SCHOOL OF ENGINEERING
UNIVERSITY OF GUELPH

WATERSHED SYSTEMS DESIGN
ENGG *4250

COURSE OUTLINE
FALL 2007
Instructor: Doug Joy

Calendar Description

Hydrological analysis of watershed systems including stream flow for design of structures and channels, flood warning, flood plain mapping, low-flow characteristics. Hydraulic analysis applied to design of dams, reservoirs, control structures, energy-dissipation structures, bridges and culverts. Analysis of steady-flow profiles, flood waves, and sediment transport, for design of natural and constructed channels, and protective works for rivers to achieve environmentally sustainable land use in watershed systems.

Prerequisites ENGG*2230 and ENGG*3650

Detailed Objectives

At the successful completion of this course, the student will have demonstrated ability to:

(i) Apply hydrological techniques to obtain flow volumes and flowrates for design of conveyance and storage systems used in management of watershed flows.

(ii) Apply the laws of conservation of mass, energy and momentum to the analysis of hydraulic conditions in conduits, open channels, control structures and storage facilities.

(iii) Translate water-related needs into system performance criteria for design purposes.

(iv) Design open channel networks for water conveyance and storage.

(v) Employ standard software in the solution of flow problems and in design calculations.

Subject Matter

Hydrological Calculations - modelling of flowrates and flow volumes from watersheds for design.

Application of Fluid Fundamentals - viscosity, surface tension, pressure force, buoyancy; flow, energy head and head loss.

Open Channel Flow - flow classification, energy and momentum principles, uniform flow, gradually varied flow, geomorphological features of natural channels.

Hydraulic Structures - dams and reservoirs, weirs and flumes, spillways and chutes, stilling basins and sediment traps, culverts, low-flow pipes and valves, pumps and turbines.

Management of Watershed Systems - flood warning, reservoir operations, operational procedures for optimum performance.

Instructor Doug Joy, Room 2342 Thornbrough; email: djoy@uoguelph.ca

Class time and Locations

Lectures	Monday	9:30 - 10:20	MACK 235
	Wednesday	9:30 - 10:20	MACK 235
	Friday	9:30 - 10:20	MACK 235
Laboratory	Thursday	15:30 - 17:20	MACK 236

Textbooks and Reference Books

The prescribed text is "Open Channel Hydraulics" by Sturm. In addition you will need to use a fluid mechanics text and a hydrology text such as those used in the prerequisite courses ENGG*2230 and ENGG*3650.

Reference books on reserve at the library are:

Bedient, P. B. 1992. *Hydrology and floodplain analysis*. McGraw-Hill New York.

Bureau of Reclamation. 1987. *Design of Small Dams*. 3rd Edition, U.S. Department of the Interior Denver.

Chow, V.T. 1959. *Open-Channel Hydraulics*. McGraw-Hill, New York.

Chow, V. T. 1988. *Applied hydrology.* Mc Graw-Hill.

Henderson, F.M. 1966. *Open Channel Flow.* Macmillan Publishing New York.

Hwang. N.C. 1986. *Fundamentals of Hydraulic Engineering Systems*. Prentice Hall New York.

Petersen, M.S. 1986 *River Engineering*. Prentice-Hall Toronto

Course Organization

The proposed schedule of lecture topics is shown in Table 1. Lectures will be used for the presentation of new material while the tutorial/lab periods will be used for the assignments and questions relating to these and the project.

One term project will be undertaken in two parts. The first part (hydrological analysis) will be assigned September 27th, to be completed by October 26th and the second part (design report) is to be completed by November 23rd with a presentation the following week.

Two (2) field trips to local sites are planned for the laboratory/tutorial sessions tentatively scheduled for October 4th and November 8th. "Provide-your-own" transportation arrangements will be required for these trips.

Examinations

The mid-term test of two (2) hours duration will held during the laboratory/tutorial session scheduled for November 1st. The final examination date is December 4th at 8:30.

It is expected that students will devote a minimum of five (5) hours per week (in addition to the scheduled time) to the course. Preparation for examinations will require additional time.

Basis of Course Grade

The course grade will be determined to be either the mark assigned for the final examination or a composite mark calculated from the following weightings:

Laboratory/tutorial assignments	-	15%
Term projects	-	35%
10% for phase I,		
15% for phase II,		
5% for your writing		
5% presentation		
Mid-term test	-	20%
Final examination	-	30%

If you obtain a failing mark in both the mid-term test and the final examination, the course grade will be the mark based on the examinations alone. In all other cases, the course grade will be based on the composite mark.

Individual Computational/Laboratory Assignments

During the semester there will be approximately six (6) laboratory/tutorial assignments. Each assignment will be distributed during the Wednesday morning lecture period, discussed in the tutorial, and completed reports are due by the Wednesday of the following week.

Design Reports

Each of the two design reports will be presented in a suitable format such as that specified for course ENGG*3100. The report team may be either an individual student or two students. If two students work together they must remain together for the two reports. One student must do all the text writing for the first report and the second student all the text writing for the second report. The specific contents for each report will be given in the request for design.

TABLE 1: Approximate Lecture schedule for ENGG*4250 - Watershed Systems Design.

Lectures	*Subject Matter*
6	Coverage in Fluid Mechanics and Hydrology of fluid properties, pressure forces, Bernoulli equation with headloss, runoff generation, hydrograph modelling, routing calculations.
9	Flow in channels (uniform flow, Chezy and Manning's equation, specific energy and specific force, subcritical, supercritical flow, hydraulic jump, flow profiles in gradually varied flow, optimal hydraulic shape, and computation for complex channels)
3	Geometry of natural channels, sediment transport equations, design of channels for natural function
5	Hydraulic structures and machinery (weirs, flumes, culverts, bridge openings, spillways, stilling basins, low-flow pipes, valves, pumps, turbines)
6	System operations (reservoir outlet sizing, operation rules for gated and ungated structures, flood forecasting, flood wave behaviour)
6	Watershed management including flood-zone mapping, flood damage mitigation by combinations of structural interventions and land-use regulation, conjugate use of surface and groundwater, mitigation of non-point-source pollution in channels and receiving water.