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: Systems Simulation   **LEVEL:** III

AIM OF THE LEARNING UNIT:
The student Designs simulations of complex systems based on mathematical methods and computational models.

CONTENTS:
  I.   Fundamentals of simulation models.
  II.   Modeling of complex systems.
  III. Valid and credible Simulation Models

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:
  • Cellier, F.E. Kofman, E. (2006). *Continuous System Simulation.* (1a Ed.). Berlin: Springer-Verlag. ISBN: 978-0387261027.
  • Fábregas Ariza, A. Wadnipar Rojas, R. Paternina Arboleda, C. Mancilla Herrera, A. (2007). *Simulación de sistemas productivos con Arena* (1ª Reimpresión). Colombia: Ed. Universidad del Norte (Ediciones Uninorte). ISBN (13): 958-8133-24-6.
  • Fritzson, P. (2006). Introducción *al Modelado y Simulación de Sistemas Técnicos y Físicos con Modelica* (1ª Edición). España: Ed. Addlink media. ISBN (13): 978-84-611-2094-9.
  • Torres Vega, P. (2010). *Simulación de sistemas* (1ª Edición). Lima: Ed. Universidad de Lima. Fondo Editorial. ISBN (13): 978-99-724-5240-6.
  • Zeigler, B.P. (2012). Guide *to Modeling and Simulation of Systems of Systems.* (1a Ed.). Berlin: Springer-Verlag. ISBN: 978-0857298645.

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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: Systems Simulation
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 Probability and Statistics with knowledge for dynamic stochastic modeling and calculations applied in the use of theoretical tools to characterize dynamic processes.

AIM OF THE LEARNING UNIT:

The student Designs simulations of complex systems based on mathematical methods and computational models.

CREDITS HOURS	LEARNING UNIT DESIGNED BY: Academia de Ciencias de la Computación	AUTHORIZED BY: Comisión de Programas Académicos del Consejo General Consultivo del IPN
THEORETICAL CREDITS / WEEK: 3.0		
PRACTICAL CREDITS / WEEK: 1.5	**REVISED BY:** Dr. Flavio Arturo Sánchez Garfias. Subdirección Académica	
THEORETICAL HOURS / SEMESTER: 54		
PRACTICAL HOURS / SEMESTER: 27		**Ing. Rodrigo de Jesús Serrano Domínguez**
AUTONOMOUS LEARNING HOURS: 54	**APPROVED BY:** Ing. Apolinar Francisco Cruz Lázaro. Presidente del CTCE	**Secretario Técnico de la Comisión de Programas Académicos**
CREDITS HOURS / SEMESTER: 81		

THEMATIC UNIT: I **TITLE:** Fundamentals of simulation models

UNIT OF COMPETENCE
The student exemplifies Simulation schemes for basic problems based on mathematical methods.

No.	CONTENTS	Teacher led-instruction HOURS		Autonomous Learning HOURS		REFERENCES KEY
		T	P	T	P	
1.1 1.1.1 1.1.2 1.1.3	The nature of the simulation Computer simulation Rrandom Numbers Evolution of the simulation time	2.0		3.0	2.0	1C, 2C, 3B, 4B, 5B
1.2 1.2.1 1.2.2 1.2.3	Systems, models and simulation System analyst Model and program Analysis: policies and performance measures	3.0		3.0	3.0	
1.3 1.3.1	Steps in a simulation study Evaluation of simulation models	3.0	1.0	4.0	3.0	
	Subtotals:	8.0	1.0	10.0	8.0	

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:

Technical data	5%
Charts	5%
Exercise-solving	10%
Cooperative Presentation	10%
Report of Practicals	20%
Proposal of project	10%
Self-Evaluation Rubrics	2%
Cooperative Evaluation Rubrics	3%
Written Learning Evidence	35%

THEMATIC UNIT: II					TITLE: Modeling of complex systems	

UNIT OF COMPETENCE

The student analyzes output data sets based on the theory of measurements.

No.	CONTENTS	Teacher led-instruction HOURS		Autonomous Learning HOURS		REFERENCES KEY
		T	P	T	P	
2.1 2.1.1 2.1.2 2.1.3	Output data analysis for a simple Collection and processing of simulated data Multiple simulations and confidence intervals Interpretation of results	2.0		3.0	2.0	1C, 2C, 3B, 4B, 5B
2.2 2.2.1 2.2.2 2.2.3	Comparing alternative system configurations Discrete event simulation System Dynamics Agent-based Simulation	3.0		4.0	3.0	
2.3 2.3.1 2.3.2	Application Example: Simulation of manufacturing systems Causal diagrams and Forrester Synergy	3.0	1.0	3.0	3.0	
	Subtotals:	8.0	1.0	10.0	8.0	

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:

Technical data	5%
Charts	5%
Computer programs w/reports	10%
Cooperative Presentation	10%
Advance of project	30%
Report of Practicals	10%
Self-Evaluation Rubrics	2%
Cooperative Evaluation Rubrics	3%
Written Learning Evidence	25%

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THEMATIC UNIT: III   **TITLE:** Valid and credible Simulation Models

UNIT OF COMPETENCE

The student creates valid simulation models of complex systems based on mathematical methods.

No.	CONTENTS	Teacher led-instruction HOURS		Autonomous Learning HOURS		REFERENCES KEY
		T	P	T	P	
3.1 3.1.1 3.1.2 3.1.3	Basics Systems Analysis System Design Application systems	2.0		2.5	2.0	1C, 2C, 3B, 4B, 5B
3.2	Some principles of simulation models valid	2.0		2.5	2.0	
3.3 3.3.1 3.3.2 3.3.3	A three-step approach to developing simulation models valid and credible Component Specification Specification of variables and parameters Specification of functional relationships	2.0		2.5	2.0	
3.4	Verification of computer simulation programs	2.0	1.0	2.5	2.0	
	Subtotals:	8.0	1.0	10.0	8.0	

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:

Technical data	5%
Charts	5%
Computer programs w/reports	10%
Cooperative Presentation	10%
Project report	50%
Report of Practicals	15%
Self-Evaluation Rubrics	2%
Cooperative Evaluation Rubrics	3%

RECORD OF PRACTICALS

No.	NAME OF THE PRACTICAL	THEMATIC UNITS	DURATION	ACCOMPLISHMENT LOCATION
1	Fundamentals of simulation models.	I	9.0	Computer Lab
2	Modeling of complex systems.	II	9.0	
3	Simulation models valid and credible.	III	9.0	
		TOTAL OF HOURS	27.0	

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 II.
The practicals worth 15% in thematic unit III.

PERIOD	UNIT	EVALUATION TERMS
1	I	Continuous evaluation 65% and written learning evidence 35%
2	II	Continuous evaluation 75% and written learning evidence 25%
3	III	Continuous evaluation 100%
		The learning unit I is 30% worth of the final score
		The learning unit II is 30% worth of the final score
		The learning unit III is 40% worth of the final score
		Other means to pass this Learning Unit:
		I. Evaluation of acknowledges previously acquired, with base in the issues defined by the academy.
		II. Official recognition by either another IPN Academic Unit of the IPN or by a national or international external academic institution besides IPN.

KEY	B	C	REFERENCES
1		X	Cellier, F.E. Kofman, E. (2006). *Continuous System Simulation*. (1a Ed.). Berlin: Springer-Verlag. ISBN: 978-0387261027.
2		X	Fábregas Ariza, A. Wadnipar Rojas, R. Paternina Arboleda, C. Mancilla Herrera, A. (2007). *Simulación de sistemas productivos con Arena* (1ª Reimpresión). Colombia: Ed. Universidad del Norte (Ediciones Uninorte). ISBN (13): 958-8133-24-6.
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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	Professional	Terminal and Integration

ACADEMY: Ciencias de la Computación **LEARNING UNIT:** Systems Simulation

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

2. AIM OF THE LEARNING UNIT:
The student Designs simulations of complex systems based on mathematical methods and computational models.

3. PROFFESSOR EDUCATIONAL PROFILE:

KNOWLEDGE	PROFESSIONAL EXPERIENCE	ABILITIES	APTITUDES
- Methods of analysis of algorithms. - Algorithm design techniques. - Simulation Systems - 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