UNIVERSITY OF HAWAII AT MĀNOA
UHM-1 FORM (ADD A COURSE OF STUDY)

1. Course Subject
BE

2. Proposed Course Number
410

3. Effective Term (Sem/Year)
Fall 2010

4. Frequency
Fall & Spring semester

5. Course Title
Biomass Conversion to Biofuels and Bioenergy

6. DANNR Course Title
Oilseeds (1 credit)

7. Core or Graduation Requirement (check one)
- Regular
- Experimental
- Two academic years
- Single (one term)

8. Grade Option (check all that apply)
- Letter Grade (L)
- Credit/No Credit (C)
- Audit (A)
- Satisfactory/Unsatisfactory (S)

9. Number of Credits
3

10. Repeat Limit
0

11. Credit Limit
3

12. Corequisite Course(s)
Enter course alpha and number for each corequisite. Use "or" or "and" instead of punctuation. Type "or concurrent" after each prerequisite course that may be taken concurrently. Also specify what type of waiver is acceptable (check only one).

"Be 375 or consent"

13. Major Requirement(s)

14. Prerequisite Course(s)
Enter course alpha and number for each prerequisite. Type "or" or "and" instead of punctuation. Type "or concurrent" after each prerequisite course that may be taken concurrently. Also specify what type of waiver is acceptable (check only one).

15. Contact Hours and Instruction Type

16. Cross-listed Course(s)

17. Catalog Description
Overview of biofuels/bioenergy production: fundamental concepts in biofuel/bioenergy production; renewable feedstocks; thermochemical and biochemical conversions of biomass to biofuel/bioenergy; biodiesel production; environmental impacts; economics and life-cycle analysis; value-added processing of biofuel residues; selected case studies.

18. Justification
See attached sheet

Requested by
MBBE
Harry Ako
APR 06, 2009

Approved by
CTAHR
Charles Kinoshita

(Date)

Office Use Only:
Graduate Division (500 level and above)

General Education

Mānoa Chancellor's Office
Catalog Description

BE 410 Biomass Conversion to Biofuels and Bioenergy (3). Overview of biofuel/bioenergy production; fundamental concepts in biofuel/bioenergy production; renewable feedstocks; thermochemical and biochemical conversions of biomass to biofuel/bioenergy; biodiesel production; environmental impacts, economics and life-cycle analysis; value-added processing of biofuel residues; selected case studies. Pre: BE 373 or consent.

Course Justification

The proposed course: Biomass Conversion to Biofuels and Bioenergy is intended as an elective course for upper level undergraduate biological engineering students. This 3 credit course aims at introducing broad topics on biofuel and bioenergy production. It covers overview of biofuel production from renewable feedstocks, fundamental concepts as applied to biofuel/bioenergy production, various renewable feedstocks, their production, availability and attributes for biofuel/bioenergy production, types of biofuel/bioenergy from biomass, biomass preprocessing, thermochemical conversion of biomass to heat and power, and biofuel, biochemical conversion of biomass to biofuel, biodiesel production from oil-seed crops, waste oil and micro-algae, microbial fuel cell, environmental impacts of biofuel production, economics and life-cycle analysis of biofuel, and value-added processing of biofuel residues. The course covers various industrial examples and case studies pertinent to biofuel production. The course also involves lab works where students will have an opportunity to get hand-on experience on biofuel production. All assignments will involve engineering design-type open questions, where students ability to design a unit or a system pertinent to biofuel production will be tested.

This new course builds-up a strong connection with the current BE core courses, e.g. BE 260: Mass and Energy Balances; BE 350/350L: Dynamic System Modeling and BE 373: Transport Phenomena. Biofuel is an emerging field that requires knowledge of chemistry, (micro) biology, math, physics and engineering. Since our BE students are already exposed to basic principles of engineering and biological systems through existing core and elective courses, the new course BE 410 provides an excellent fit to the BE program. Currently there is no course available at UHM that focuses on renewable biofuel/bioenergy. The proposed course will provide an excellent opportunity for BE students to apply the knowledge of biology and engineering in biofuel/bioenergy field. Thus, the proposed BE 410 course has a potential to significantly improve the professional and academic career prospects of our BE students.

1. What is the course modification?
BE 410 is a new course.

2. Why is the course being requested?
The BE program currently does not have any undergraduate level course that covers broad topics on biofuel and bioenergy. The course aims to provide strong foundation in biorenewables, especially biofuel and bioenergy to BE students and better prepared them for professional career.
3. How will the content be organized?

This is a 3-credit course and will meet for 75 minute lecture, two times per week. In addition, the students will be divided into a group of 5 and each group will conduct one biofuel experiment in the lab. The students will prepare a group lab report based on their experiment.

**BE 410: Biomass Conversion to Biofuel and Bioenergy**  
Department of Molecular Biosciences and Bioengineering  
University of Hawai’i at Mānoa

**Instructors:**  
*Samir K. Khanal, Ph.D., P.E.*  
Office: Agricultural Science 415K  
Telephone: 956-3812  
Office Hours: TBA  
Email: khanal@hawaii.edu

*Scott Turn, Ph.D.*  
Office: Hawaii Natural Energy Institute  
Telephone: 956-2346  
Office Hours: TBA  
Email: sturn@hawaii.edu

**Field Trip and Lab Co-Coordinator:**  
*Ryan Kurasaki, P.E.*  
Office: AEI 105  
Telephone: 956-7259  
Email: rkurasak@hawaii.edu

**Teaching Assistant:** There will be a teaching assistant assigned for this class. If you have questions related to the material, you may request a meeting with the TA (TBA).

**Meeting times and locations:** The classes will be held in TBA. The venue and time will be TBA. The exam and field trip dates will be announced in the first class. Any change in class schedule will be announced a week in advance except for unforeseen circumstances.

**Objectives of the course:** To introduce the broad concepts of biofuel and bioenergy production from renewable feedstocks with particular emphasis on 2nd and third generation liquid fuel.


**Other reference materials:** USDA and USDOE biomass/biofuel report, and video shows. Notes, handouts, and supplementary reading materials will be posted on Laulima: [https://laulima.hawaii.edu/portal](https://laulima.hawaii.edu/portal)

(Log on with your UH username and password)

UHM-1 Form for BE 410, 5/28/2009
Prerequisites: BE 373 or Consent

Catalog Description: 3 credits. Overview of biofuel/bioenergy production; fundamental concepts in biofuel/bioenergy production; renewable feedstocks; thermochemical and biochemical conversions of biomass to biofuel/bioenergy; biodiesel production; environmental impacts, economics and life-cycle analysis; value-added processing of biofuel residues; selected case studies.

Grading:

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<tr>
<td>Exam-1</td>
<td>20%</td>
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<td>Exam-2</td>
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<td>Exam-3</td>
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<td>Homework</td>
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<td>Lab project</td>
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<tr>
<th>Week</th>
<th>Topics</th>
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<tr>
<td>1</td>
<td>Course outline, current energy consumption, overview of biofuel/bioenergy and biorefinery concepts</td>
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<td>2</td>
<td>Fundamental concepts in understanding biofuel/bioenergy production</td>
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<td>3</td>
<td>Renewable feedstocks and their production</td>
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<td>4</td>
<td>Feedstocks availability, characterization and attributes for biofuel/bioenergy production</td>
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<td>5</td>
<td>Biomass preprocessing: drying, size reduction, and densification</td>
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<td>6</td>
<td>Various biofuels/bioenergy from biomass</td>
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<td>7</td>
<td>Biomass conversion to heat and power: thermal gasification of biomass, anaerobic digestion</td>
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<td>8</td>
<td>Biomass conversion to biofuel: thermochemical conversion, syngas fermentation</td>
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<td>9</td>
<td>Biochemical conversion to ethanol: biomass pretreatment</td>
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<td>10</td>
<td>Different enzymes, enzyme hydrolysis, and their applications in ethanol production</td>
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<td>11</td>
<td>Biodiesel production from oil seeds, waste oils and algae</td>
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<td>12</td>
<td>Hydrogen production, microbial fuel cells and environmental impacts of biofuel production</td>
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<td>13</td>
<td>Energy balance and life-cycle analysis of biofuel production</td>
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<td>14</td>
<td>Value-added processing of biofuel residues and co-products</td>
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<td>15</td>
<td>Field visit to a biofuel/bioenergy plant in Hawaii: Possible Companies: H Power, Oils of Aloha, Pacific Biodiesel and HC &amp; S Company</td>
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4. What other courses at UHM closely parallel the proposed course, and in what way will the latter make a distinct contribution?
No course currently exists at UH Mānoa that covers the broad topics on biofuel/bioenergy production. Therefore, the proposed course is extremely important to broaden-up the concepts of biorenewables among BE students.

5. Where or how does the proposed course fit into the current and future curriculum?

The course is intended to introduce biorenewables, especially biofuel/bioenergy concepts to BE students, which is currently lacking in the BE curriculum. The proposed course provides a unique opportunity for BE students to expose them to emerging field of biofuels. This further reinforces students’ abilities to relate materials from math, science, and engineering courses to biological engineering.

Given the coverage of broad concepts on biofuel/bioenergy production, it is envisioned that the proposed course could be used to fulfill part of the comprehensive biological engineering curriculum at the University of Hawai‘i at Mānoa.

6. Why is the number of credits and level justified? Explain the prerequisites and the absence thereof.

In order to cover broad spectrum of concepts of renewable biofuel/bioenergy, 3 credit hours are required. The prerequisite for this course is BE 373 or consent from the course instructors.

7. How will the course assist students to achieve the critical skills and competencies expected of CTAHR graduates?

   i) *Written Communications*. Students will be asked to review journal papers and summarize the findings as part of homework assignments. Student will be guided as how to prepare a write-up and will be graded with comments. In addition, students will also be responsible in preparing lab report and will be graded with comments.

   ii) *Oral Communications*. Students are expected to take part in classroom discussion.

   iii) *Analytical/problem solving skills*. An integral part of this course is to use basic mathematical, scientific, and engineering skills in several homework problems that require critical thinking skills.

   iv) “Real world” experience. Industry visits and selected case studies will provide students with an opportunity to expose to ‘real world’ engineering systems and issues encountered in the fields. In addition, students will be exposed to several application examples during the course.

   vi) *Computer skills*. Students will gain practice with standard computer software for modeling, drawing, data analysis, and engineering graphics.

   viii) *Global perspective*. The reading of literature and classroom discussion will also provide students opportunity to comprehend the renewable biofuel issues on a larger-scale.

8. How will students be evaluated?
There will be three exams of equal weightage. The exams will be closed book and the problems will be designed to check students’ critical and logical thinking skill. The mark distributions are given below:

Exam-1: 20%
Exam-2: 20%
Exam-3: 20%
Homework: 20%
Lab project: 20%

9. What are the minimum qualifications for teaching this course? Is a qualified instructor now available?

A Ph.D. degree in Engineering with relevant experience in biofuel/bioenergy is required. The course will be co-taught by Dr. Samir K. Khanal (MBBE) and Dr. Scott Turn (HNEI). Dr. Khanal is an Assistant Professor in the Department of Molecular Biosciences and Bioengineering and has nearly 10 yrs of academic experience in the field of bioengineering/renewable biofuel/bioenergy. Dr. Khanal was involved in teaching several sections of the proposed course at Iowa State University (ISU) and delivered over 30 invited lectures on biofuels around the globe. Dr. Khanal has authored a book entitled “Anaerobic Biotechnology for Bioenergy Production: Principles and Application” (Wiley-Blackwell), which also covers a considerable part on biofuel/bioenergy. Dr. Scott Turn is an Associate Researcher in Hawaii Natural Energy Institute. Dr. Turn has over 15 years of experience in renewable fuel research/teaching. Dr. Turn has been a leading author on several biofuel-related white papers for Hawaii including Hawaii Bioenergy Master Plan.

10. How will the course be financed, assuming no further cutbacks?

In general, no special equipment or supplies will be required. The instructors will use their research facilities for laboratory work. The proposed course will be financed by department and college instructional funds.

11. Has the course been offered before? Is there a demand for it?

This course has never been offered. With growing emphasis on renewable energy, there is a relatively large demand for the course in UHM.

12. Is the course cross-listed with another department?

No