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: Embedded Systems **LEVEL:** III

AIM OF THE LEARNING UNIT:
The student implements embedded systems applications on advanced technological devices.

CONTENTS:

I. Embedded Systems Introduction.
II. Embedded Systems Architecture.
III. Embedded Systems Applications.

TEACHING PRINCIPLES:
The teacher will apply a study-case learning strategy, through inductive and heuristic methods using analysis techniques, technical data, charts, cooperative presentation, exercise-solving and the production of the learning evidences. Moreover, an autonomous learning will be encouraged by the development of a final Project.

EVALUATION AND PASSING REQUIREMENTS:
The program will evaluate the students in a continuous formative and summative way, which will lead into the completion of project portfolio. Some other assessing methods will be used, such as revisions, practical´s, class participation, exercises, learning evidences and a final project.

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:

- Hallinan, C. (2010). *Embedded Linux Primer*. (Second Edition). USA: Prentice Hall. ISBN-10: 0-137-01783-6, ISBN-13: 978-0-137-01783-6.
- Kamal, R. (2009). *Embedded Systems: Architecture, programming and design*. (Second Edition). India: McGraw-Hill Education. ISBN-10: 0070151253, ISBN-13: 978-0070151253.
- Marwedel, P. (2005). *Embedded System Design*. (First Edition). USA: Springer. ISBN-10: 0-387-30087-2, ISBN-13: 978-0-387-30087-0.
- Noergaard, T. (2005). *Embedded Systems Architecture*. (First Edition). USA: Elsevier. ISBN-10: 0-750-67792-9, ISBN-13: 978-0-750-67792-9.
- Peckol, J. (2007) *Embedded Systems: A Contemporary Design Tool*. (First Edition). USA: John Wiley & Sons, Inc. ISBN-10: 0471721808, ISBN-13: 0-978-0-471-72180-2.

INSTITUTO POLITÉCNICO NACIONAL

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: Embedded Systems
TYPE OF LEARNING UNIT: Theorical - Practical, Optative.
VALIDITY: August, 2011.
LEVEL: lll.
CREDITS: 7.5 TEPIC – 4.39 SATCA

ACADEMIC AIM

This program contributes to the profile of the Ingeniería en Sistemas Computacionales graduate because him development the abstraction, analysis and designs abilities and the implementation of embedded systems use deferent electronic devices such as FPGA and microcontrollers. At the same time the Academic Program contributes to reinforcing and integrated knowledge of other Learning Units to designing and coordinating projects with respect to dedicated systems. Decision making, solution of problems, assertive communication, and creative, strategic thought.

This unit has the units Computer Architecture, Introduction to microcontrollers, Operative Systems and Object-Oriented analysis and design as antecedents. The consequent units are Terminal Work I and II.

AIM OF THE LEARNING UNIT:

The student implements embedded systems applications on advanced technological devices.

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 Digitales

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. 2011

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

THEMATIC UNIT: I **TITLE:** Embedded Systems Introduction

UNIT OF COMPETENCE

The student analyzes the elements in an Embedded System based on dedicated systems applications.

No.	CONTENTS	Teacher led-instruction HOURS		Autonomous Learning HOURS		REFERENCES KEY
		T	P	T	P	
1.1	Definition of Embedded Systems	1.0		0.5		1B, 2B, 3B, 4B, 5B
1.2	Processor embedded into a system			0.5		
1.3	Hardware embedded units			0.5		
1.4	Embedded Software in a system			0.5		
1.5	Complex systems design and Processor	1.0		1.5		
1.6	Design process in Embedded Systems			1.0		
1.7	Formalization of System Design			0.5		
1.8	Examples of design	1.0		1.5		
1.9	Classification of Embedded Systems			0.5		
	Subtotals:	3.0		7.0		

TEACHING PRINCIPLES

This Thematic Unit must begin with a framing of the course and the formation of teams.
Will be study-case 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 description use HDL (Hardware description languages) of embedded systems.

LEARNING EVALUATION

Diagnostic Test
Project Portfolio:

Charts	5%
Exercise-solving	15%
Computer programs w/reports	70%
Self-Evaluation Rubrics	5%
Cooperative Evaluation Rubrics	5%

THEMATIC UNIT: II **TITLE:** Embedded Systems Architecture

UNIT OF COMPETENCE

The student programs diverse hardware and software resources based on Embedded Systems applications.

No.	CONTENTS	Teacher led-instruction HOURS		Autonomous Learning HOURS		REFERENCES KEY
		T	P	T	P	
2.1	Hardware of the embedded system	0.5	1.0	0.5	1.0	1B, 2B, 3B, 4B, 5B
2.1.1	Input of the embedded system	1.5		2.0		
2.1.2	Sensors					
2.1.3	Conversion analogical/digital					
2.1.4	Communication system	1.5		1.5		
2.1.5	Processing unit	1.5		2.5		
2.1.6	Microprocessor					
2.1.7	Microcontroller					
2.1.8	Digital signal processor					
2.1.9	FPGA's					
2.1.10	Output of the embedded system	1.5		2.0		
2.1.11	Conversion digital / analogical					
2.1.12	Actuators					
2.2	Software of the embedded system	0.5	1.0	0.5	1.0	
2.2.1	Programming embedded	1.5		2.0		
2.2.2	Languages C, C++ y Java					
2.2.3	Software modeling	1.5		2.0		
2.2.4	State Machine					
2.2.5	Unified Modeling Language (UML)					
2.2.6	Real-time operating system (RTOS)	3.0		4.0		
2.2.7	Service of the operating system					
2.2.8	Administration of process					
2.2.9	Administration of memory					
2.2.10	Administration of peripherals					
2.2.11	Routine of interrupt					
	Subtotals:	13.0	2.0	17.0	2.0	

TEACHING PRINCIPLES

This Thematic Unit must begin with a framing of the course and the formation of teams.
Will be study-case 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 description use HDL (Hardware description languages) of embedded systems.

LEARNING EVALUATION

Project Portfolio:

Embedded systems modeling	30%
Report of Practical	35%
Self-Evaluation Rubrics	2%
Cooperative Evaluation Rubrics	3%
Written Learning Evidence	30%

THEMATIC UNIT: III **TITLE:** Embedded Systems Applications

UNIT OF COMPETENCE

The student implements different embedded systems applications through FPGA and diverse computer platforms.

No.	CONTENTS	Teacher led-instruction HOURS		Autonomous Learning HOURS		REFERENCES KEY
		T	P	T	P	
3.1	Wire network device		2.0	2.0	3.0	1B, 2B, 3B, 4B, 5B
3.2	Wireless network device		1.0	2.0	2.0	
3.3	Peripherals in embedded systems		1.5	2.0	2.0	
3.4	WEB service embedded		2.0	2.0	3.0	
3.5 3.5.1 3.5.2	Processor embedded Processor Hard-core Vs Sotf-core Processor Sotf-core implantation		1.5	4.0	2.0	
3.6	Operating system embedded		1.0	2.0	2.0	
	Subtotals:	0	9.0	14.0	14.0	

TEACHING PRINCIPLES

This Thematic Unit must begin with a framing of the course and the formation of teams.
Will be study-case 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 description use HDL (Hardware description languages) of embedded systems.

EVALUACIÓN DE LOS APRENDIZAJES

Project Portfolio:	
Embedded systems modeling	25%
Exercise-solving	5%
Report of Practical	50%
Self-Evaluation Rubrics	2%
Cooperative Evaluation Rubrics	3%
Written Learning Evidence	15%

RECORD OF PRACTICALS

No.	NAME OF THE PRACTICAL	THEMATIC UNITS	DURATION	ACCOMPLISHMENT LOCATION
1	Wired network device through RS-485 y TCP/IP.	II	1.0	Electronic Digital Labs
2	Wireless network device through the creation of personal area network (PAN) with the standard IEEE 802.15.4 y TCP/IP.	II	1.5	
3	Peripherals programming to embedded systems. (Touch Screen, mini cameras y memory SD).	II	1.5	
4	WEB server embedded with the standard IEEE 802.3 (Ethernet).	III	5.0	
5	WEB server embedded with the standard IEEE 802.11 (WIFI).	III	6.0	
6	Processor soft-core embedded described in HDL and implemented on FPGA.	III	6.0	
7	Operating system embedded into Processor soft-core.	III	6.0	
		TOTAL OF HOURS	27.0	

EVALUATION AND PASSING REQUIREMENTS:

The practical of the thematic unit II worth 15% of the final score. In the thematic unit III it worth 50% of the final score. The thematic unit I don't have worth. It will be evaluated the functionality of the applications, the explanation of the prototype and the report of the practice. This last one should be conformed for: Theoretical introduction, the description of the solution, details of implementation of the solution and conclusions.
The practical are considered mandatory to pass this learning unit.

PERIOD	UNIT	EVALUATION TERMS	
1	I	Continuous evaluation	100%
2	II	Continuous evaluation Written learning evidence	70% 30%
3	III	Continuous evaluation Written learning evidence	85% 15%

The learning unit I is 15% worth of the final score.
The learning unit II is 25% worth of the final score.
The learning unit III is 60% 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.

Si esta unidad de aprendizaje se acredita en evaluación Extraordinaria ó a Título de Suficiencia, se realizará de acuerdo a los lineamientos establecidos en la reunión de academia que para tal efecto se realice previamente.

CLAVE	B	C	REFERENCES
1	X		Hallinan, C. (2010). *Embedded Linux Primer*. (Second Edition). USA: Prentice Hall. ISBN-10: 0-137-01783-6, ISBN-13: 978-0-137-01783-6.
2	X		Kamal, R. (2009). *Embedded Systems: Architecture, programming and design*. (Second Edition). India: McGraw-Hill Education. ISBN-10: 0070151253, ISBN-13: 978-0070151253.
3	X		Marwedel, P. (2005). *Embedded System Design*. (First Edition). USA: Springer. ISBN-10: 0-387-30087-2, ISBN-13: 978-0-387-30087-0.
4	X		Noergaard, T. (2005). *Embedded Systems Architecture*. (First Edition). USA: Elsevier. ISBN-10: 0-750-67792-9, ISBN-13: 978-0-750-67792-9.
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DIRECCIÓN DE EDUCACIÓN SUPERIOR

EDUCATIONAL PROFILE BY LEARNING UNIT

1. **GENERAL PERFORMANCES**

SCHOOL: Escuela Superior de Cómputo

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

FORMATION AREA:

Institutional	Basic Scientific	Professional	Terminal and integration

ACADEMIC: Sistemas Digitales **LEARNING UNIT:** Embedded Systems

SPECIALTY AND ACADEMIC REQUIRED LEVEL: Master Degree or PhD in Digital systems or similar

2. **PURPOSE OF THE LEARNING UNIT:**
The student implements embedded systems applications on advanced technological devices.

3. **EDUCATIONAL PROFILE:**

KNOWLEDGE	PROFESSIONAL EXPERIENCE	ABILITIES	APTITUDES
• Digital system design • Design and application on microcontrollers and FPGA's • Computer Architecture • Communications • Networks • Operative system • Embedded systems • Handling of real-time operating system on microcontrollers and FPGA's • Object-Oriented Programming • Software engineering • UML Modeling • Applications of Institutional Educational Model.	• Experience in area educational. • Experience in the industry (not indispensable).	• Analysis and synthesis. • Problems resolution. • Cooperative. • Leadership. • Handling of groups. • Decision making. • Verbal fluency of ideas. • Capacity to transmit knowledge's. • MEI Application. • Applications of Institutional Educational Model.	• Responsible. • Tolerant. • Honest. • Respectful. • Participative. • Interested to learning • Professional ethics. • Analytic. • Assertive.

DESIGNED BY **REVISED BY** **AUTORIZED BY**

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Date: 2011