

Proposal For A New Masters Degree Program In Bioresources Engineering

- I. The new proposed Master of Science in Bioresources Engineering will prepare students for employment in industry, consulting and government. The area of emphasis of the new MS program will be in Natural Resources Engineering . The objectives of the program are to provide an opportunity for training beyond the bachelor's degree for students and enhance the research and scholarship of the Bioresources Engineering Department. Well established areas of research in the Bioresources Engineering Department are in water resources and animal and plant systems. Research in the Department in water resources includes projects in nonpoint pollution, stormwater management, water quality modeling, bioremediation, and application of wastewater, irrigation water management and vegetative control on drainage ditches. Research in plant and animal systems includes projects on vegetable harvesting, mushroom environmental management, poultry house environmental management and sensor technology.

II. Rationale and Demand

A1. Compatibility with the University of Delaware Mission.

The proposed MS program will apply the ideals of excellence in research and scholarship as identified in the University of Delaware's mission statement to Bioresources Engineering. Graduates from this program will fulfill the needs for qualified engineers in land and water resources. Research findings will enhance the economy of the Mid-Atlantic States and the quality of life of the population.

A2. Description of the Planning Process

In 2001, the Bioresources Engineering Department underwent an academic program review. In preparing the self study report there was discussion at several department meetings on graduate education. The academic program review team cited the lack of a graduate program as one of the weaknesses of the Department. Although several of the faculty members have joint appointments in the College of Engineering and the Department participates in the interdisciplinary Operations Research graduate program, this approach has not been entirely successful. In particular it has been difficult for new faculty to utilize and advise graduate students in their research under the current arrangements. Because of this it was decided that the Department needed to create opportunities for the new faculty members that have been hired since 2001 to advise and utilize graduate students in their research. The only satisfactory way to do this is to develop an MS program in Bioresources Engineering. A new water resources engineering faculty member has been hired and there will be three additional faculty members retiring within the next four to seven years. The Department, in preparing for the future, has decided that to recruit high quality faculty members and strengthen the

research program, it is important that the Department develop a graduate program. The graduate program will help in the recruitment of high quality faculty members.

A3. Impact on Other Programs

The proposed MS program should have minimum impact on other programs. The Civil and Environmental Engineering Department has a graduate program in environmental and water resources engineering but the two programs should not be competing for the same pool of graduate students. Environmental research in the Bioresources Engineering Department is focused on nonpoint source pollution, while research in Civil and Environmental Engineering is focused on assessment and treatment of environmental contaminants, environmental chemistry, biological waste treatment, groundwater hydrology and design and management of waste treatment facilities.

A4. Utilization of Existing Resources

The proposed MS degree will build on existing University of Delaware coursework and the Bioresources Engineering Department and College of Agriculture and Natural Resources research (CANR) capabilities. The Department has a water quality analysis laboratory (111 Worrihow Hall), machinery research laboratory (124 Worrihow Hall) and a clean laboratory for instrumentation and electronics and a watershed research laboratory (304 Worrihow Hall) and a mixed use facility (BREG shop). The CANR Research and Education Center facilities at Georgetown including the nearby Warrington Farm are available for field research and poultry research. Facilities at the CANR farm in Newark and land in southern New Castle County are also available for field research.

B1. Enrollment Projections

Students may enroll fulltime or part time. The number of students accepted each year will depend upon funding available and faculty research.

B2. Specific Student Clientele

Students admitted to the program will be from bioresources engineering or similar named engineering programs, civil and environmental engineering, mechanical engineering and electrical engineering bachelor degree programs. Students with the appropriate course work from undergraduate engineering technology, appropriate science and/or technical programs will also be admitted, but may be required to take additional courses upon admission if they do not have an engineering degree.

C. Transferability (not applicable)

D. Graduate/Professional Program Access (not applicable) or See II A2

E. Demand and Employment Factors

The demand for graduates of the program should be strong. Federal agencies like the Natural Resources Conservation Service who hire bioresources/agricultural engineers require an MS as an entry level degree. There is a strong demand in the environmental engineering consulting field for engineers with MS degrees. Within the region, there are few competing MS programs. Most of the major universities in the area with engineering programs are emphasizing the PhD degree in their graduate programs. Water quality engineering was a \$5.3 billion market in the U.S. in 2005. It grew by 9 percent from 2004 to 2005 and previous to that has had double digits growth for a few years. Southeastern Pennsylvania, Maryland and Delaware are under tremendous urbanization pressure. The population of Sussex County, Delaware, increased by over 30 percent from 1990 to 2000. With urbanization comes the demand for water resources engineers for stormwater management and site development. The emphasis in stormwater management is on the adoption of green technology which requires advanced training for engineers that they do not receive with a BS degree.

E1. Regional/State/National Factors

There is no other graduate program in bioresources engineering or similarly named programs in Delaware. The University of Maryland and Pennsylvania State University have both MS and Ph.D. programs in bioresources engineering. Rutgers University eliminated their bioresources engineering department a number of years ago and no longer have an undergraduate or graduate program in bioresources engineering. Consequently, we expect some students from the Delaware Valley, particularly part-time individuals already employed, to participate in the program. Since there is no other MS program in bioresources engineering in the Delaware Valley, we also expect the program will also serve as a feeder program for students interested in doing a PhD in bioresources engineering at other land grant institutions.

F2. Accrediting/Professional Mandates (not applicable)

G. Other Strengths

G1. Special Features

Bioresources Engineering Department faculty have conducted research since the Department was formed in 1969. With the hiring of four new faculty members in the last five years, the research capacity of the Department has been greatly enhanced. The Department has the only irrigation research program in the Mid-

Atlantic States and one of three or four poultry engineers at land grant institutions in the U.S. Some faculty members in the Department are connected with the Center for the Critical Zone, the Avian Bioscience Center and the Center for Energy and Environmental Policy. The proposed graduate program will strengthen the research, increase the number of individuals involved in research and increase faculty research productivity in the Department. At the present time faculty have to rely on undergraduates to work on their research projects or graduate students enrolled in other programs in departments where faculty have joint appointments. The proposed graduate program in Bioresources Engineering will compliment the strong ABET (Accreditation Board for Engineering and Technology) accredited program the Department has in Engineering Technology.

G2. Collaborative Agreements (not applicable)

III. Enrollment, Admissions and Financial Aid

A. Enrollment Limitations/Criteria

Students will be admitted to the program based upon the availability of funding and their ability to meet the recommended entrance requirements.

B. Admission Requirements

B1 Criteria

The following criteria will apply to the students admitted:

- a. A BS in engineering or related field.
- b. An undergraduate index of 2.8 overall and 3.0 in their major field of study out of 4.0 or the equivalent for students with degrees outside the US.
- c. A combined score of 1050 on the verbal and quantitative portions of the GRE.
- d. A paper-based TOEFL score of at least 550 (or 213 computer-based) is required for non-native English students.
- e. Three letters of recommendations that address the student's likelihood of successfully completing graduate education.

Students who do not meet all of these criteria may be admitted on a provisional basis subject to approval and completion of subject area deficiencies as indicated by the Department Graduate Studies Committee. Students who do not have a degree in

engineering may be admitted, but may be required to take additional courses upon admission.

B2. Transfer policy (not applicable)

B3. Retention Policy (not applicable)

C. Student Expenses and Financial Aid

C1. Extraordinary Required Student Expenses

No extraordinary expenses beyond the normal graduate student fees or expenses are expected.

C2. Student Financial Support

We anticipate that most students will be supported on external grant funds or compete for fellowships from the Delaware Water Resources Center or Institute for Soils and Environmental Quality or EPA. Assistance will be offered on a competitive basis to applicants best fitting the needs of the external granting agencies and sponsoring faculty. Part-time students will provide their own funding. Three assistantships will be requested from CANR. Highly qualified students will be encouraged to apply for competitive University assistantships and fellowships.

IV. Curriculum Specifics

A. Degree Awarded

Master of Science in Bioresources Engineering

B. Curriculum

B1. Requirements

A minimum of 30 credits is required for the Master of Science degree. It is to include 24 credits of approved course work and 6 credits of thesis BREG 869. Of the 24 credit hours of approved course work, at least 3 credits must be a statistics or advanced math course. Only graduate level courses (500 – 599), (600 - 699), (800 - 899) are applicable towards the course requirements. Selection of courses will be done in consultation with the chair of the thesis committee based upon the student's interest and area of research.

The awarding of the Master of Science degree is also contingent upon an approved research proposal, the successful oral defense of the research performed and an acceptable thesis.

B2. Sample Curriculum

Upon acceptance into the program, students will meet with their advisor to formalize their curriculum. The program will offer a focus area in Natural Resources Engineering or another suitable area within the discipline. Students will choose approved courses relevant to their area of study and research. A list of potential graduate courses students may take from outside the Department along with a list of graduate courses the Department will offer is included in Appendix E. The list of graduate courses in Appendix E is very broad to cover the diverse interests of students that may enroll in the program. Because of the diverse interests of the students and because enrollment in the program will be relatively small, it is not anticipated that the additional student load from Bioresources Engineering MS students would exceed one to two students per year in any course.

The Department presently offers BREG 603, 628 and 666 as graduate level courses. The Department plans on expanding their graduate course offerings by cross listing another course and developing three new courses. The new cross listed course would be BREG/PLSC607 Plant and Soil Water Relations. The three new courses would be BREG 621 Nonpoint Source Pollution Control, BREG 622 Watershed Modeling, and BREG 631 Experimental Methods for Engineers. Two of the new courses will be taught by Dr. Inamdar the new water resources engineering faculty member hired and third course will be taught by Dr. Glancey

All students enrolled in the program will be required to take BREG 631 Experimental Methods for Engineers and a graduate level advanced mathematics or statistics course. Students may choose from the following list including, but not limited to:

- CIEG 601 Introduction to the Finite Element Methods
- CIEG 605 Intermediate Topics in Finite Element Analysis
- MATH 503 Advanced Calculus for Applications
- MATH 508 Introduction to Complex Variables and Applications
- MATH 535 Introduction to Partial Differential Equations
- MATH 611 Introduction to Numerical Analysis and Scientific Computing
- MEEG 891 Advanced Engineering Mathematics
- STAT 601 Probability Theory for Operations Research and Statistics
- STAT 611 Regression Analysis
- STAT 635 Statistical Quality Control
- STAT 657 Statistics for Earth Scientists

Students in the Natural Resources Engineering focus area will have to take two of the following courses:

- BREG 621 Nonpoint Source Pollution
- BREG 622 Watershed Modeling
- BREG 628 Natural Wastewater Treatment Systems
- CIEG 636 Biological Aspects of Environmental Engineering
- CIEG 698 Groundwater Flow and Contaminant Transport

Students interested in developing a focus in another aspect of Bioresources Engineering can propose an alternate program of study for approval by their graduate committee.

V. Resources Available

A. Learning Resources

The MS program will be supported by excellent print and electronic resources available for engineering and agriculture through Morris Library and its branches. A letter from the Director of Libraries verifying support is included in Appendix D.

B. Faculty/Administrative Resources

The proposed graduate program will be administered by a faculty member who will serve as the graduate studies coordinator and chair the Department's graduate studies committee. This person will be appointed by the chair of the Bioresources Engineering Department. The following Bioresources Engineering Department faculty and professional staff are available to support the proposed graduate program and are encouraged to advise graduate students.

Name	Specialization	Rank	Highest Academic Degree
Carmine Balascio	Water Resources	Associate Professor	Ph.D.
Eric Benson	Machine Vision and Applied Controls	Assistant Professor	Ph.D.
Anastasia Chirside	Environmental Engineering	Assistant Professor	Ph.D.
James Glancey	Machine Design and Automation	Associate Professor	Ph.D.
Kenneth Lomax	Biological Engineering	Associate Professor	Ph.D.
Ian McCann	Irrigation Management	Assistant Professor and Extension Engineer	Ph.D.
William Ritter	Water Resources	Professor	Ph.D.
Garrett Van Wicklen	Poultry Housing	Associate Professor and Extension Engineer	Ph.D.
Shreeram Inamdar	Water Resources	Assistant Professor	Ph.D.

C. External Funding

The Bioresources Engineering Department has over \$400,000 in external funding to support research. Funding sources include USDA, US Poultry and Egg Association, EPA, DNREC, New Castle County, and CANR Agricultural Experiment Station competitive grants.

VI. Resources Required

A. Learning Resources

No new learning resources are needed to implement the proposed program.

B. Faculty/Administrative Resources

No new positions will be required for the proposed program.

C. Budgeting Needs:

It is anticipated that most graduate assistantships and fellowships will come from external research contracts and grants and from internal and external competitive graduate fellowship programs. To start the program the Department will request three research and/or teaching assistantships from the College of Agriculture and Natural Resources. When the current research associate line is vacated upon retirement of the person in that position, the line will be turned into four additional assistantships. It is anticipated that these assistantships will be used to recruit graduate students and provide funding for the first year of work (either a TA or RA) and the second year of support would come from extramural funding.

VII. Implementation and Evaluation

A. Implementation Plan

Once the graduate program is approved by the various University committees and the Faculty Senate, the Department will start soliciting applications immediately for the next academic year. New proposed courses will be submitted as soon as possible for approval by the College and University committees. The Bioresources Engineering Department underwent an academic program review (APR) in 2001. It is anticipated that the next APR will include a review of the proposed program, assuming that provisional status is approved.

B. Evaluation Plan

The normal university process will be to give the new program temporary status. Review for permanent approval will be scheduled for five years after the startup

of the program. The review procedure for the program will follow standard University of Delaware review protocol for M.S. programs.

Appendix A (not applicable)

Appendix B (not applicable)

Appendix C (not applicable)

Appendix D Director of Libraries support
letter



UNIVERSITY OF
DELAWARE LIBRARY
OFFICE OF THE DIRECTOR

University of Delaware
Newark, Delaware 19717-5267
Phone: 302/831-2231
Fax: 302/831-1046
Library Web: <http://www.lib.udel.edu>

January 12, 2005

MEMORANDUM

To: William F. Ritter
Chairperson
Bioresources Engineering

From: Susan Brynteson 
The May Morris Director of Libraries

I am responding to your request to supply information about the capability of the University of Delaware Library to support the proposal for the Master of Science degree in Bioresources Engineering in the College of Agriculture and Natural Resources.

The University of Delaware Library is well able to support the Bioresources Engineering program at the master's level. Enclosed is a description of collections, resources and services available.

I would be pleased to respond to any questions.

SB/nb
Enclosure

c: Robin W. Morgan, Dean, College of Agriculture and Natural Resources



UNIVERSITY OF
DELAWARE LIBRARY
OFFICE OF THE DIRECTOR

University of Delaware
Newark, Delaware 19717-5267
Phone: 302/831-2231
Fax: 302/831-1046
Library Web: <http://www.lib.udel.edu>

January 12, 2006

Report on Library Services and Collections in Support of the Bioresources Engineering Program
for the College of Agriculture and Natural Resources

General Description

The University of Delaware Library includes the Hugh M. Morris Library, where the main collection is housed; three branch libraries located on the Newark campus, the Agriculture Library, the Chemistry Library, and the Physics Library; and a fourth branch library, the Marine Studies Library, located in Lewes, Delaware. The Library collections parallel the University's academic interests and support all disciplines. In addition to collections which directly support the Bioresources Engineering program, the Library has strong collections in Agriculture (General), Animal and Food Sciences, Biology, Biotechnology, Chemistry and Biochemistry, Chemical Engineering, Civil and Environmental Engineering, Environmental Sciences, Entomology, Food and Resource Economics, Materials Science and Engineering, Mechanical Engineering, and Plant and Soil Sciences.

Books, periodicals, microforms, government publications, computer databases and other electronic resources, maps, manuscripts, and media provide a major academic resource for the University of Delaware, the surrounding community, the state of Delaware, and the nation. Library staff members provide a wide range of services, including reference assistance, circulation, interlibrary loan, instructional programs, and assistance to the visually impaired.

The University of Delaware Library is a U.S. depository library and a U.S. patent depository library and contains a complete file of every patent the U.S. Office of Patents and Trademarks has issued.

The online catalog, called DELCAT, provides access to millions of items by author, title, subject, and keyword.

Library collections number over 2,600,000. In 2004/2005, the Library Web www.lib.udel.edu received over 50,000,000 hits.

The University of Delaware Library is a member of the Association of Research Libraries, OCLC, the Center for Research Libraries, PALINET, CIRLA (The Chesapeake Information and Research Library Alliance), and NERL (NorthEast Research Libraries).

William F. Ritter
January 12, 2006
Page 2

Specific support for the Bioresources Engineering Program

Funds are designated at the beginning of each fiscal year for the support and strengthening of the collections, including Bioresources Engineering. Support for the Bioresources Engineering program is supplemented by funds used to purchase materials in the related areas noted previously as well as funds for the purchase of electronic resources.

The Library subscribes to many print journals and electronic journals which support Bioresources Engineering. A list of electronic journals by subject is available from the Library Web by clicking on "Electronic Journals" at the top of the main page www.lib.udel.edu. The list for Bioresources Engineering is available at: <http://www2.lib.udel.edu/subj/agr/ejrnl/bioresources.htm>

In addition to various reference sources in print (see the "Research Guides" section of the Subject Guides <http://www2.lib.udel.edu/subj/agr/resguide/index.htm> available under the section "Subject Guides A-Z" on the Library Web page), the Library also makes available several electronic databases which support Bioresources Engineering, including Biological and Agricultural Index Plus, AGRICOLA, AGRIS, Biological Abstracts, Biological Sciences Set, CAB Abstracts, Chemical Abstracts (SciFinder Scholar), Compendex, Environmental Sciences and Pollution Management, and TOXNET.

In addition, the Library provides access to such important electronic databases as ABI/Inform, America: History and Life, EconLit, Expanded Academic ASAP Plus, General Business File ASAP, Historical Abstracts, LexisNexis Academic, LexisNexis Congressional Universe, LexisNexis Statistical Universe, New York Times (Historical), PAIS International, ProQuest Digital Dissertations (Dissertation Abstracts), Sociological Abstracts, STAT-USA, and Web of Science. Several databases incorporate the Library's major linking service, Article Express, for electronic access to the full text of journal articles. Census information and other demographic data are available as is a wide range of printed and electronic reference sources.

A professional librarian, Frederick Getze, Associate Librarian in the Branch Libraries Department, serves as liaison to the faculty in the Bioresources Engineering program. Suggestions for purchases received by the Library for materials related to Bioresources Engineering are directed to Mr. Getze, who also regularly consults faculty about priorities and the direction the collections should take. Mr. Getze is also available for instruction in the use of the Library for students and faculty. He maintains a subject Web site for Bioresources Engineering which can be accessed from the Library Web www.lib.udel.edu by clicking on "Subject Guides A to Z" or directly by the URL <http://www2.lib.udel.edu/subj/agr/>.

Susan Brynteson
The May Morris Director of Libraries

Appendix E. List of Available Graduate Courses in the Department:

BREG 603 - Soil Physics (3)
BREG 607/PLSC 607 - Plant and Soil Water Relations (co-list) (3)
BREG 628 - Natural Wastewater Treatment Systems (3)
BREG 621 - Nonpoint Source Pollution (new) (3)
BREG 622 - Watershed Modeling (new) (3)
BREG 631 - Experimental Methods for Engineers (new) (3)
BREG 666 - Special Problems (1-6)
BREG 869 - Masters Thesis (new) (1-6)

List of Potential Courses Outside the Department for the Graduate Program

ANSC 632 - Elements of Pathology
ANSC 633 - Poultry Pathology
ANSC 635 - Introduction to Virology
ANSC 636 - Immunology of Domestic Animals
ANSC 637 - Avian Immunology
ANSC 644 - Bioinformatics
ANSC 842 - Avian Microanatomy

CIEG 601 - Introduction to the Finite Element Method
CIEG 605 - Intermediate Topics in Finite Element Analysis
CIEG 624 - Soil Dynamics
CIEG 625 - Geoenvironmental Engineering
CIEG 630 - Water Quality Modeling
CIEG 632 - Chemical Aspects of Environmental Engineering
CIEG 633 - Hazardous Waste Management
CIEG 634 - Contaminant Transport and Separation in Environmental System
CIEG 635 - Air Pollution and Its Control
CIEG 636 - Biological Aspects of Environmental Engineering
CIEG 637 - Water and Wastewater Quality
CIEG 832 - Theory of Wastewater Treatment
CIEG 833 - Fate of Organic Pollutants in the Environment
CIEG 698 - Groundwater Flow and Contaminant Transport

CISC 621 - Algorithm Design and Analysis
CISC 670 - Program Languages
CISC 681 - Artificial Intelligence
CISC 685 - Mechatronics
CISC 805 - Computability Theoretic Learning

FREC 608 - Statistical Research Methods
FREC 611 - Regional Watershed Management

FREC 682 - Spatial Analysis of Natural Resources
FREC 806 - Research Techniques and Procedures

GEOG 612 - Physical Climatology
GEOG 620 - Atmospheric Physics
GEOG 651 - Microclimatology
GEOG 652 - Seminar in Climatology
GEOG 653 - Synoptic Climatology
GEOG 655 - Water Budget in Environmental Analysis
GEOG 656 - Hydroclimatology
GEOG 657 - Climate Dynamics

GEOL 611 - Fluvial Geomorphology
GEOL 628 - Hydrogeology
GEOL 803 - Topics in Geomorphology

MATH 503 - Advanced Calculus for Applications
MATH 508 - Introduction to Complex Variables and Applications
MATH 535 - Introduction to Partial Differential Equations
MATH 611 - Introduction to Numerical Analysis and Scientific Computing

MEEG 610 - Intermediate Solid Mechanics
MEEG 615 - Mechanical Properties of Materials
MEEG 616 - Composite Materials Structure
MEEG 617 - Composite Materials
MEEG 618 - Fracture of Solids
MEEG 619 - Mechanical Behavior of Materials and Structures
MEEG 620 - Intermediate Dynamics
MEEG 630 - Intermediate Fluid Mechanics
MEEG 633 - Bioengineering Fluids and Transport
MEEG 636 - Fluid Mechanics Measurements
MEEG 640 - Intermediate Heat Transfer
MEEG 641 - Combustion
MEEG 642 - Introduction to Fuel Cells
MEEG 652 - Flow of Viscous Materials
MEEG 653 - Manufacturing Processes and Materials
MEEG 655 - Principles of Composites Manufacturing
MEEG 663 - Computer-Aided Design
MEEG 673 - Introduction to Robotics
MEEG 817 - Composite Materials
MEEG 821 - Advanced Dynamics
MEEG 831 - Fluid Mechanics
MEEG 852 - Fluid Dynamics II
MEEG 862 - Advanced Engineering Analysis
MEEG 891 - Advanced Engineering Mathematics
MEEG 801 - Advanced Thermodynamics

MEEG 690 - Intermediate Engineering Mathematics

ORES 601 - Survey Operations Research I
ORES 602 - Survey Operations Research II
ORES 603 - Simulation Modeling and Analysis
ORES 801 - Optimization Models and Methods

PLSC 607 - Plant and Soil Water Relations
PLSC 608 - Environmental Soil Chemistry
PLSC 619 - Soil Microbiology
PLSC 655 - Pollution Microbiology
PLSC 660 - Pesticides in the Environment

STAT 601 - Probability Theory for Operations Research and Statistics
STAT 611 - Regression Analysis
STAT 635 - Statistical Quality Control
STAT 657 - Statistics for Earth Scientists

Proposed New Course Descriptions

BREG 621 Nonpoint Source Pollution

Credits: 3

Course Description:

Understanding the sources, transport pathways, and transformations of pollutants generated by anthropogenic activities. Nutrients (e.g., nitrogen, phosphorus, carbon), pesticides, metals (e.g., mercury, lead, cadmium), and organics (PAHs, PBDEs) will be discussed. Impacts of these pollutants on terrestrial and aquatic ecosystems will be highlighted using specific case studies. Topics covered include – acid deposition and its impacts; nitrogen and phosphorus pollution; pesticide contamination and transport; mercury pollution; and bacterial pollution in urban and agricultural watersheds.

Catalog Description:

Understanding the sources, transport pathways, and transformations of important pollutants and toxic chemicals generated by anthropogenic activities. Topics include transport, transformation, and fate of these pollutants in watersheds. Impacts of these pollutants on soil, forest, and aquatic ecosystems using specific case studies. PREQ: EGTE 321, CIEG 440 or Permission of Instructor

BREG 622 Watershed Modeling

Credits: 3

Course Description:

Understanding principles and algorithms for runoff generation, infiltration, evapotranspiration, groundwater flow, surface water routing, and sediment transport. Model uncertainty and calibration. Value of spatial data in model evaluations. Use of uncertainty methods (e.g. GLUE) for model evaluation. Hands-on use and application of watershed models. Comparisons of spatially-distributed, multi-parameter complex models (e.g., GIS-based Soil Water Assessment Tool [SWAT]) against simple, process-based models (e.g., TOPMODEL).

Catalog Description:

Application and understanding of mathematical models for quantification and analysis of hydrologic processes. Understanding the mechanistic concepts, assumptions behind the models, and the advantages and limitations associated with using the models. Value of observed data in calibrating the models and the uncertainty associated with model predictions. PREQ: EGTE 321, CIEG 440 or Permission of Instructor

BREG 631 Experimental Methods for Engineers

Credits: (3)1 lecture, 2 lab

Course Description:

Experimental Methods for Engineers is aimed to provide first year graduate students with hands-on laboratory experience including the design of engineering experiments and computerized data acquisition. Strong emphasis is placed on problem solving, and the importance of accuracy, error, and uncertainty analysis. After completing the course, students are expected apply knowledge from their science courses in order to design experiments, collect credible data, and analyze and interpret experimental results. We rely heavily on Labview and Matlab as the core components in the laboratory experience. Students in many academic disciplines can use this course as a springboard for research opportunities.

Catalog Description:

Generalized theory for designing engineering experiments, computerized data acquisition and reduction, processing and statistical analysis of experimental data including proper procedures for measuring and analyzing time varying quantities, error analysis and uncertainties. Programming and data collection and analysis will be accomplished using Labview and Matlab. PREQ: Permission of Instructor

**University Department Support For BREG MS Students Taking Courses
a. Plant and Soil Science Department**

Date: Fri 13 Jan 15:00:51 EST 2006

From: "Sparks, Donald" <dlsparks@UDel.Edu> [Add To Address Book](#) | [This is Spam](#)

Subject: RE: BREG MS Proposal

To: "William F. Ritter" <writer@UDel.Edu>

Cc: "David Frey" <dfrey@UDel.Edu>

Bill,

We have no problem with the group of courses you list from our department.

Good luck with your proposal.

Regards,

Don

Donald L. Sparks

S. Hallock du Pont Chair of Plant and Soil Sciences

and Department Chairman

University of Delaware

Newark, DE 19717-1303

(302) 831-8153 phone

(302) 831-0605 fax

dlsparks@udel.edu

<http://ag.udel.edu/soilchem>

From: William F. Ritter [mailto:writer@UDel.Edu]

Sent: Friday, January 13, 2006 1:30 PM

To: Sparks, Donald

Subject: BREG MS Proposal

Dear Don

The Bioresources Engineering Department is proposing a Master of Science program. The focus areas of study for the program are in land and water resources and plant and animal systems. Enrollment in the program is expected to be about 15 students. Since Bioresources Engineering is very diverse the program will not have a core set of courses required, but students will be able to select courses from a wide area. I was wondering if we could list the following courses from your department that students could enroll in if

they had the proper prerequisites and were interested in taking any of these courses. I would not expect more than 1 or 2 students to enroll in a particular course in a given semester since our MS program is so diverse and we are only expecting about 15 students in the program at any one time. Attached also is a copy of the complete proposal.

PLSC 607 - Plant and Soil Water Relations
PLSC 608 - Environmental Soil Chemistry
PLSC 619 - Soil Microbiology
PLSC 655 - Pollution Microbiology
PLSC 660 - Pesticides in the Environment
Bill Ritter

William F. Ritter
Bioresources Engineering Department
University of Delaware
Newark, DE. 19716
TEL:302-831-2468
FAX:302-831-2469
[E-Mail:writter@udel.edu](mailto:writter@udel.edu)

b. Mechanical Engineering

Date: Fri 13 Jan 17:36:23 EST 2006
From: "Tom Buchanan" <buchanan@UDel.Edu> [Add To Address Book](#) | [This is Spam](#)
Subject: RE: BREG MS Proposal
To: "William F. Ritter" <writter@UDel.Edu>

Bill,

The Mechanical Engineering Department is happy to support your proposal to create an MS in Bioresources Engineering. Best of luck with your new endeavor!

Regards,

Tom

Thomas S. Buchanan, Ph.D.
Chair of Mechanical Engineering
University of Delaware
126 Spencer Laboratories
Newark, DE 19716 USA
Ph: 1-302-831-2423 Fax: 1-302-831-3619

c. Mathematical Science Department

Date: Mon 16 Jan 11:48:56 EST 2006

From: Peter Monk <monk@math.udel.edu> [Add To Address Book](#) | [This is Spam](#)

Subject: Re: Bioresources

To: writer@UDel.Edu

Cc: George Hsiao <hsiao@math.udel.edu>, David Edwards <edwards@math.udel.edu>, Peter Monk <monk@math.udel.edu>

Bill

We would be delighted to see your students in the classes you list.
I wish you the best of luck!

Sincerely

Peter Monk
Interim Chair

Department of Mathematical Sciences
University of Delaware
Newark, DE 19716, USA
FAX : 302-831-4511
Phone: 302-831-2652
<http://www.math.udel.edu/~monk>

On Jan 16, 2006, at 11:35 AM, William Ritter wrote:

Dear Dr Broadridge

The Bioresources Engineering Department is proposing a Master of Science program. The focus areas of study for the program are in land and water resources and plant and animal systems. Enrollment in the program is expected to be about 15 students. Since Bioresources Engineering is very diverse the program will not have a core set of courses required, but students will be able to select courses from a wide area. I was wondering if we could list the following courses from your department that students could enroll in if they had the proper prerequisites and were interested in taking any of these courses. I would not expect more than 1 or 2 students to enroll in a particular course in a given semester since our MS program is so diverse and we are only expecting about 15 students in the program at any one time. Attached also is a copy of the complete proposal.

MATH 503 - Advanced Calculus for Applications
MATH 508 - Introduction to Complex Variables and Applications
MATH 535 - Introduction to Partial Differential Equations
MATH 611 - Introduction to Numerical Analysis and Scientific Computing
Bill Ritter

William F. Ritter
Bioresources Engineering Department
University of Delaware
Newark, DE. 19716
TEL:302-831-2468
FAX:302-831-2469
E-Mail:writer@udel.edu

d. Computer Science Department

Date: Sun 15 Jan 11:24:42 EST 2006

From: Dave Saunders <saunders@cis.udel.edu> [Add To Address Book](#) | [This is Spam](#)

Subject: Re: BREG MS Proposal (fwd)

To: glyde@UDel.Edu

Cc: Dave Saunders <saunders@mail.eecis.udel.edu>, "William F. Ritter" <writer@UDel.Edu>, Cherry Vicki <cherry@mail.eecis.udel.edu>, chester@cis.udel.edu, John Case <case@stimp.eecis.udel.edu>

Thanks, Henry,

Bill, there is not a resource problem. Adequately prepared students would be welcome in these courses. However, it is hard to imagine these students having adequate background to keep up with CS grads who come into these courses after 4 or 5 (undergrad and grad) years of CS studies. We would want to advise carefully any students considering this. In any case, I've forwarded your note to our Graduate Committee. We'll review it and see what suggestions we may have.

Best, -dave

Henry Glyde wrote:

Dear Bill,

I am forwarding your message to Dave Saunders who is the Chair of CIS. Regards, Henry

----- Forwarded message -----

Date: Fri, 13 Jan 2006 14:00:56 -0500

From: William F. Ritter <writer@udel.edu>

To: glyde@udel.edu

Subject: BREG MS Proposal

Dear Henry

The Bioresources Engineering Department is proposing a Master of Science program. The focus areas of study for the program are in land and water resources and plant and animal systems. Enrollment in the program is expected to be about 15 students. Since Bioresources Engineering is very diverse the program will not have a core set of courses required, but students will be able to select courses from a wide area. I was wondering if we could list the following courses from your department that students could enroll in if they had the proper prerequisites and were interested in taking any of these courses. I would not expect more than 1 or 2 students to enroll in a particular course in a given semester since our MS program is so diverse and we are only expecting about 15 students in the program at any one time. Attached also is a copy of the complete proposal.

CISC 621 - Algorithm Design and Analysis

CISC 670 - Program Languages

CISC 681 - Artificial Intelligence

CISC 685 - Mechatronics

CISC 805 - Computability Theoretic Learning

Bill Ritter

William F. Ritter

Bioresources Engineering Department

University of Delaware

Newark, DE. 19716
TEL: 302-831-2468
FAX: 302-831-2469
E-Mail: writter@udel.edu

e. Geography Department

Date: Wed 8 Feb 19:30:43 EST 2006

From: "Dan Leathers" <leathers@UDel.Edu> [Add To Address Book](#) | [This is Spam](#)

Subject: RE: BREG MS Proposal

To: "'William F. Ritter'" <writter@UDel.Edu>

Hi Bill:

I was just looking back over some e-mails that I set aside to get back to ASAP. I can't remember if I ever got back to yours. If I did I apologize for the duplicate reply..... if not, I'm sorry for the tardy reply.

Yes, we would be happy to have you list these classes. Any of your students are always welcome to take any of our grad courses.

If you need any additional information, please let me know.

Take care!

Dan

-----Original Message-----

From: William F. Ritter [<mailto:writter@UDel.Edu>]

Sent: Friday, January 13, 2006 1:57 PM

To: leathers@UDel.Edu

Subject: BREG MS Proposal

Dear Dan

The Bioresources Engineering Department is proposing a Master of Science program. The focus areas of study for the program are in land and water resources and plant and animal systems. Enrollment in the program is expected to be about 15 students. Since Bioresources Engineering is very diverse the program will not have a core set of courses required, but students will be able to select courses from a wide area. I was wondering if we could list the following courses from your department that students could enroll in if they had the proper prerequisites and were interested in taking any of these courses. I would not expect more than 1 or 2 students to enroll in a particular course in a given semester since our MS program is so diverse and we are only expecting about 15 students in the program at any one time. Attached also is a copy of the complete proposal.

GEOG 612 - Physical Climatology
GEOG 620 - Atmospheric Physics
GEOG 651 - Microclimatology
GEOG 652 - Seminar in Climatology
GEOG 653 - Synoptic Climatology
GEOG 655 - Water Budget in Environmental Analysis
GEOG 656 - Hydroclimatology
GEOG 657 - Climate Dynamics

Bill Ritter

William F. Ritter
Bioresources Engineering Department
University of Delaware
Newark, DE. 19716
TEL:302-831-2468
FAX:302-831-2469
[E-Mail:writter@udel.edu](mailto:writter@udel.edu)

f. Civil Engineering Department

Date: Wed 8 Feb 19:59:45 EST 2006

From: Michael J Chajes <chajes@ce.udel.edu> [Add To Address Book](#) | [This is Spam](#)

Subject: Re: BREG MS Proposal

To: "William F. Ritter" <writter@UDel.Edu>

Bill,

We will be happy to accommodate students in your proposed Master of Science program in our classes.

Michael

William F. Ritter wrote:

Dear Michael

The Bioresources Engineering Department is proposing a Master of Science program. The focus areas of study for the program are in land and water resources and plant and animal systems. Enrollment in the program is expected to be about 15 students. Since Bioresources Engineering is very diverse the program will not have a core set of courses required, but students will be able to select courses from a wide area. I was wondering if we could list the following courses from your department that students could enroll in if they had the proper prerequisites and were interested in taking any of these courses. I would not expect more than 1 or 2 students to enroll in a particular course in a given semester since our MS program is so diverse and we are only expecting about 15 students in the program at any one time. Attached also is a copy of the complete proposal.

CIEG 601 - Introduction to the Finite Element Method
CIEG 605 - Intermediate Topics in Finite Element Analysis
CIEG 624 - Soil Dynamics
CIEG 625 - Geoenvironmental Engineering
CIEG 630 - Water Quality Modeling
CIEG 632 - Chemical Aspects of Environmental Engineering
CIEG 633 - Hazardous Waste Management
CIEG 634 - Contaminant Transport and Separation in Environmental System
CIEG 635 - Air Pollution and Its Control
CIEG 636 - Biological Aspects of Environmental Engineering
CIEG 637 - Water and Wastewater Quality
CIEG 832 - Theory of Wastewater Treatment
CIEG 833 - Fate of Organic Pollutants in the Environment
CIEG 698 - Groundwater flow and Contaminant Transport

Bill Ritter

William F. Ritter
Bioresources Engineering Department
University of Delaware
Newark, DE. 19716
TEL: 302-831-2468
FAX: 302-831-2469
[E-Mail: writter@udel.edu](mailto:writter@udel.edu)

--

Michael J. Chajes, Chairperson
301 DuPont Hall
Department of Civil & Environmental Engineering
University of Delaware
Newark, DE 19716

302-831-2442 (Phone)
302-831-3640 (FAX)

chajes@ce.udel.edu
www.ce.udel.edu/faculty/chajes

g. Animal and Food Science Department

From: Carl Schmidt [mailto:schmidtc@UDel.Edu]
Sent: Monday, February 06, 2006 11:33 AM
To: William F. Ritter
Cc: Limin Kung; Jack Gelb
Subject: Re: Forgot Attachment

Dr. Ritter;

It would appear as if two courses listed in the proposal for master's degree are no longer offered by our department.

Carl

ANSC 632 - Elements of Pathology

No longer offered

ANSC 633 - Poultry Pathology

ANSC 635 - Introduction to Virology

ANSC 636 - Immunology of Domestic Animals

ANSC 637 - Avian Immunology

ANSC 642 - Bioinformatics

ANSC 842 - Avian Microanatomy

No longer offered

Carl J. Schmidt
Associate Professor
Department of Animal & Food Sciences
051 Townsend Hall
University of Delaware
Newark, DE 19716-2150

schmidtc@udel.edu
302-831-1334
Fax: 302-831-2822
<http://udel.edu/~schmidtc>

On Jan 23, 2006, at 8:18 AM, Jack Gelb wrote:

Carl,

Would you review the attached doc and make a recommendation?

Please note below, the courses from our Dept. that BREG would like to list. ANSC 632 has not been taught for many years so we should make Dr. Ritter aware of this. I am not sure that last time ANSC 842 was taught, either.

List of Potential Courses Outside the Department

ANSC 632 - Elements of Pathology

ANSC 633 - Poultry Pathology

ANSC 635 - Introduction to Virology

ANSC 636 - Immunology of Domestic Animals

ANSC 637 - Avian Immunology

ANSC 642 - Bioinformatics

ANSC 842 - Avian Microanatomy

Thanks,

Jack

h. Geology Department

Date: Tue 16 May 12:33:37 EDT 2006

From: James Pizzuto <pizzuto@UDel.Edu> [Add To Address Book](#) | [This is Spam](#)

Subject: Re: Geology Courses For BREG MS students

To: writer@UDel.Edu

Bill: I guess in some sense I dropped the ball on this, didn't I? The answer, though, is yes to these courses.

As you know, we are undergoing some pretty dramatic changes in personnel, and this list is likely to change somewhat, but it is a reasonable thing to put down for now.

Good luck.

Jim

William Ritter wrote:

> Jim

> Our MS proposal for Bioresources Engineering is being voted on by the College faculty on Thursday at the spring faculty meeting. Is it safe to say that these three geology courses will be offered in the future and our students could take any of them if they wanted.

> GEOL 611 - Fluvial Geomorphology

> GEOL 628 - Hydrogeology

> GEOL 803 - Topics in Geomorphology

> Bill Ritter

> William F. Ritter

> Bioresources Engineering Department

> University of Delaware

> Newark, DE. 19716

> TEL:302-831-2468

> FAX:302-831-2469

> E-Mail:writer@udel.edu

I. Food and Resource Economics Department

Date: Tue 16 May 14:31:43 EDT 2006

From: "Ilvento, Tom" <ilvento@UDel.Edu> [Add To Address Book](#) | [This is Spam](#)

Subject: RE: FREC and OR Courses for BREG MS Students

To: <writer@UDel.Edu>

Bill,

It will be fine, except we haven't taught these two courses in a long, long time. In fact FREC 611 seems to be cross-listed with UAPP611.

FREC 611 - Regional Watershed Management

FREC 806 - Research Techniques and Procedures

twi

Thomas W Ilvento
Professor and Chair
213 Townsend Hall

Newark, DE 19716
Voice: 302-831-6773
Cell: 302-388-0971
Fax: 302-831-6243

-----Original Message-----

From: William Ritter [mailto:writter@UDel.Edu]
Sent: Tuesday, May 16, 2006 12:27 PM
To: Ilvento, Tom
Subject: FREC and OR Courses for BREG MS Students
Tom

For the Bioresources Engineering Department proposed MS in Bioresources Engineering is it ok to list the following courses that your Department teach that the students could take if they wanted to. There probably would be no more then one or two students enroll at any one time in a course given the breadth of the our student interests and the diverse nature of Bioresources Engineering.

FREC 608 - Statistical Research Methods
FREC 611 - Regional Watershed Management
FREC 682 - Spatial Analysis of Natural Resources
FREC 806 - Research Techniques and Procedures
ORES 601 - Survey Operations Research I
ORES 602 - Survey Operations Research II
ORES 603 - Simulation Modeling and Analysis
ORES 801 - Optimization Models and Methods

Bill Ritter
William F. Ritter
Bioresources Engineering Department
University of Delaware
Newark, DE. 19716
TEL:302-831-2468
FAX:302-831-2469
E-Mail:writter@udel.edu



Duffield Associates, Inc.
5300 Emestone Road
Wilmington, DE 19808-1232
Phone: 302.239.6634
Fax: 302.239.8485
duffield.com

May 10, 2006

Dean Robin W. Morgan
University of Delaware
Agriculture and Natural Resources Department
113 Townsend Hall
Newark, DE 19716

RE: Proposed Masters Degree in Bioresources Engineering
University of Delaware

Dear Dr. Morgan:

I am writing on behalf of Duffield Associates, Inc. to indicate our firm's support for the creation of a new Master of Science in Bioresources Engineering at the University of Delaware (UD). Based on information Duffield Associates recently received, it is our understanding that UD is currently considering the creation of a new MS degree in this area of specialization.

By way of background, our firm specializes in the geosciences (geotechnical, environmental, water resources, structural, and construction engineering). We have a staff of approximately 120 people with offices in Wilmington, Delaware; Georgetown, Delaware; and Philadelphia, Pennsylvania.

Based on our understanding of the proposed MS program, a Bioresources Engineering program at UD would include research and training in the following technical areas:

- Stormwater management
- Water quality modeling
- Bioremediation
- Nonpoint pollution
- Water management
- Vegetative control of ditches/slopes

Our company provides professional services in each of the above areas. Based on the general shortage of civil engineering graduates that we have observed over the last several years (including those specializing in water resources), we very strongly support a program that would develop more qualified engineers in this technical specialty.

Printed on Recycled Stock

Dean Robin W. Morgan
RE: Bioresources Engineering
May 10, 2006
Page 2

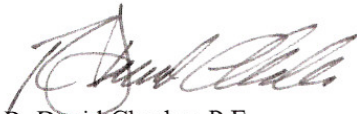
Because, we are not aware of any other graduate program in Bioresources Engineering in the State of Delaware at this time, we feel that the State of Delaware and society in general, would benefit from the training of more capable engineers in this technical specialty. For this reason, we very strongly support the creation of a new MS degree program in Bioresources Engineering at UD.

If you have any questions regarding the above or wish to discuss this issue further, please contact us.

Thank you for your consideration.

Very truly yours,

DUFFIELD ASSOCIATES, INC.

A handwritten signature in black ink, appearing to read 'R. David Charles'.

R. David Charles, P.E.
Chief Executive Officer

RDC:lba
WORD\0506-BIORESOURCE ENG.COR

cc: William F. Ritter, P.E. – University of Delaware
Mr. Charles E. Mason – University of Delaware