UM | Faculty of Agricultural and Food Sciences

SOIL 7230: Advanced Topic in Landscape Characterization and Processes I

Course Syllabus
Fall 2023

Course Calendar Description:
An examination of methods of landscape characterization and of landscape processes, their impacts, interactions and modelling. Prerequisite: SOIL 3600, SOIL 4510, or SOIL 4530 or consent of the instructor.

Instructor/Coordinators:
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General Course Information:
SOIL 7230 provides graduate students with access to a variety of advanced topics pertaining to landscape characterization and processes. This is the first of two such courses, the second being *SOIL 7240: Advanced Topic in Landscape Characterization and Processes II*. These are independent courses that provide complementary information and training. SOIL 7230 is not a prerequisite for SOIL 7240. As a pair, these courses provide both breadth and depth of training in fundamental knowledge, methodologies and modelling of landscape processes.

Each course is delivered in three 4-week modules. Modules are selected by the instructor, in consultation with the students, and are designed to meet the needs of the graduate students in their research programs and to provide breadth to their training. Three modules must be successfully completed for each of SOIL 7230 and SOIL 7240.

Course Content:
Modules include, but are not limited to:

Module A: Land Resources Data and Information
- An examination of the availability of, and the strengths and weakness of the available land resources data and information.

Module B: Topographic Analysis
- Datums and coordinates
- Methods of collecting of topographic data (theodolites to GPS to image analysis)
- Accuracy, precision, reliability of topographic data
- Topographic analyses (e.g., gradients, curvatures, convergence, source area)
- Landform classification

Module C: Geostatistical Analysis
- Spatial description (e.g., moving-window statistics)
- Spatial continuity (e.g., variograms)
- Point estimation (e.g., inverse distance)
- Kriging, block kriging, cokriging

Module D: Impacts and Assessment of Soil Erosion and Sedimentation
- Indicators of soil erosion (e.g., radioisotopes)
- Impacts on biophysical processes (e.g., crop growth, GHG emissions)
- Issues of scale

Module E: Wind and Water Erosion
- Fluid mechanics and erosion
- Factors affecting wind and water erosion
- Interactions with other landscape processes
- Experimental materials and methods

Module F: Tillage Erosion
- Mechanics of soil movement by tillage
- Factors affecting tillage erosion
- Interactions with other landscape processes
- Experimental materials and methods

Module G: Landscape Hydrology
- Movement of water into, through and over the landscape
- Factors affecting water movement
- Interaction with landscape processes

Module H: Formation and Evolution of Soils and Landscapes
- Origin of soil and landscapes and their modification through natural processes and human activities
- Soil geomorphology: the relationships between soils and landscapes

Module I: Modelling
- Modelling approaches (e.g., conceptual, numerical and analytical, physical and stochastic)
- Model development, including verification techniques
- Data sources and quality (e.g., reliability, continuity, consistency)
- Programming (e.g., R language)
- Model evaluation using sensitivity analysis and validation
- Interpretation of model output (e.g., uncertainty analyses)

Fall 2023 Offering

The **first module** will focus on the origins of the soils and landscapes within Northern Great Plains (Module H above), the land resource data and information available to describe them (A above), and the impacts of human activities on these data and information (D above).

The **second module** will focus on the methods used to measure properties and processes within landscapes (E, F, G above), and the need for and means of characterizing spatial and temporal variability of these properties and processes (C above).

The **third and final module** of the course will be based on Module I, modelling, is intended to assist students in applying an environmental model of their choice, one that complements their individual research interests. The focus of this module is understanding the value of and techniques for the evaluation of model performance to ensure that meaningful results are achieved. There is only one assignment that will be developed and executed individually with the instructor (one-on-one) over a 3- to 4-week period. The intent is to thoroughly examine and evaluate the behaviour/performance of one component of the selected model.

Course Delivery:
The course consists of one introductory session, three 4-week modules, and one concluding session. Each module consists of one 2-3-hour session per week for four weeks. Each session includes a lecture from the instructor, discussion of readings, and discussion of assignments and course project. This is to be supplemented by group and one-on-one discussion and instruction and by an additional 2 to 4 hours per week of individual study. The course will be delivered in a classroom, but the internet and telecommunication will be used to facilitate remote teaching and learning.

Course Materials:
Selected documents will be given to students as required readings. Many of these documents will be selected by and shared between students. No textbook is required.

Course Work:
Multiple assignments will be carried out in each module. These assignments include written reviews of readings, quantitative exercises, and oral presentations. Each student will submit a written report at the end of the course, and this report will demonstrate the student's understanding of the materials they covered in the course. Normally, this report will take the form of a compendium of each student's assignments, incorporating feedback received during the course, and including an overview demonstrating the integration of the knowledge gained and its application to their thesis project.

Course Evaluation:
Each of the three modules is equally weighted, 33.3% of the student's final grade. A combination of assignments, presentations and participation will be used to assess student performance. Students will be graded on: 1) their preparation for and participation in class discussions of readings; 2) their performance on module assignments; and 3) their performance on the course report. A Grade of A will be based on the superior understanding of the materials covered, demonstrating insight, clarity and originality.

General Marking Scheme:
Module 1: 22%: 7% participation, 15% assignment(s)
Module 2: 22%: 7% participation, 15% assignment(s)
Module 3: 22%: 7% participation, 15% assignment(s)
Final Report 34%