SCHROETER AND ASSOCIATES
PRESENTS

Hydrologic Modelling For Water Resources/Environmental Practitioners

Course Description - Winter/Spring 2011

OBJECTIVES: Students who successfully complete this course will be able to:

1. Describe the major computational elements in a representative selection of deterministic hydrologic models, including both continuous and event models, covering the range in space and time aggregation from annual-time-interval lumped models to highly distributed models of small watersheds with time intervals of one hour or less (e.g. one minute).
2. Identify the physical quantities for which input data is required in the models described in (1) and give quantitative estimates of the range of values expected for each input quantity.
3. Identify and describe computational procedure, using state-of-the-art algorithms, for various processes included in a hydrologic model. It may include

    (a) Treatment of meteorological inputs (e.g. precipitation and air temperature).
    (b) Computation of infiltration and superficial water generation
    (c) Computation of watershed evapotranspiration.
    (d) Calculation of soil water storage changes in space and time
    (e) Computation of interception and depression storage.
    (f) Calculate snow accumulation, ablation (melt) and re-distribution
    (g) Calculation of contribution to ground water.
    (h) Computation of overland flow, reservoir and channel (flood) routing.

4. Make good initial estimates of key model input variables/parameters in the absence of calibration data.
5. Describe the procedure used to calibrate a watershed model and the criteria used to test its success.
6. Students will build a model of a sample watershed using representative hydrologic modelling software, and will learn how to calibrate and validate it, run sensitivity tests, and apply it for a practical application.

TEACHING AND LEARNING METHODS:

Lectures by the course instructor are video recorded and supplied on DVD (or in WebEx form), together with the course notes. These will be sent-out as required over the first 16 weeks. On-line tutorial help will be available with the instructor via e-mail or phone calls. Reference material for the lectures will be mostly the course notes and text, but also some technical papers and reports. Student learning will come through six practical assignments. Some of these can be handled using spreadsheet software (e.g. EXCEL or LOTUS), but the watershed modelling assignment will require a hydrologic modelling software package (e.g. GAWSER).

TEXT:

Hydrologic Modeling of Small Watersheds, C.T. Haan et al., 1982 (Out of print, copies included in course fee)

COURSE INSTRUCTOR:

Dr. Harold O. Schroeter, P.Eng., Schroeter & Associates - hydrologic modelling consultant
Regular office phone: 519-426-1658 (call for fax number) E-Mail: hschroet@mgl.ca

PROPOSED METHOD OF EVALUATION:

Assignments (all 6)	80%
Final examination (Take Home)	20%.

An outline of proposed topics, a tentative schedule of lectures and assignments due dates are given below.

PROPOSED TOPIC/LECTURE OUTLINE

1. Introduction to hydrologic modelling. These lectures give an overview of the hydrologic modelling task, defining general terms (e.g. routing, storage elements), describing how watersheds are represented in models by linked elements (schematics), and reasons/purpose for the modelling. A scheme for classifying models is given as a general framework for discussing different models throughout the course.

2. Abstractions from rainfall and snowmelt: This section reviews methods to compute abstractions (e.g. depression and interception storage, infiltration and evapotranspiration) from rainfall/snowmelt to provide estimates of runoff amounts, and contributions to subsurface or roundwater storage. The infiltration methods discussed will include: rational, SCS curve number, constant rate, Horton, Holton, Philips, Green-Ampt, and others. An initial treatment of precipitation inputs is given as well.

3. Reservoir and channel routing: Techniques for reservoir and channel routing are reviewed, including: storage-indication, linear and non-linear reservoirs, lag-and-route, progressive-average-lag, Muskingum (with the Cunge approximations for K and X), and kinematic and dynamic waves (derivation of the St. Venant equations included with an example finite difference solution).

4. Watershed (Overland Flow) Routing: Several methods are discussed: linear or n-linear reservoirs, unit hydrograph, time/area versus time, including releases from subsurface or groundwater storage (e.g. baseflow). Procedures for estimating key model parameters are outlined as well.

5. Watershed Evapotranspiration: The energy balance of a ground surface will be reviewed together with some simplified techniques to predict watershed evapotranspiration, including Penman and Linacre equations.

6. Snow accumulation, redistribution and ablation/melt procedures: These lectures include topics about snow cover distribution in different landscape units, measured patterns observed in the past 24 years, an approach to account for snow cover distribution in hydrologic models (e.g. ASAAM), and how to calculate snowmelt, using the GAWSER approach and by energy balance.

7. Treatment of Rainfall and other Meteorological Inputs: Issues relating to rainfall distribution, both in space and time (including influences of different time increments), as well as accuracy, are discussed, including some of the 'design events' (e.g. Regional Storm, SCS 24 hour, Chicago, AES 30%, PMP). Methods for 'filling-in' for missing data in meteorological records are presented as well.

8. Watershed Modelling (or putting it all together): These lectures deal with assembling the series of linked subcatchment, channel and reservoirs elements that form a complete model of a specific watershed. Information about how to estimate certain parameters, and topics relating to lumped versus distributed models, and event versus continuous simulation are discussed. Concepts relating to geomorphology are discussed regarding channel cross-section estimates when no elevation-distance tables exist, and other watershed characteristics.

9. Sensitivity Testing, Calibration, Verification and Validation: These lectures outline how to conduct (and why) sensitivity tests, and how to calibrate, verify and validate a hydrologic model, including explanations about what criteria are used to test the success of a particular model. Actual sensitivity and calibration/verification tests would be done on a sample model in the related assignment, including some discussion about identifying how well or not well certain processes are represented in the model. Some of the pitfalls/flaws in 'apparent' calibrations from the instructor's experience, particularly problems with the specified storms, are outlined as well.

10. Practical Applications: The purpose of these lectures is to broaden the students scope of awareness in hydrologic model applications, by presenting 'case studies' from some of the recent projects that the instructor as been involved in, including topics in flood forecasting, water budget and irrigation demand estimates, and instream flow requirements. The related assignment will be some practical application of the model that the student groups have developed. This could be a simple pre and post-development scenario, with a standard detention pond sizing activity. (for the correspondence course, these will all be case studies).

FINAL EXAMINATION

The final examination will be a 7-day take home one that will involve a practical modelling activity using the model developed by the students throughout the course assignments. Further details about the final examination will be released during Session 12 (around Lecture 34, Week 21).

COMPUTATIONAL ASSIGNMENTS

There will be six computational assignments, where the required documentation for possible submission to the course instructor will be informal inter-office type memos, a common practice in the consulting industry. *The first five assignments can be handled with spreadsheet-style computations* to help the student learn specific calculation procedures. The last assignment will involve use of a hydrologic modelling software package to build a working watershed model. That software package can be used for the other assignments as well.

HYDROLOGIC MODELLING SOFTWARE

The student may choose a particular hydrologic modelling software package that they are familiar with, and must identify the processes presented in the package to the course instructor. However, a representative program (the Guelph All-Weather Sequential-Events Runoff model, GAWSER) will be made available to the students for use in the course (the cost of this is included in the course fee).

PROPOSED SCHEDULE OF LECTURES AND ASSIGNMENT DUE DATES

The course will be carried-out over 25 weeks to make it possible for busy professionals to watch all the lectures, and complete the assignments in a reasonable amount of time. Consequently, all the lectures will be sent out by Week 15, so the students can concentrate on the watershed modelling assignment (No.6) for the last 8 weeks. You will be given 7 days to complete the final examination. The results of the final examination and Assignment 6 will be reported in Lecture 37 (which may be a webcast or something else). International Students will be mailed all course materials in one large package.

Session	Lectures	Week Number	Topics	Assignments
1	1, 2 & 3	1	Introduction to Hydrologic Modelling, classifying models	
2	4 5 & 6	2	Rainfall data and Design inputs Abstractions from rain/snowmelt 1	 Hand out 1
3	7, 8 & 9	4	Abstractions from rain/snowmelt 2	
4	10, 11 & 12	5	Reservoir, Channel & Watershed (Overland) Routing 1	Hand out 2 Collect 1
5	13, 14 & 15	7	Reservoir, Channel & Watershed (Overland) Routing 2	Hand-out 3
6	16 17, 18	9	Energy Balance and watershed evapotranspiration, Release Hydrologic Modelling software (GAWSER)	Hand-out 4 Collect 2 & 3
7	19, 20 & 21	11	Snow accumulation, melt and redistribution 1 (Distribution of Snow cover)	Collect 4
8	22 & 23 24	13	Snow accumulation, melt and redistribution 2, and Treatment of Meteorological inputs	Hand out 5
9	25, 26 and 27	15	Watershed Modelling ('putting it' all together) & virtual watershed tour Impacts of Watershed delineation	Hand out 6 Collect 5
10	28, 29, 30	17	Sensitivity Testing, Calibration, Verification & Validation 1	
11	31, 32, 33	19	Sensitivity Testing, Calibration, Verification & Validation 2	
12	34, 35, 36	21	Practical Applications – Case Studies 1, 2 and 3	
		Weeks 15 to 22	Students working on Assignment No. 6	
		23		Collect 6
13	Exam	24	Take-home examination distributed by e-mail (to be completed by Week 25)	
14	37	25	Wrap-up – reporting results of Assignment 6 and Take home exam	

NOTES: There are a total of 18 Lecture DVDs, each one about 150 minutes in length.

REGISTRATION FORM

HYDROLOGIC MODELLING COURSE

Course registration is limited, so return this form to the Course Instructor ASAP. You can start the course as soon as we receive payment, at which time course materials will be sent out.

The course registration fee of $1,400 is payable to ***Schroeter & Associates***, and must be paid before any course materials are sent out. Include this form with your payment. We accept Visa or Mastercard.

NAME: ______________________________

AFFILIATION: ______________________________

ADDRESS: ______________________________

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TELEPHONE: **1- (   ) -** ______________________________

FAX: **1- (   ) -** ______________________________

E-MAIL: ______________________________

PREREQUISITES: Have you attended an undergraduate course in hydrology? (Y/N) __________

If no, contact the course instructor for special permission to participate.

Credit Card No: ______________________ Expiry Date: ______________

Card Signature: ______________________ For Office Use: ______________

Send or e-mail (scan this page) this registration form to

Hydrologic Modelling Course
c/o Schroeter & Associates
68 Parker Drive, Simcoe, Ontario. N3Y 1A4 (**E-mail Address**: hschroet@mgl.ca.)

NOTE: This registration form will serve as the invoice for course fee payment
HST (13%) is included in the course fee (#124878679 RT0001).