FORM 40G REV. 1/07

REQUEST FOR ADDITION, EXPIRATION, OR REVISION OF A GRADUATE COURSE (500-600 LEVEL)

EFD 26-12

DEPARTMENT: Agricultural and Biological Engineering

EFFECTIVE SESSION: Fall

INSTRUCTIONS: Please check the items below which describe the purpose of this request.

☑ 1. New course with supporting documents (complete proposal form)
□ 2. Add existing course offered at another campus
□ 3. Expiration of a course
□ 4. Change in course number
□ 5. Change in course title
□ 6. Change in course credit/type
□ 7. Change in course attributes
□ 8. Change in instructional hours
□ 9. Change in course description
□ 10. Change in course requisites
□ 11. Change in semesters offered
□ 12. Transfer from one department to another

	PROPOSED:	EXISTING:
Subject Abbreviation	ABE	
Course Number	65100	
Long Title	Environmental Informatics	
Short Title	Environmental Informatics	

Abbreviated title will be entered by the Office of the Registrar if omitted. (22 CHARACTERS ONLY)

TERMS OFFERED
Check All That Apply:
□ Summer ☑ Fall □ Spring

CAMPUS(ES) INVOLVED
□ Calumet
□ Cont Ed
□ Ft. Wayne
□ Indianapolis
□ N. Central
□ Tech Statewide
☑ W. Lafayette

CREDIT TYPE

1. Fixed Credit: Cr. Hrs. 3
2. Variable Credit Range:
   Minimum Cr. Hrs
   (Check One) To □ Or □
   Maximum Cr. Hrs
3. Equivalent Credit: Yes □ No □
4. Thesis Credit: Yes □ No □

COURSE ATTRIBUTES: Check All That Apply

1. Pass/Not Pass Only □
2. Satisfactory/Unsatisfactory Only □
3. Repeatable □
   Maximum Repeatable Credit: □
4. Credit by Examination □
5. Designator Required □
6. Special Fees □
7. Registration Approval Type
   Department □ Instructor □
8. Variable Title □
9. Remedial □
10. Honors □
11. Full Time Privilege □
12. Off Campus Experience □

Instructional Type	Minutes Per Mtg	Meetings Per Week	Weeks Offered	% of Credit Allocated	Delivery Method (Asyn. Or Syn.)	Delivery Medium (Audio, Internet, Live, Text-Based, Video)
Lecture	50	2	15	45	Syn	Live
Recitation						
Presentation						
Laboratory	110	1	15	55	Syn	Live
Lab Prep						
Studio						
Distance						
Clinic						
Experiential						
Research						
Ind. Study						
Pract/Observ						

Cross-Listed Courses

COURSE DESCRIPTION (INCLUDE REQUISITES):

This course will educate students in the use, manipulation and analysis of environmental data by introducing them to scripting languages (e.g. c-shell, python), data types (e.g. ASCII, binary, NetCDF), databases (e.g. XML, DBF) and data visualization software (e.g. GMT, ArcMap) as well as techniques for checking data quality, working with missing data, and handling large and diverse sources of time series and spatial data. Students will manipulate, check and insert data from a variety of sources, use that data as input to a distributed hydrologic model, analyze model output and learn methods for properly documenting their data use (creation of metadata) and long-term archival storage of those data. The course format will consist of two 1 hour lectures and a 2 hour computer lab weekly. Skills learned should be applicable to most computer operating systems, but the majority of work for this class will be done within the Unix/Linux environment. Students taking this course should have experience with one or more programming languages, including but not limited to C, Fortran, Perl, Python, Java, Basic, or to writing scripts or macros within programs such as MatLab, S-Plus, R, SAS.

Calumet Department Head ____ Date ____
Calumet School Dean ____ Date ____
Calumet Undergrad Curriculm Committee ____ Date ____

Fort Wayne Department Head ____ Date ____
Fort Wayne School Dean ____ Date ____
Fort Wayne Chancellor ____ Date ____

Indianapolis Department Head ____ Date ____
Indianapolis School Dean ____ Date ____
Undergrad Curriculm Committee ____ Date ____

North Central Department Head ____ Date ____
North Central Chancellor ____ Date ____
Date Approved by Graduate Council ____

7/17/12
West Lafayette Department Head ____ Date ____
West Lafayette College/School Dean ____ Date ____
Graduate Council Secretary ____ Date ____

Graduate Area Committee Convener ____ Date ____
Graduate Dean ____ Date ____
West Lafayette Registrar ____ Date ____

OFFICE OF THE REGISTRAR

TO: The Faculty of the College of Engineering
FROM: Department of Agricultural and Biological Engineering
RE: New Graduate Course, ABE 65100 Environmental Informatics

The faculty of the Department of Agricultural and Biological Engineering have approved the following new course. This action is now submitted to the Engineering Faculty with a recommendation for approval.

ABE 65100 Environmental Informatics

Sem. 1, Class 2, Lab 2, Cr. 3.
Requisites, Restrictions, and Attributes: Graduate student standing

Description: This course will educate students in the use, manipulation and analysis of environmental data by introducing them to scripting languages (e.g. c-shell, python), data types (e.g. ASCII, binary, NetCDF), databases (e.g. XML, DBF) and data visualization software (e.g. GMT, ArcMap) as well as techniques for checking data quality, working with missing data, and handling large and diverse sources of time series and spatial data. Students will manipulate, check and insert data from a variety of sources, use that data as input to a distributed hydrologic model, analyze model output and learn methods for properly documenting their data use (creation of metadata) and long-term archival storage of those data. The course format will consist of two 1 hour lectures and a 2 hour computer lab weekly. Skills learned should be applicable to most computer operating systems, but the majority of work for this class will be done within the Unix/Linux environment. Students taking this course should have experience with one or more programming languages, including but not limited to C, Fortran, Perl, Python, Java, Basic, or to writing scripts or macros within programs such as MatLab, S-Plus, R, SAS.

Reason: Data volumes in the environmental field are increasing with the release of field observations, advent of sensor networks, the increase in the number of high-resolution and multispectral remote sensing images, and the increasing use of distributed models. To most effectively utilize these new and varied data streams, students require a new tool box of skills so that they can handle data in a wide variety of formats, and manipulate large numbers of files or even just a few very large files. Additionally, there is an increasing understanding by funding agencies that open access and sharing of data should be a requirement for public funding and will facilitate collaboration. NSF in particular has stated a belief that future breakthroughs will be driven by advanced computing techniques that will facilitate the collaborative exploration and mining of data sets, and now requires proposals to include a data management plan to address long-term storage and accessibility to publically funded data sets.

This course will teach a level of technological literacy that is in increasing demand in Agricultural and Biological Engineering, the Colleges of Agriculture, Engineering and Science, and in environmental sciences in general. Skills developed in this course will be valuable in other upper level graduate courses that focus more on data analysis and use, such as ABE 59100-011 Ecohydrology, AGRY 59800-027 Advanced Topics in Hydrology, CE 54900 Computational Watershed Hydrology. It is also listed as a tools course for the Ecological Sciences and Engineering (ESE) program (currently listed as ABE 69100-001 Environmental Data Handling).

This course is related to the eight courses at Purdue with Bioinformatics in the title (BIOL 47800, CHM 48900, CNIT 22700, CNIT 55800, CS 47800, CSCI 54800, STAT 47800, STAT 581), with CNIT 55800 Bioinformatics Computing and Systems Integration perhaps having the most in common with this course. However, those courses cater to students with a background in pharmaceuticals, biotechnology, genetics and life sciences, while environmental informatics is designed for students with backgrounds in agriculture, hydrology, climatology and environmental sciences. This course is also related to many of the programming courses offered through Purdue, however, the focus for this course is not on any one language but on how to using programming techniques to streamline and automate the processing of large data sets.

This course is intended for graduate students in environmental sciences and engineering programs, including those from Agricultural and Biological Engineering, Civil Engineering, Earth and Atmospheric Sciences, Agronomy, and Forestry and Natural Resources. The course was taught as Environmental Informatics during the fall of 2010 (8 students) and fall of 2011 (15 students). The students who took the course were from Agricultural and Biological Engineering, Agronomy, Forestry and Natural Resources, and Civil Engineering. In the fall of 2011 several of the students who enrolled were from the Ecological Sciences and Engineering program.

Bernard A. Engel　　　　　　Date: March 16, 2012
Professor and Head
Agricultural and Biological Engineering Department

APPROVED FOR THE FACULTY
OF THE SCHOOLS OF ENGINEERING
BY THE ENGINEERING
CURRICULUM COMMITTEE

ECC Minutes ______________
Date 7/30/2012
Chairman ECC R. Cipra

Name of Instructor: Keith Cherkauer

Course Objectives:

After the completion of this course, students should be able to:

1. Write scripts or batch files to control tasks requiring multiple steps.
2. Write scripts or programs to process multiple data files.
3. Design quality control programs to check for obvious inconsistencies in data.
4. Design programs that will fill missing or invalid data with a "best guess" value.
5. Identify a variety of file formats and understand how to transfer data into and out of them.
6. Manipulate data from a variety of sources so that it is properly formatted for use with a distributed model.
7. Analyze large data volumes using summary statistics and plots.
8. Develop metadata for processed data sets to provide documentation for processing and analysis completed.
9. Prepare a long-term archival storage plan for data after processing and analysis has been completed.

Course Outline of Topics/Syllabus:

Course Outline (tentative):

1. Introduction to Programming
    a. Read: Downy, A. (2008), Think Python: An Introduction to Software Design, version 1.1.14. Available from http://www.greenteapress.com/thinkpython/
    b. Labs: Materials from Think Python
    c. Objectives: Demonstrate an understanding of the Python language and programming basics
2. Introduction to Unix/Linux and the C-shell environment
    a. Read: Unix/Linux commands (Siever)
    b. Labs: Setup account on pasture and write simple c-shell scripts
    c. Objectives: Demonstrate an understanding of how to operate within a c-shell/bash-shell environment in a Unix/Linux terminal
3. Introduction to AWK
    a. Read: AWK (Siever), AWK Tutorial
    b. Labs: Process ASCII datasets using simple AWK commands
    c. Objectives: Demonstrate an understanding of the AWK scripting language and when its application to data processing is desired

4. Introduction to Data Formats
   a. Read: Class handouts
   b. Labs: Develop python programs to process Binary data formats, use convert program to change image formats, use python to build and access database
   c. Objectives: understand the differences in standard scientific and graphic image formats, and identify programs that can interpret them
5. Data Quality Checking
   a. Read: Papers on NCDC data quality checking, others
   b. Labs: Write python code to open, evaluate, remove or replace missing or bad data, and reformat data
   c. Objectives: Learn to evaluate data sets to identify bad or missing data, identify strategies for automating the data checking process, understand how to write simple programs for filtering, filling and reformatting data
6. Strategies for Working with Large Datasets
   a. Read: Materials on data mining and the generation of summary statistics
   b. Labs: Write python code to calculate summary statistics and evaluate large data sets
   c. Objectives: Learn to identify strategies for reducing large data volumes to more manageable sizes and forms for rapid evaluation and analysis
7. Data Visualization
   a. Read: Various documents on producing high quality figures
   b. Labs: Use the Generic Mapping Tools and ArcGIS to produce presentation and publication quality figures
   c. Objectives: Compose presentation quality figures from a variety of data sources and understand what is required to produce figures for presentations and publications
8. Creation of Metadata and Development of Data Management Plan
   a. Presentations: Representatives from Purdue Libraries, Discovery Park Information Technology, Information Technology at Purdue.
   b. Labs: Development of metadata and a long-term storage plan for class materials.
   c. Objectives: Develop and integrate metadata describing data sources, processing and analysis completed, usage requirements, and contact information.

Method of Evaluation or Assessment:

The student's grade will be determined as follows:

Assignments	400 pts
Final project proposal	25 pts
Final project interim report	25 pts
Final project report	75 pts
Final project presentation	75 pts
Total	600 pts

The following are approximate criteria for assigning grades:

$A \geq 540$, $B \geq 480$, $C \geq 420$ and $D \geq 360$

Reading List/Textbook:

Downy, A. (2008), Think Python: An Introduction to Software Design, version 1.1.14. Available from http://www.greenteapress.com/thinkpython/

Other reading material will made available via the course web site.

G. Library Resources

Impact on Learning Outcomes

This course will prepare students (both undergraduate and graduate) to meet the following learning outcomes:

College Outcomes

- **Professional Preparation**
    - Technological literacy
- **Scientific Principles**
- **Critical thinking and problem solving**
- **Communication (oral, written)**

Program Outcomes

College Learning Outcomes addressed by this course:

______ **Professional Preparation**: Demonstrate proficiency in their chosen discipline that incorporates knowledge skills, technology, and professional conduct.

___X__ **Scientific Principles:** Demonstrate use of the scientific method to identify problems, formulate and test hypotheses, conduct experiments and analyze data, and derive conclusions.

___X__ **Critical Thinking:** Demonstrate critical thinking by using data and reasoning to develop sound responses to complex problems.

___X__ **Communication:** Demonstrate the ability to write and speak with effectiveness while considering audience and purpose.

____X_ **Teamwork:** Demonstrate the ability to work effectively as part of a problem-solving team.

______ **Cultural Understanding:** Demonstrate knowledge of a range of cultures and an understanding of human values and points of view of other than their own.

______ **Social Science Principles:** Demonstrate ability to apply social, economic, political, and environmental principles to living in a global community.

______ **Civic Responsibility:** Demonstrate awareness of civic responsibility to community and society at large.

___X__ **Lifelong Learning:** Demonstrate skills necessary for lifelong learning.

Department Learning Outcomes Addressed by this course:

___X__ an ability to apply knowledge of mathematics, science, and engineering

___X__ ability to design and conduct experiments, as well as to analyze and interpret data.

______ an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability

___X__ an ability to function on multidisciplinary teams

______ an ability to identify, formulate, and solve engineering problems

______ an understanding of professional and ethical responsibility

___X__ an ability to communicate effectively

______ the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context

___X__ a recognition of the need for, and an ability to engage in life-long learning

______ a knowledge of contemporary issues

___X__ an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice