SCHOOL OF ENGINEERING
UNIVERSITY OF GUELPH

WATERSHED SYSTEMS DESIGN
ENGG *4250

COURSE OUTLINE
Winter 2012
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 the ability to:

(i) Apply hydrological techniques to obtain flow volumes and flow rates for the 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 flow rates 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, THRN 2342; email: djoy@uoguelph.ca

Class time and Locations

Lectures	Tue	8:30-10:00	MACN202
	Thu	8:30-10:00	MACN202
Laboratory	Tue	1:30 - 3:20	CRSC403

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 2. 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 projects.

There will be three design projects throughout the semester. Each of these projects will be completed in groups of two and each group will need to make a presentation to the class on one of the projects. You may select your own groups and these must be selected by January 16th, after that time groups will be assigned. Group names are to be submitted by email to the instructor.

All materials for the course will be communicated through the Courselink website for the course. All lecture notes, assignments and other information will be posted prior to being discussed in class. It is expected that all students will have access to this information in the class.

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

Examinations

The final examination date is April 11, 7:00 PM

Basis of Course Grade

Laboratory/tutorial assignments	-	20%
Projects (3 @ 15% each)	-	45%
Final examination	-	35%

You must obtain a passing grade (>50%) on the final exam to pass the course. If you do not, your final exam mark will be your final grade.

Individual Computational/Laboratory Assignments

During the semester there will be approximately five laboratory/tutorial assignments. These will typically be available on Monday of the week they are assigned, discussed on the Tuesday tutorial and be due the following Monday. These are to be done in a format suitable for an engineering office as outlined in ENGG*1100. All assignments should be submitted as a hard copy unless specifically identified in the assignment. Late assignments will be accepted with a 10% penalty per day late.

Design Projects

Each of the three design reports will be presented in a suitable format such as that specified for course ENGG*3100. Important dates for the projects are outlined in Table 1. With three design projects each group will be required to present their design solution to the class and be prepared to defend their design solution and calculations. Your presentation and ability to handle technical questions will make up part of your grade on the design report.

Table 1: Project Dates

Design Project	Due Date	Presentation Date
#1	Feb 6	Feb 7
#2	Mar 5	Mar 6
#3	Mar 26	Mar 27

TABLE 2: 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.