CEE 690
Modeling Hydrologic-Hydraulic Systems

Catalog data:	20-CEE-690. Modeling Hydrologic-Hydraulic Systems. 3 ug./gr. cr. Urban Runoff, Hydrologic Abstractions, Saint Venant Equations, Continuous Simulation, Water Quality, Numerical Methods
Prerequisites:	Hydraulic Systems (20-CEE-493) and Hydrology (20-CEE-543).
Textbook:	1. SWMM Hydrology: Rain, Temperature and Runoff; James, William and Robert C. James, 2000 2. SWMM Hydraulics: Extran, Transport and Storage; James, William and Robert C. James, 2000. 3. ProSTORM Program Documentation - Storage, Treatment, Overflow, Runoff Model (STORM); Dodson & Associates, Houston, TX
References:	StormWater Mgmt. Model (SWMM)- Version 4 User Manual; U.S.EPA, Athens, GA; selected journal articles & extensive class handouts.
Coordinator:	Edward H. Burgess, Adjunct Associate Professor and Associate, CDM; 513.352.5430 burgesseh@cdm.com
Goals:	The course provides students at the senior/graduate level with an opportunity to develop an understanding of the theoretical basis of several widely used hydrologic and hydraulic computer models and to gain practical experience with their application.
Lecture or lab topics:	1. Introduction to types of models, numerical methods, modeling objectives, model limitations, and model selection criteria. 2. Review of basic hydrology (*rainfall hyetographs, return periods, IDF curves, abstractions, infiltration, excess rainfall, overland flow*). 3. Review of fundamental hydraulics (*steady vs. unsteady flow, concepts of energy/momentum, Bernoulli Equation, open channel vs. closed conduits, uniform vs. varied flow, supercritical vs. subcritical flow, St. Venant equations and kinematic wave approximation, backwater profile solution techniques*). 4. Review of surface water quality and non-point source pollution (*key pollutant constituents and sources, build-up/wash-off processes, Sartor and Boyd model, event mean concentrations*). 5. SWMM/RUNOFF theory: Horton vs. Green-Ampt for infiltration, land-use analysis for hydrologic parameters, kinematic wave routing; input coding techniques, output analysis, application guidelines, calibration parameters and techniques. 1. SWMM/EXTRAN theory: Inflow hydrographs, link-node representation of conduits and channels, wave celerity and time step selection, use of equivalent conduits, model representation of appurtenances (weirs, pumps, orifices, storage basins), computational methods for free surface vs. surcharge flow conditions, debugging numerical instabilities, input coding techniques, output analysis, application guidelines, calibration parameters and techniques.

2. STORM model theory: STORM conceptualization of urban watersheds, use of long-term rainfall record, dry-weather flow computation, modified Rational Formula for runoff computation, unit storage and unit treatment concepts, mass balance computations for runoff-storage-treatment-overflow, modeled water quality parameters and computational techniques, input coding techniques, computation of overflow statistics, graphical analysis of model output, application guidelines, calibration parameters and techniques.

Computer usage:

1. Classes conducted in a CEE computer lab to enable each student to have individual access to microcomputer facilities for experimentation with the models as part of each class session.
2. Three homework assignments requiring computer model application (dataset preparation and editing, debugging of runtime errors and results interpretation) with each of the three models studied (SWMM/RUNOFF, SWMM/EXTRAN, STORM).
3. Group model sensitivity analysis exercises with in-class simulations by the students as they vary model input values for selected parameters and evaluate the results.
4. Use of spreadsheet software to pre-process model input data, organize datasets, and analyze model output.

ABET criterion 3: a, c, e, g, j, k

ABET criterion 8: a, b, e

Date prepared: January 28, 2003
Last Update : April 25,2007