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OFFICE OF THE SENATE COUNCIL

1. General Information

1a. Submitted by the College of: ARTS &SCIENCES

Date Submitted: 3/6/2014

1b. Department/Division: Earth and Environmental Sciences

1c. Contact Person

Name: Kevin Yeager

Email: kevin.yeager@uky.edu

Phone: 859-257-5431

Responsible Faculty ID (if different from Contact)

Name: 10801447

Email: kevin.yeager@uky.edu

Phone: 859-257-5431

1d. Requested Effective Date: Semester following approval

1e. Should this course be a UK Core Course? No

2. Designation and Description of Proposed Course

2a. Will this course also be offered through Distance Learning?: No

2b. Prefix and Number: EES 685

2c. Full Title: Groundwater Modeling

2d. Transcript Title:

2e. Cross-listing:

2f. Meeting Patterns

LECTURE: 3

2g. Grading System: Letter (A, B, C, etc.)

2h. Number of credit hours: 3

2i. Is this course repeatable for additional credit? No

If Yes: Maximum number of credit hours:

If Yes: Will this course allow multiple registrations during the same semester?

2j. Course Description for Bulletin: This course teaches the basic concepts in groundwater modeling and provides basic exposure to standard modeling software.

2k. Prerequisites, if any: EES 585 Hydrogeology; or consent of instructor.

2l. Supplementary Teaching Component:

3. Will this course taught off campus? No

If YES, enter the off campus address:

4. Frequency of Course Offering: Spring,

Will the course be offered every year?: Yes

If No, explain:

5. Are facilities and personnel necessary for the proposed new course available?: Yes

If No, explain:

6. What enrollment (per section per semester) may reasonably be expected?: 15-20 students

7. Anticipated Student Demand

Will this course serve students primarily within the degree program?: Yes

Will it be of interest to a significant number of students outside the degree pgm?: Yes

If Yes, explain: [var7InterestExplain]

8. Check the category most applicable to this course: Traditional – Offered in Corresponding Departments at Universities Elsewhere,

If No, explain:

9. Course Relationship to Program(s).

a. Is this course part of a proposed new program?: No

If YES, name the proposed new program:

b. Will this course be a new requirement for ANY program?: No

If YES, list affected programs:

10. Information to be Placed on Syllabus.

a. Is the course 400G or 500?: No

b. The syllabus, including course description, student learning outcomes, and grading policies (and 400G-/500-level grading differentiation if applicable, from **10.a** above) are attached: Yes

Distance Learning Form

Instructor Name:

Instructor Email:

Internet/Web-based: No

Interactive Video: No

Hybrid: No

1.How does this course provide for timely and appropriate interaction between students and faculty and among students? Does the course syllabus conform to University Senate Syllabus Guidelines, specifically the Distance Learning Considerations?

2.How do you ensure that the experience for a DL student is comparable to that of a classroom-based student's experience? Aspects to explore: textbooks, course goals, assessment of student learning outcomes, etc.

3.How is the integrity of student work ensured? Please speak to aspects such as password-protected course portals, proctors for exams at interactive video sites; academic offense policy; etc.

4.Will offering this course via DL result in at least 25% or at least 50% (based on total credit hours required for completion) of a degree program being offered via any form of DL, as defined above?

If yes, which percentage, and which program(s)?

5.How are students taking the course via DL assured of equivalent access to student services, similar to that of a student taking the class in a traditional classroom setting?

6.How do course requirements ensure that students make appropriate use of learning resources?

7.Please explain specifically how access is provided to laboratories, facilities, and equipment appropriate to the course or program.

8.How are students informed of procedures for resolving technical complaints? Does the syllabus list the entities available to offer technical help with the delivery and/or receipt of the course, such as the Information Technology Customer Service Center (http://www.uky.edu/UKIT/)?

9.Will the course be delivered via services available through the Distance Learning Program (DLP) and the Academic Technology Group (ATL)? NO

If no, explain how student enrolled in DL courses are able to use the technology employed, as well as how students will be provided with assistance in using said technology.

10.Does the syllabus contain all the required components? NO

11.I, the instructor of record, have read and understood all of the university-level statements regarding DL.

Instructor Name:

SIGNATURE|MOKER|David P Moecher|EES 685 NEW Dept Review|20131115

SIGNATURE|RHANSON|Roxanna D Hanson|EES 685 NEW College Review|20140306

SIGNATURE|ZNNIKO0|Roshan N Nikou|EES 685 NEW Graduate Council Review|20140312

Courses | Request Tracking

New Course Form

https://myuk.uky.edu/sap/bc/soap/rfc?services=

Open in full window to print or save

Generate R

Attachments:

Browse... Upload File

	ID	Attachment
Delete	3188	EES 685 - GW Modeling Syllabus-Revised - A Sawyer

First 1 Last

Select saved project to retrieve... Get New

(*denotes required fields)

1. General Information

a. * Submitted by the College of: ARTS & SCIENCES Submission Date: 3/6/2014

b. * Department/Division: Earth and Environmental Sciences

c.

* Contact Person Name: Kevin Yeager Email: kevin.yeager@uky.edu Phone: 859-257-5431

* Responsible Faculty ID (if different from Contact) 10801447 Email: kevin.yeager@uky.edu Phone: 859-257-5431

d. * Requested Effective Date: ◉ Semester following approval OR ○ Specific Term/Year [1]

e.

Should this course be a UK Core Course? ○ Yes ◉ No

If YES, check the areas that apply:

☐ Inquiry - Arts & Creativity	☐ Composition & Communications - II
☐ Inquiry - Humanities	☐ Quantitative Foundations
☐ Inquiry - Nat/Math/Phys Sci	☐ Statistical Inferential Reasoning
☐ Inquiry - Social Sciences	☐ U.S. Citizenship, Community, Diversity
☐ Composition & Communications - I	☐ Global Dynamics

2. Designation and Description of Proposed Course.

a. * Will this course also be offered through Distance Learning? ○ Yes [4] ◉ No

b. * Prefix and Number: EES 685

c. * Full Title: Groundwater Modeling

d. Transcript Title (if full title is more than 40 characters):

e. To be Cross-Listed [2] with (Prefix and Number):

f. * Courses must be described by at least one of the meeting patterns below. Include number of actual contact hours[3] for each meeting pattern type.

3	Lecture		Laboratory[4]		Recitation		Discussion
	Indep. Study		Clinical		Colloquium		Practicum
	Research		Residency		Seminar		Studio
	Other	If Other, Please explain:					

g. * Identify a grading system: ◉ Letter (A, B, C, etc.) ○ Pass/Fail ○ Graduate School Grade Scale

h. * Number of credits: 3

i. * Is this course repeatable for additional credit? ○ Yes ◉ No

If YES: Maximum number of credit hours:

If YES: Will this course allow multiple registrations during the same semester? ○ Yes ○ No

j. * Course Description for Bulletin:

This course teaches the basic concepts in groundwater modeling and provides basic exposure to standard modeling software.

k. Prerequisites, if any:

EES 585 Hydrogeology; or consent of instructor.

l. Supplementary teaching component, if any: ○ Community-Based Experience ○ Service Learning ○ Both

3. * Will this course be taught off campus? ○ Yes ◉ No

If YES, enter the off campus address:

4. Frequency of Course Offering.

a. * Course will be offered (check all that apply): ☐ Fall ☑ Spring ☐ Summer ☐ Winter

b. * Will the course be offered every year? ◉ Yes ○ No

If No, explain:

5. * Are facilities and personnel necessary for the proposed new course available? ◉ Yes ○ No

If No, explain:

6. * What enrollment (per section per semester) may reasonably be expected? 15-20 students

7. Anticipated Student Demand.

a. * Will this course serve students primarily within the degree program? ◉ Yes ○ No

b. * Will it be of interest to a significant number of students outside the degree pgm? ◉ Yes ○ No

If YES, explain:

We anticipate students in the College of Engineering, particularly from the Department of Civil Engineering; and students from the College of Agriculture, particularly from the Department of Plant and Soil Sciences to

8. * Check the category most applicable to this course:

☑ Traditional -- Offered in Corresponding Departments at Universities Elsewhere
☐ Relatively New – Now Being Widely Established
☐ Not Yet Found in Many (or Any) Other Universities

9. Course Relationship to Program(s).

a. * Is this course part of a proposed new program? ○ Yes ◉ No

If YES, name the proposed new program:

b. * Will this course be a new requirement for ANY program? ○ Yes ◉ No

If YES, list affected programs::

10. Information to be Placed on Syllabus.

a. * Is the course 400G or 500? ○ Yes ◉ No
If YES, the *differentiation for undergraduate and graduate students must be included* in the information required in **10.b**. You must include: (i) identi additional assignments by the graduate students; and/or (ii) establishment of different grading criteria in the course for graduate students. (See SR

b. ☑ * The syllabus, including course description, student learning outcomes, and grading policies (and 400G-/500-level grading differentiation if appl **10.a** above) are attached.

[1] Courses are typically made effective for the semester following approval. No course will be made effective until all approvals are received.
[2] The chair of the cross-listing department must sign off on the Signature Routing Log.
[3] In general, undergraduate courses are developed on the principle that one semester hour of credit represents one hour of classroom meeting per week for a semester, exclusive of any laboratory meeting. Laboratory meeting, generally, re two hours per week for a semester for one credit hour. (from SR 5.2.1)
[4] You must also submit the Distance Learning Form in order for the proposed course to be considered for DL delivery.
[5] In order to change a program, a program change form must also be submitted.

Rev 8/09

Submit as New Proposal Save Current Changes

Syllabus—EES 685: Groundwater Modeling
3 credit lecture course, Slone Research Building, Rm. 203, day/time TBD

Professor: Dr. Audrey Sawyer, 111 Slone (e-mail audrey.sawyer@uky.edu, phone 218-1536)
Office hours: by appointment

Suggested reading:
Anderson and Woessner, 2002, Applied Groundwater Modeling

Course content and activities: This course teaches basic concepts in groundwater modeling and provides basic exposure to standard modeling software.

Prerequisites:
EES 585 Hydrogeology; or consent of instructor

Grading:
Participation: 10%
In-class exercises: 10%
Assignments: 45%
Final Project: 35%

- Handouts and links to readings will be available on Blackboard.
- Attendance is expected but not required. However, the best way to succeed is to attend class, since the software needed to complete assignments will be taught in lectures. There will be approximately 4 in-class exercises during the semester, and I will announce these exercises through Blackboard at least 2 days in advance. If you miss a lecture, get the notes from a classmate. You do not need to notify me about absences from lectures unless you miss an in-class exercise. I will arrange makeups for missed exercises in two cases: if you notify me in advance by email, or if you notify me within 1 week after the missed exercise and have an excused absence (serious illness, illness or death of family member, university-related trip, major religious holiday, or another reasonable and unforeseeable explanation that prevented you from providing advanced notice).
- In-class exercises: One or more modeling exercises may be conducted during any class period. These may include deliverables such as a graph or short write-up and will be given credit in approximate proportion to the effort required.
- Assignments: Up to 5 out-of-class assignments will be given. Late penalties for assignments will be 20% per day, unless you have spoken with me before the deadline and received my approval for an extension or have an excused absence on the deadline (serious illness, illness or death of family member, university-related trip, major religious holiday, or another reasonable cause for absence).
- Final Project: Students will be required to complete a final project involving the development and application of a groundwater model. The specific topic is optional. Projects that contribute to ongoing thesis research are encouraged. A short 1-2 page proposal for the final project is required. Project ideas must be approved ***prior to proposal submission***. The proposal should contain the following: (1) a clear justification for the project, (2) a description of the modeling methods that will be used, and (3) some discussion of what you might learn or accomplish (anticipated results). A final report will be submitted, and in-class presentations

will be conducted. This is a class assignment (not a formal research project); the goal is to explore an idea and generate some preliminary results that you can build upon later.

- Overall grades will be as follows: 90 and above = A; 80–90 = B; 70–80 = C; below 70 = E.
- I encourage you to ask me questions in or out of class, and you are welcome to discuss assignments with classmates. However, all submissions must ultimately be your own work. In your final project, cite all material that you summarize from any source. Plagiarism is a form of cheating. Cheating is a serious academic offense and will be met with an E in the course, in accordance with university regulations.
- If you have a documented disability that requires academic accommodations, please see me as soon as possible during office hours, or email me to schedule an appointment outside office hours. In order to receive accommodations for this course, you must provide me with a Letter of Accommodation from the Disability Resource Center. The center is located in Room 2, Alumni Gym. If you have not registered with the Disability Resource Center for coordination of campus disability services, please contact the Center by calling 257-2754 or email the center director, Jacob Karnes, jkarnes@email.uky.edu

Course goals:
The primary objective of this course is to develop familiarity with concepts and methods of mathematical and numerical modeling of saturated fluid flow and solute transport in the subsurface.

Learning outcomes:
By the end of the course, students will be able to:

- Explain each term in the groundwater flow and advection-dispersion equations.
- Explain advantages and disadvantages of finite element and finite difference techniques and choose the appropriate discretization scheme for your problem.
- Set up and solve the steady groundwater flow equation using finite difference and finite element approaches by hand or your own computer code.
- Understand the *art* of groundwater modeling, the basic approach, and how to avoid common pitfalls. Specifically, you will be able to choose an appropriate domain for a flow model, choose between von Neumann and Dirichlet boundary conditions, and identify problems with model set-up based on model results.
- Set up and run models in industry-standard software, including MODFLOW, MT3D, SUTRA, and the GUIs associated with Argus ONE. The ultimate goal is not expertise in particular software, but the ability to pick up a modeling tool and figure out how to use it.
- Know whether to use SUTRA, MODFLOW, or COMSOL for specific modeling problems.
- Read and understand other modeling studies and critically evaluate them.

Tentative class schedule (subject to change; readings as noted):
Week 1: Review of hydrogeologic concepts, introduction to developing mathematical models from conceptual models

Problem Set 1 (PS1) assigned

Week 2: Numerical solutions: Groundwater flow using finite difference approach
Week 3: Numerical solutions: Groundwater flow using finite element approach

PS1 due, PS2 assigned

Week 4: Introduction to modeling software GUIs: Argus ONE and MODFLOW

PS2 due, PS3 assigned

Week 5: MODFLOW, advective transport with MODPATH

Week 6: Fluid mass budgets and ZONEBUDGET, postprocessing tools

PS3 due, PS4 assigned

Week 7: Overview of solute transport concepts, analytical and numerical transport models

PS4 due, PS5 assigned

Week 8: MT3D, sorption and reactions

Week 9: Variable density flow and transport OR variably saturated flow (Richard's Equation)

PS5 due, final project and presentation guidelines/rubrics distributed

Week 10: Variable density or saturation modeling with SUTRA

Ideas for final projects due for approval.

Week 11: Heat transport and multiphysics modeling with COMSOL

Lineup for final presentations randomly selected from hat and announced.

Weeks 12-14: Work on final projects and give presentations

Project write-ups are due the last day of classes. There is no final exam.