ITSON
Educar para Trascender

NOMBRE DEL CURSO: SYSTEM DYNAMICS
CLAVE/ID CURSO: 1133G / 006993
DEPARTAMENTO: DPTO CS. AGUA Y MEDIO AMBIENTE
BLOQUE/ACADEMIA A LA QUE PERTENECE: moelacion ambiental
INTEGRANTES DEL COMITE DE DISEÑO: Dr. Agustin Robles-Morua, Dr. Jaime Garatuza, Dra. Zulia Sanchez, Dr. Luis Mendez

REQUISITOS: Requisito de System Dynamics: Ecuaciones Diferenciales e Ingles Universitario B1 I
HORAS TEORÍA: 3
HORAS LABORATORIO: 0
HORAS PRÁCTICA: 0
CRÉDITOS: 5.62
PROGRAMA(S) EDUCATIVO(S) QUE LO RECIBE(N): Ingenieria en Ciencias Ambientales
PLAN: 2016
FECHA DE ELABORACIÓN: Febrero 2019

Competencia a la que contribuye el curso: Gestion Ambiental	**Tipo de Competencia** Básica
Competencia(s) generica(s) de impregnación: Specific	**Nivel de Dominio** Básico

Descripción general del curso: This course belongs to the 6th semester, of the Environmental Management block. It consists of 3 competency units in which the student will learn the basic foundations of the systems approach, construction of dynamics models, which will help them in the decision-making process within the field of environmental sciences and as support for subsequent courses of environmental and subterranean hydrology, environmental impact assessment, environmental modeling and sustainable management of natural resources among others. The course includes the topics of identification and representation of the interrelationships of the components of a system, construction of a dynamic model, estimation of the parameters, validation of the model and preparation of sensitivity analysis. In addition, it will develop generic skills such as sustainability and problem solving. For which differential equations and foundations of environmental engineering are required as previous prerequisites

Unidad de Competencia 1	**Elementos de Competencia**	**Requerimientos de Información**
Provide the fundamental knowledge about the concepts associated with system dynamics and modeling according to the theory of systems.	Describe the basic concepts of systems theory, according to Donella Meadows. Explain the fundamental dynamic patterns of the environment. Schematize the stages of the simulation / modeling of different processes of the environment	SYSTEM DYNAMICS • Introduction • Concepts of system theory • Classification of systems. o Linear and non-linear o Static and dynamic o Dynamic balance and stability • Fundamental dynamic patterns • Stages of the modeling / simulation process.

Criterios de Evaluación

	Evidencias	**Criterios**
Desempeños	•□Solve exercises to identify the different components and their type of different examples of dynamic environmental systems.	•□Assignments will be delivered within the defined deadlines and following the specific format where the student's full name, assignment number and delivery date are included. •□All the work must be shown, not just presenting the solutions to the problems.
Productos	•□Solving theoretical exercises on different examples of dynamic environmental systems.	•□The presentation of the results of the exercises will be adapted to the criteria and methodology indicated by the teacher (format, content and presentation). •□In the exercises, the conversion constants suitable for the handling of units of different environmental systems will be used. •□In the exercises, the different components of a dynamic system will be defined.
Con	•□Fields of application in Environmental Engineering. •□Key concepts: System dynamics, cause and effect, fundamental patterns in the environment, feedback loops, dynamic stability, simulation and modeling the environment.	

Conocimientos	

Unidad de Competencia 2	**Elementos de Competencia**	**Requerimientos de Información**
Build diagrams of Stocks and flows to represent environmental systems (models).	•□Symbolically represent a dynamic model for an environmental system. •□Categorize the variables as Stocks and flows in a dynamic model of environmental systems. •□Use feedback loops to incorporate the dynamics in an environmental system.	STOCKS and FLOWS: •□Stock Variables. •□Flow Variables. •□Auxiliary and constant variables. •□Feedback loops. •□Construction of influence diagrams

Criterios de Evaluación

	Evidencias	**Criterios**
Desempeños	•□Solve exercises to identify the different components and their type of different examples of dynamic environmental systems.	•□Assignments will be delivered within the defined deadlines and following the specific format where the student's full name, assignment number and delivery date are included. •□All the work must be shown, not just presenting the solutions to the problems.
Productos	•□Solve exercises about how to conceptualize different types environmentally related systems.	•□The presentation of the results of the exercises will be adapted to the criteria and methodology indicated by the teacher (format, content and presentation). •□In the exercises, the conversion constants suitable for the handling of units of different environmental systems will be used. •□In the exercises, the different components of a dynamic system will be defined using diagrams (STOCKS and FLOWS). •□Conduct exercises with practical cases of real examples of environmental systems
Conocimientos	•□Fields of application in Environmental Engineering. •□Key concepts: State variables, fundamental patterns of growth in the environment, feedback loops, dynamic stability.	

Unidad de Competencia 3	**Elementos de Competencia**	**Requerimientos de Información**
Design, develop and validate population and other environmental dynamic models (exponential, logistic, monod and oscillatory).	•□Use numerical methods of simulation using a computer package (EXCEL and VENSIM). •□Explain the most common growth models by means of differential equations. •□Solve exponential, logistic and oscillatory models in numerical form and by means of computer packages (EXCEL and VENSIM).	•□Construction of a Stocks and flows model. •□Population growth models. •□Growth and decay models (exponential and logistic). - Numerical simulation - Differential equation - Computational solution •□Oscillatory models. - Numerical simulation - Differential equation - Computational solution

		•□Use of EXCEL and VENSIM software for modeling.

Criterios de Evaluación		
	Evidencias	**Criterios**
Desempeños	•□Solve exercises in specialized software to perform simulations and evaluate the interrelationships of the components of different types of environmental dynamic systems.	•□Assignments will be delivered within the defined deadlines and following the specific format where the student's full name, assignment number and delivery date are included. •□All the work must be shown, not just presenting the solutions to the problems.
Productos	•□Exercises solved in computer or through mathematical expressions about different examples of dynamic environmental systems.	•□The presentation of the results of the exercises will be adapted to the criteria and methodology indicated by the teacher (format, content and presentation). •□In the exercises, the conversion constants suitable for the handling of units of different environmental systems will be used. •□In the exercises, the different components of a dynamic system will be defined using diagrams (STOCKS and FLOWS). •□Conduct exercises with practical cases of real examples of environmental systems
Conocimientos	•□Fields of application in Environmental Engineering. •□Key concepts: State variables, fundamental patterns of growth in the environment, feedback loops, dynamic stability. •□Case studies: Project on exponential bacterial growth. Project on growth and decay. Project on the prey-predator model. Project on population growth in a community of Sonora. Project on the system of dams and surface water of the Yaqui River basin.	

Evaluación del curso	
Criterio	**Ponderación**
Unidad de competencia 1	20%
Unidad de competencia 2	20%
Unidad de competencia 3	60%
	100% (Cumpliendo total de criterios)

Bibliografía Básica				
Autor	**Titulo**	**Edición**	**Editorial**	**ISBN**
Juan Martin-Garcia	Theory and practical exercises of system dynamics	2006	MIT PRESS	84-609-9804-5

Software del Curso				
Tipo	**Nombre**	**Versión**	**Licencia**	**Disponible en ITSON**
Software Básico	Vensim PLE	(Student version)	Disponible en CISCO	Si
Software Básico	Microsoft Excel / Visual Basic	2010 en aedlante	Disponible en CISCO	Si