (2004). *Digital Signal Processors: Architectures, Implementations, and Applications,* Prentice-Hall, USA, 2004. ISBN: 0-13-035214-4.
3		X	Oppenheim, AV, Schafer, RW. (2009). *Discrete-Time Signal Processing* (3a. Ed.). USA: Pearson. ISBN: 0-13-198842-5.
4	X		Usategui, A. Angulo-Martinez, JM, I.Mictocontroladores Avanzados: DsPic. Controladores Digitales de Señales. Madrid España: Ediciones Paraninfo S.A. ISBN:0-13-198842-5.
5		X	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

TEACHER EDUCATIONAL PROFILE PER LEARNING UNIT

1. GENERAL INFORMATION

ACADEMIC UNIT: Escuela Superior de Cómputo.

ACADEMIC PROGRAM: Ingeniería en Sistemas Computacionales. **LEVEL** III

FORMATION AREA:

Institutional	Basic Scientific	Professional	Terminal and Integration

ACADEMY: Sistemas Distribuidos **LEARNING UNIT:** Advanced Signal Processing

SPECIALTY AND ACADEMIC REQUIRED LEVEL: Masters Degree or Doctor in Computer Science.

2. **AIM OF THE LEARNING UNIT:**
The student designs signal processing systems implemented in specialized hardware based on the device programming techniques.

3. PROFFESSOR EDUCATIONAL PROFILE:

KNOWLEDGE	PROFESSIONAL EXPERIENCE	ABILITIES	APTITUDES
• Programming expertise and dsPIC DSPs. • Advanced Signal Processing • Programming languages. • MEI. • English Language	• One year experience in the analysis of algorithms. • One year experience in the use of algorithm design techniques. • Two years experience in handling groups and collaborative work. • One year experience as a Professor of Higher Education.	• Analysis and synthesis. • Problems resolution. • Cooperative. • Leadership. • Applications of Institutional Educational Model. • Decision making.	• Responsible. • Tolerant. • Honest. • Respectful. • Collaborative. • Participative. • Interested to learning. • Assertive.

DESIGNED BY	REVISED BY	AUTHORIZED BY
Rosaura Palma Orozco COORDINATING PROFESOR	Dr. Flavio Arturo Sánchez Garfias Subdirector Académico	Ing. Apolinar Francisco Cruz Lázaro Director

Date: 2011