The University of Jordan
School of Engineering
Civil Engineering Department

M.Sc. Water and Environment
Second Semester 2018/2019
Elective course

Course name: Simulation in Environmental Engineering
Course number: 0901776

Course Description: Material balance formulation, mass transfer processes, biological and chemical kinetics, ideal flow reactors, general flow systems, gas exchange and stream reparation dissolved exchange and stream reparation, dissolved oxygen balance equations, streams, lakes and estuarine analysis, modeling of biochemical oxygen demand, nitrification, photosynthesis and other water quality parameters, general applications

Course objectives
1. Recognize the purpose, uses and development process of simulation
2. Understand the different modeling types, their scope and limitations
3. Understand the idea, methodology and basic tools of environmental modeling
4. Develop a model for an environmental problem
5. Recognize the role of simulation in environmental management & decision making

Textbook:
Selected chapters from:
1- Nirmalkhandan N. (2001) Modeling Tools for Environmental Engineers and Scientists, CRC Press, Boca Raton, Florida.
2- Zhen-Gang Ji, (2007), HYDRODYNAMICS AND WATER QUALITY MODELING RIVERS, LAKES, AND ESTUARIES, John Wiley & Sons, Inc., Hoboken, New Jersey
3- Marcello Benedini, George Tsakiris (2013) Water Quality Modelling for Rivers and Streams
4- Ashok Kumar Verma (2015) Process Modelling and Simulation in Chemical, Biochemical and Environmental Engineering, CRC Press, Boca Raton, Florida.
5- Mohammed Abdel-Magid and Isam Abdel-Magid (2017) Computer modeling applications for environmental engineers. CRC Press, Boca Raton, Florida.
6- Aral MM (2010) Environmental Modeling and Health Risk Analysis, Springer.
7- Schnelle K.B. and Dey P.R. (1999) Atmospheric Dispersion Modelling Compliance Guide,McGraw-Hill.
8- J.C.Gibbings, Dimensional Analysis, Springer
9- Søren Asmussen and Peter W. Glynn, Stochastic Simulation: Algorithms and Analysis, Springer.

Suggested reading:
1- Floor Brouwer (1987) Integrated Environmental Modelling: Design and Tools, Martinus Nijhoff Publishers, Dordrecht
2- L.Benarie M.M. (1980) Urban Air Pollution Modelling, Cambridge, MA: The MIT Press.
3- Dunnivant F.M. and Anders E. (2006) A Basic Introduction to Pollutant Fate and Transport, John Wiley & Sons, Inc., New Jersey.

4- Ramaswami A., Milford J.B. and Small M.J. (2005) Integrated Environmental Modelling, John Wiley and Sons, Inc., New Jersey.
5- Schnoor J.L. (1996) Environmental Modeling, John Wiley & Sons, Inc., New York.
6- Zannetti P. (1990) Air Pollution Modelling, Theories, Computational Methods and available Software, Van Nostrand Reinhold, New York
7- Clark M. Mark (2009), Transport Modeling For Environmental Engineers and Scientists, Wiley
8- Wymore, A. 1993. *Model-Based Systems Engineering*. Boca Raton, FL, USA: CRC Press
9- Estefan, J. 2008. *Survey of Candidate Model-Based Systems Engineering (MBSE) Methodologies,* Revision B. Pasadena, CA, USA: International Council on Systems Engineering (INCOSE), INCOSE-TD-2007-003-02.

Topics covered: Students will be exposed to the details of modeling and simulation technologies. They will cover the following:
Introduction to simulation and modeling, Type of models: Physical models, Mathematical models, and Numerical models. Types of Mathematical model. Types of Numerical Models. Mathematical and numerical models development process. Error propagation, uncertainty and sensitivity analysis. Simulating environmental systems and pollution problems.

Grading
Mid term exam 30%
Projects and Term papers 30%
Final Exam 40%