

INSTITUTO POLITÉCNICO NACIONAL
SECRETARÍA ACADÉMICA
DIRECCIÓN DE EDUCACIÓN SUPERIOR



SYNTHESIZED SCHOOL PROGRAM

ACADEMIN UNIT: Escuela Superior de Cómputo

ACADEMIC PROGRAM: Ingeniería en Sistemas Computacionales

LEARNING UNIT: SCADA Systems

LEVEL: III

AIM OF THE LEARNING UNIT :

The student evaluates all the different subsystems that belong to a data acquisition system based on the supervision of industrial processes.

CONTENTS:

- I. Introduction to SCADA systems.
- II. Industrial Interfaces for data communication.
- III. Human Machine Interfaces (H.M.I.).

TEACHING PRINCIPLES:

This unit is formulated based on a project oriented learning strategy and the heuristic method, this is to promote the cognitive processes after the development of the abstraction abilities, analysis and design of supervised control and data acquisition systems, by using the appropriate analysis techniques and practical applications that shows evidence on the concepts from this unit. The learning techniques to employ will be: Problem solving, collaborative and participatory work, documental investigation, led discussions, worksheets, graphic organizers and a final project.

EVALUATION AND PASSING REQUIREMENTS:

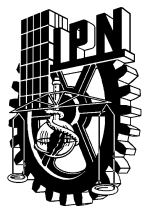
This unit is going to be evaluated from a projects portfolio consisting of: formative and summative assessments beside self and co- evaluation rubrics.

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:

- Bailey, D. Wright, E. (2003). *SCADA for industry, IDC Technologies*. Great Britain: Elsevier. ISBN 0750658053.
- Boyer, S. (2009). *SCADA: Supervisory Control and Data Acquisition*, 4^a ed., Great Britain: ISA. ISBN: 1936007096.
- Clarke, G. Wright, E. (2004). *Practical Modern, SCADA Protocols, DNP3, 60870.5 and Related System*. Unites States: Elsevier. ISBN 9780750657990.
- Krutz, R. (2006). *Security SCADA Systems*. Unites States: Wiley. ISBN 9780764597879.
- Rodriguez, A. (2007). *Sistemas SCADA guía practica*. España: Marcombo. ISBN 978426714558.



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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: SCADA systems

TYPE OF LEARNING UNIT: Theoretical - Practical, Optative.
VALIDITY: August 2011

LEVEL: III

CREDITS: 7.5 TEPIC – 4.39 SATCA

ACADEMIC AIM

This unit contributes to the graduate profile of the computer system engineer, by developing their abilities to design supervised control and data acquisition systems, applying advanced technology, like high integration devices on the solution of computational problems as well as the implementation and evaluation of these systems. A critical, strategically and creative thinking is allowed besides a collaborative work and assertive communication.

This unit requires mainly of the learning units: Computer architectural, Digital systems design, Introduction to microcontrollers, Instrumentation, Object Oriented Programming, database to manipulate the data received from the supervised physical variables to implant the Control and Supervision System

AIM OF THE LEARNING UNIT:

The student evaluates all the different subsystems that belong to a data acquisition system based on the supervision of industrial processes.

CREDIT 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
Subdirector Académico

APPROVED BY:

Ing. Apolinar Francisco Cruz Lázaro
Presidente del CTCE.

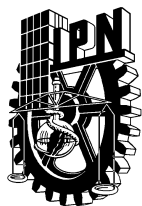
AUTHORIZED BY: Comisión de Programas Académicos del Consejo General Consultivo del IPN. 2011

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



THEMATIC UNIT : I		TITLE: Introduction to SCADA systems				
UNIT OF COMPETENCE						
The student classifies the components of a SCADA system based on their application in the control and supervising systems.						
No.	CONTENTS	Teacher led-instruction HOURS		Autonomous Learning HOURS		REFERENCES KEY
		T	P	T	P	
1.1	SCADA system definition.	0.5		2.0		1B,2B,3B,5B
1.2	Real time systems	2.0				
1.3	Fundamental principles of modern SCADA systems.	2.0		2.0		
1.4	SCADA system architecture.	1.5		3.0		
1.4.1	Software.					
1.4.2	Hardware.					
1.4.3	Communication network.					
1.5	Comparison of SCADA, DCS, PLC and smart instruments.	1.5		3.0		
1.6	New technologies in SCADA systems.	1.5		3.0		
	Subtotals:	9.0		13.0		
TEACHING PRINCIPLES						
This thematic unit must begin with a framing of the course and the formation of teams, a lecture of the main topics is given by the facilitator, by using the heuristic method.						
The approach to this unit is using the project oriented learning strategy and the heuristic method. This approach is going to permit encourage of the next learning strategies: brainstorming, investigation reports, documental researching, led discussions, conceptual maps, problem solving, lectures given by the team of complementary topics and reports of practicals.						
LEARNING EVALUATION						
Diagnostic Test						
Project Portfolio:						
Worksheet		10%				
Conceptual Map		10%				
Exercise-solving		15%				
Cooperative presentation		10%				
Proposal of project		15%				
Self-Evaluation Rubric		5%				
Co-Evaluation Rubric		5%				
Written Learning Evidence		30%				

THEMATIC UNIT: II		TITLE: Industrial Interfaces for data communication					
UNIT OF COMPETENCE							
The student analyzes data acquisition and distribution systems based on any of the communication interface available.							
No.	CONTENTS	Teacher led-instruction HOURS		Autonomous Learning HOURS		REFERENCES KEY	
		T	P	T	P		
2.1	Wiring.	1.5		1.5		1B,2B,3B,6C	
2.1.1	Interference and noise in wires.						
2.1.2	Origin of interference and noise in wires.						
2.1.3	Noise and interference reduction methods in wires						
2.1.4	Wire Types						
2.1.5	Communications subsystem's Components.						
2.2	Protocols.	1.5	1.5	3.0	3.0		
2.2.1	MODBUS.						
2.2.2	DNP.						
2.2.3	Other protocols.	1.5					
2.3	Local area network						
2.3.1	Topologies.			2.0	3.0		
2.3.2	Ethernet IEEE 802.3.						
2.3.3	Wireless network.						
2.4	Modems.	1.5	1.5				
2.4.1	MODEM Description and use.						
2.4.2	Standard interfaces RS232, RS422 y RS485.						
2.4.3	Flow control.						
2.4.4	Modulation techniques			3.0	4.5		
2.4.5	Data communication error correction, detection and compression.						
	Subtotals:	6.0	3.0	9.5	10.5		
TEACHING PRINCIPLES							
The approach to this unit is using the project oriented learning strategy and the heuristic method. This approach is going to permit encourage of the next learning strategies: brainstorming, investigation reports, documental researching, led discussions, conceptual maps, problem solving, lectures given by the team of complementary topics and reports of practicals.							
LEARNING EVALUATION							
Project Portfolio:							
Conceptual map		5%					
Cooperative presentation		5%					
Exercise-solving		10%					
Report of practicals		30%					
Advance of the Project		10%					
Self Evaluation Rubric		5%					
Co-Evaluation Rubric		5%					
Written Learning Evidence		30%					



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LEARNING UNIT:

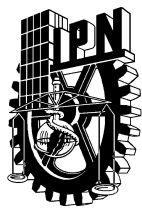
SCADA Systems

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RECORD OF PRACTICALS

No.	NAME OF THE PRACTICAL	THEMATIC UNITS	DURATION	ACCOMPLISHMENT LOCATION
1	Data acquisition system	II y III	4.5	Computer Labs.
2	Digital Control	II y III	4.5	
3	Embedded WEB server I.	II y III	4.5	
4	Embedded WEB server II.	II y III	4.5	
5	Wired network devices	II y III	4.5	
6	Wireless network devices	II y III	4.5	
		HOURS	27.0	
EVALUATION AND PASSING REQUIREMENTS				
The practicals are considered mandatory to pass this learning unit. The practicals worth 30% of the grade in thematic units II and III				



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LEARNING UNIT:

SCADA Systems

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PERIOD	UNIT	ASSESSMENT PROCEDURE
1	I	Continuous evaluation 70% and written learning evidences 30%.
2	II	Continuous evaluation 70% and written learning evidences 30%.
3	III	Continuous evaluation 100%. The learning unit I is 20% worth of the final score The learning unit II is 40% worth of the final score The learning unit III is 40% worth of the final score Other means to pass this Learning Unit: <ul style="list-style-type: none">Evaluation of acknowledges previously acquired, with based 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.

CLAVE	B	C	BIBLIOGRAFÍA
1	X		Bailey, D. Wright, E. (2003). <i>SCADA for industry</i> , IDC Technologies. Great Britain: Elsevier. ISBN 0750658053.
2	X		Boyer, S. (2009). <i>SCADA: Supervisory Control and Data Acquisition</i> . 4 ^a ed., Great Britain: ISA. ISBN: 1936007096.
3	X		Clarke, G. Wright, E. (2004). <i>Practical Modern, SCADA Protocols, DNP3, 60870.5 and Related System</i> . Unites States: Elsevier. ISBN 9780750657990.
4		X	Krutz, R. (2006). <i>Security SCADA Systems</i> . Unites States: Wiley. ISBN 9780764597879.
5	X		Rodriguez, A. (2007). <i>Sistemas SCADA guía practica</i> . España: Marcombo. ISBN 978426714558.
6		X	Douglas, E. (2006). <i>Internetworking with TCP/IP, Volume 1</i> . 5 ^a ed. Unites States: Addison-Wesley. ISBN: 9780131876712.
7		X	Wheat, J. Hiser, R. (2001). <i>Designing a Wireless Network, Understand How Wireless Communication works</i> . Unites States: Syngress. ISBN: 1-928994-45-8
8		X	Wiles, J. Claypoole, T. (2007). <i>Techno Security's Guide to Securing SCADA</i> . Unites States: Elsevier. ISBN 9781597492829.



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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:	Profesional	Terminal and Integration
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ACADEMY: Sistemas Distribuidos **LEARNING UNIT:** SCADA Systems

SPECIALTY AND REQUIRED ACADEMIC LEVEL: Masters Degree or Doctor in Computer Science, Control Engineering or similar.

2. AIM OF THE LEARNING UNIT:

The student evaluates all the different subsystems that belong to a data acquisition system based on the supervision of industrial processes.

3. PROFESSOR EDUCATIONAL PROFILE:

KNOWLEDGE	PROFESSIONAL EXPERIENCE	ABILITIES	APTITUDES
<ul style="list-style-type: none">• Data acquisition systems• Industrial protocols• Human Machine Interfaces• Computer architecture• Microprocessors and microcontrollers• Communications• Operative systems• Structured programming and object oriented programming• Software engineering• Unified Modeling Language• MEI knowledge.	<ul style="list-style-type: none">• One year in digital systems design• One year in industrial networks• One year using simulation software• One year in groups management and collaborative work• One year experience in the Institutional Educational Model.	<ul style="list-style-type: none">• Analysis and synthesis• Group management• Verbal fluency• Teaching skills• Problem solving• Leadership• TIC knowledge	<ul style="list-style-type: none">• Responsible.• Honest.• Respectful.• Tolerant.• Assertive.• Collaborative.• Participatory.• Social and institutional commitment

DESIGNED BY

REVISED BY

AUTHORIZED BY

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Subdirector Académico

Ing. Apolinar Francisco Cruz Lázaro
Director

Date: 2011