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: Bioinformatics **LEVEL:** III

AIM OF THE LEARNING UNIT:
The student Produces the structural, functional and evolutionary information in biological sequences biochemical and biophysical knowledge based on coding in the language of biological sequences.

CONTENTS:

I. Introduction to Bioinformatics and Biomathematics.
II. Visualization of biomolecules and sequence analysis.
III. Physical modeling and activity – structure relation.

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:

- Abel Fabre, F. (2001). Bioética: orígenes, presente y futuro. (1ª Ed.). España: Instituto Borja de Bioética. ISBN (10): 84-7100-799-1.
- Alonso Bedate, C. Mayor Zaragoza, F. (2003). Gen-Ética. (1ª Ed.). Barcelona, España: Editorial Ariel. ISBN (10): 84-344-1241-1.
- Ashby, W.R. (1957). An Introduction To Cybernetics. (2a Ed.). London: Chapman & Hall. ISBN (13): 978-0412056703.
- Attwood,T. K. Parry-Smith, D. J. (2002). Introducción a la Bioinformática (1ª Ed.). Madrid, España: Prentice Hall. ISBN (13): 978-8420535517.
- Bollobás, B. (1979). Graph theory: an introductory course. (1a Ed.). New York: Springer Verlag. ISBN (13): 978-0387903996.

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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: Bioinformatics
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 of Engineering in Computer Systems 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 from learning units Probability and Statistics with the knowledge to analyze information, Advanced Mathematics for Engineering and Discrete Mathematics with the use of theoretical tools to characterize the objects of study.

AIM OF THE LEARNING UNIT:
The student Produces the structural, functional and evolutionary information in biological sequences biochemical and biophysical knowledge based on coding in the language of biological sequences.

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 Ciencias de la Computación

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:** Introduction to Bioinformatics and Biomathematics.

UNIT OF COMPETENCE

The student describes biological systems based on the fundamentals of Bioinformatics and Biomathematics.

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 1.1.4	Introduction to Bioinformatics General systems theory Bioinformatics Biological sequences Bioethics	3.0	1.5	6.0	3.0	B1, B3, C4, C7, C8, C9, C10, C11, C12, C15
1.2 1.2.1 1.2.2 1.2.3 1.2.4 1.2.5 1.2.6	Basics of Biomathematics Matrix algebra Optimization Combinatorics Graph theory Information Theory Grammars	3.0	1.5	6.0	3.0	
	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 the heuristic 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:

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

THEMATIC UNIT: II **TITLE:** Visualization of biomolecules and sequence analysis.

UNIT OF COMPETENCE

The student analyzes sequences of biomolecules based bioinformatics tools.

No.	CONTENTS	Teacher led-instruction HOURS		Autonomous Learning HOURS		REFERENCES KEY
		T	P	T	P	
2.1 2.1.1 2.1.2	Viewing biomolecules Types of scientific visualization Generation of computer graphics	3.0	1.5	6.0	3.0	B1, B3, C4, C13
2.2 2.2.1 2.2.2 2.2.3 2.2.4	Sequence Analysis Pattern Recognition Threading homology Phylogenetic Genomics	3.0	1.5	6.0	3.0	
	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:

Technical data	5%
Charts	5%
Computer programs	10%
Cooperative Presentation	10%
Report of Practicals	10%
Advance of the Project	30%
Self-Evaluation Rubrics	2%
Rubric of Co-Evaluation	3%
Written Learning Evidence	25%

THEMATIC UNIT: III **TITLE:** Physical modeling and activity – structure relation.

UNIT OF COMPETENCE

The student Simulates physical and biological events based structure activity relationship between biomolecules.

No.	CONTENTS	Teacher led-instruction HOURS		Autonomous Learning HOURS		REFERENCES KEY
		T	P	T	P	
3.1	Physical-biological modeling of biomolecules	3.0	1.5	6.0	3.0	B2, C4, C5, C14
3.1.1	Potential Landscape					
3.1.2	Molecular Dynamics					
3.1.3	Monte Carlo methods					
3.1.4	Structure prediction					
		3.0	1.5	6.0	3.0	
3.2	Structure activity relationship between biomolecules					
3.2.1	Quantifying the business relationship - structure					
3.2.2	Biomolecular docking					
3.2.3	Combinatorial models					
	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:

Technical data	5%
Charts	5%
Computer programs	20%
Cooperative Presentation	10%
Report of Practicals	10%
Self-Evaluation Rubrics	5%
Cooperative Evaluation Rubrics	5%
Project Report	40%

RECORD OF PRACTICALS

No.	NAME OF THE PRACTICAL	THEMATIC UNITS	DURATION	ACCOMPLISHMENT LOCATION
1	Biological information	I	3.0	Computer Labs.
2	Computer Tools for Biomathematics	I	6.0	
3	Interactive visualization of biomolecules	II	3.0	
4	Homology modeling	II	6.0	
5	Biomolecular Simulation	III	3.0	
6	Search for drug candidates	III	6.0	
		TOTAL OF HOURS	27	

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 10% in thematic unit III.

PERIOD	UNIT	EVALUATION TERMS
1 2 3	I y II III IV	Continuous evaluation 65% and written learning evidence 35% Continuous evaluation 75% and written learning evidence 25% 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: • 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.

KEY	B	C	REFERENCES
1	X		Abel Fabre, F. (2001). *Bioética: orígenes, presente y futuro*. (1ª Ed.). España: Instituto Borja de Bioética. ISBN (10): 84-7100-799-1.
2	X		Alonso Bedate, C. Mayor Zaragoza, F. (2003). *Gen-Ética*. (1ª Ed.). Barcelona, España: Editorial Ariel. ISBN (10): 84-344-1241-1.
3	X		Ashby, W.R. (1957). *An Introduction To Cybernetics*. (2a Ed.). London: Chapman & Hall. ISBN (13): 978-0412056703.
4		X	Attwood,T. K. Parry-Smith, D. J. (2002). *Introducción a la Bioinformática* (1ª Ed.). Madrid, España: Prentice Hall. ISBN (13): 978-8420535517.
5		X	Bollobás, B. (1979). *Graph theory: an introductory course*. (1a Ed.). New York: Springer Verlag. ISBN (13): 978-0387903996.
6		X	Brookshear, J. G. (2000). *Teoría de la computación: lenguajes formales, autómatas y complejidad.* (3ª Ed.). México: Addison Wesley Longman. ISBN (13): 978-9684443846.
7		X	Cuevas, G. Cortés, F. (2003). *Introducción a la Química Computacional*. (1ª Ed.). México: Fondo de Cultura Económica. ISBN (13): 978-9681671051.
8		X	Gibas, C. Jambeck, P. (2001). *Developing Bioinformatics Computer Skills*. (1a Ed.). USA: O'Reilly. ISBN (13): 978-1600330292.
9		X	Grimaldi Ralph, P. (1998). *Matemáticas discreta y combinatoria: Introducción y aplicaciones*. (3ª Ed.). México: Addison-Wesley Iberoamericana. ISBN (13): 978-9684443242.
10		X	Grossman, S. I. (2008). *Algebra lineal*. (6ª Ed.). México: Mc Graw-Hill. ISBN (13): 978-9701008904.
11		X	Hearn, D. Baker, P. (2005). *Gráficos Por Computadora Con Opengl*. (3a Ed.). Madrid, España: Pearson Educación. ISBN (13): 978-8420539805.
12		X	Leach, A. (2001). *Molecular Modelling: Principles and Applications.* (2a Ed.). Singapur: Prentice Hall. ISBN (13): 978-0582382107.
13		X	Sarabia, A.A. (año). *La Teoría General de Sistemas*: Ingeniería de Sistemas. (1a Ed.). Madrid, España: editorial. ISBN (13): 978-9681815677.
14		X	Schlick, T. (2002). *Molecular Modeling and Simulation - An Interdisciplinary Guide*. (2a Ed.). New York: Springer. ISBN (13): 978-0387954042.
15		X	Xiong, J. (2006). *Essential Bioinformatics*. (1a Ed.). London: Cambridge University Press. ISBN (13): 978-0521840989.

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SECRETARÍA ACADÉMICA

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: Ciencias de la Computación **LEARNING UNIT:** Bioinformatics

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

2. AIM OF THE LEARNING UNIT:

The student Produces the structural, functional and evolutionary information in biological sequences biochemical and biophysical knowledge based on coding in the language of biological sequences.

3. PROFESSOR EDUCATIONAL PROFILE:

KNOWLEDGE	PROFESSIONAL EXPERIENCE	ABILITIES	APTITUDES
• Methods of analysis of algorithms. • Algorithm design techniques. • Bioinformatics • 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