The Hashemite University **Faculty of Natural Res. & Eniron.** **Dept. Land Management & Environ.** **2nd Semester, 2010/2011**		**Dr. Mohammed I. Al-Qinna** **qinna@hu.edu.jo** **Env. Mathematical Modeling (1202478)** **3 Credit Hours (2 + 3)**

Courses Description:
The course sheds light on the concepts and procedure of modeling, solutions of some differential equations, Laplace Transform and initial value problems. The course examines why models are needed, how they tested, and used as decision- policy-making tools. Typical problems associated with environmental systems - spatial and temporal scale effects, dimensionality, variability, uncertainty, and data insufficiency are addressed. This course designed to using mathematical models of environmental systems.

Course Outline	Week
Introduction	1
Modeling Concepts 1- Modeling process, 2- Modeling concept, 3- Model verification, validation and calibration, 4- Approximation and errors, 5- Sensitivity analysis.	2
Descriptive, Regression and Spatial Statistics 1- Summarizing data, 2- Test for normality, 3- Criteria for regression model analysis, 4- Curve fitting procedure, 5- Criteria for choosing the best fit, 6- Nonlinear estimation, 7- Spatial statistics.	3-5
Models of Growth and Decay 1- Growth and decay models, 2- Growth analyses.	6-7
Artificial Neutral Networks, Decision trees and Data Mining 1- Artificial neural network, 2- Decision trees 3- Data mining.	8-9
Development of Conservation and Rate Equations 1- Conservation Equations, 2- Steady-state transport rate equations, 3- development of the transient-state equations, 4- nature of dynamic systems, **5-** Environmental process model.	10-11

Compartmental Analysis and Chemical Kinetics 1. Compartmental analysis, 2. One compartment systems, 3. Two compartment systems, 4. Chemical kinetics.	12-14
Numerical Approximation of Functions and Equations a- Approximation by Taylor's polynomial, b- Roots of polynomial equation, c- Numerical integration of functions, d- Solution of systems of linear equations, e- Numerical integration of ordinary differential equations, f- Numerical integration of systems of differential equations, g- Numerical integration of partial differential equations.	15-16

Books:

- Graedel, T.E. and B.R. Allenby. 1996. Desgin for environment. AT&T, Prentice Hall, Upper Saddle River, New Jersey.
- Jerlad L. Schnoor. 1996.Environmental Modeling: Fate and Transport of Pollutants in Water, Air and Soil. John Wiley & Sons, inc., New York.

Evaluation:

First Hour Exam	15%
Second Hour Exam	15%
Laboratory	20%
Final Hour Exam	50%

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Laboratory Description:

This laboratory course train students on the modeling techniques, concepts and procedure for simple and complex solutions of linear and nonlinear differential equations. The students will be trained using powerful statistical programming software. The lab also defines solutions using Laplace Transforms selected according to initial value problems and boundary conditions. The laboratory exercises details the students on examining, testing, and validation of the final models using adequate theories. Typical problems associated with environmental systems of both spatial and temporal scale effects, dimensionality, variability, uncertainty, and data insufficiency are addressed.

Laboratory Exercise	Week
Introduction To JMP Programming Software	**1**
Database and data Entry	**2**
Data Distribution Analysis: Measure of Central Tendency, Measure of dispersion, Measure of shape.	**3-4**
Linear Regression Analysis: Criteria for regression model analysis, Curve fitting procedure, Criteria for choosing the best fit.	**5-6**
Advanced Linear Regressions: Stepwise Regression, Logestic regression, Multivariate analyses.	**7-8**
Nonlinear Modeling: Formula Editing, Estimation and Parameterization, Understanding the Nonlinearity concept, Criteria for choosing the best fit.	**9-10**
Data Mining: Fuzzy logic Modeling, Artificial neural network Modeling, Spatial Modeling.	**11-12**
Derivation of Conservation Differential Equations: Steady-state transport rate equations, Development of the transient-state equations.	**13-14**
Solution of Conservation Differential Equations: Function of boundary conditions, examples.	**15-16**

Book:

- Jerlad L. Schnoor. 1996. Environmental Modeling. John Wiley & Sons, inc., New York.

Evaluation:

Assignments	10%
Final Hour Exam	10%

Program:

Product: JMP
Release: 6 BUSINESS UNIT OF SAS