

NEW COURSE FORM

1. General Information.

- a. Submitted by the College of: Engineering Today's Date: 9-3-10
- b. Department/Division: Biosystems & Agricultural Engineering
- c. Contact person name: Czarena Crofcheck Email: crofcheck@uky.edu Phone: 257-3000x212
- d. Requested Effective Date: Semester following approval OR Specific Term/Year¹: Fall 2011

2. Designation and Description of Proposed Course.

- a. Prefix and Number: BAE 505
- b. Full Title: Thermochemical Processing of Biomass
- c. Transcript Title (if full title is more than 40 characters): _____
- d. To be Cross-Listed² with (Prefix and Number): _____

- e. Courses must be described by at least one of the meeting patterns below. Include number of actual contact hours³ for each meeting pattern type.

3 Lecture _____ Laboratory¹ _____ Recitation _____ Discussion _____ Indep. Study _____
_____ Clinical _____ Colloquium _____ Practicum _____ Research _____ Residency _____
_____ Seminar _____ Studio _____ Other – Please explain: _____

- f. Identify a grading system: Letter (A, B, C, etc.) Pass/Fail

- g. Number of credits: 3

- h. 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

- i. Course Description for Bulletin: Introduction to thermal and catalytic processes for the conversion of biomass to biofuels and other biobased products. Topics include gasification, fast pyrolysis, hydrothermal processing, syngas to synfuels, and bio-oil upgrading.

- j. Prerequisites, if any: BAE 503, BAE 504, consent of instructor

- k. Will this course also be offered through Distance Learning? YES⁴ NO

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

3. Will this course be taught off campus? YES NO

4. Frequency of Course Offering.

- a. Course will be offered (check all that apply): Fall Spring Summer

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, represents at least 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.

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- 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? 10
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: _____
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 requirement⁵ for ANY program? YES NO
If YES⁵, 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) identification of additional assignments by the graduate students; and/or (ii) establishment of different grading criteria in the course for graduate students. (See SR 3.1.4.)
- 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.

⁵ In order to change a program, a program change form must also be submitted.

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Signature Routing Log

General Information:

Course Prefix and Number: BAE 505

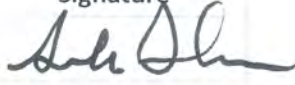

7-3000

Proposal Contact Person Name: Czarena Crofcheck Phone: X 212 Email: crofcheck@uky.edu

INSTRUCTIONS:

Identify the groups or individuals reviewing the proposal; note the date of approval; offer a contact person for each entry; and obtain signature of person authorized to report approval.

Internal College Approvals and Course Cross-listing Approvals:

Reviewing Group	Date Approved	Contact Person (name/phone/email)	Signature
Dept. Chair	4-11-11	S.A. Shearer 17-3000/Scott.A.Shearer@uky.edu	
Engineering Faculty	11-04-11	R. Swelgard 7-81327 rswelgar@engr.uky.edu	
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External-to-College Approvals:

Council	Date Approved	Signature	Approval of Revision ⁶
Undergraduate Council			
Graduate Council			
Health Care Colleges Council			
Senate Council Approval		University Senate Approval	

Comments:

⁶ Councils use this space to indicate approval of revisions made subsequent to that council's approval, if deemed necessary by the revising council.

BAE 505 - Thermochemical Processing of Biomass

INSTRUCTOR:

Dr. Czarena Crofcheck
212 CE Barnhart Building
257-3000x212; email: crofcheck@uky.edu

COURSE DESCRIPTION:

Introduction to thermal and catalytic processes for the conversion of biomass to biofuels and other biobased products. Topics include gasification, fast pyrolysis, hydrothermal processing, syngas to synfuels, and bio-oil upgrading.

COURSE GOALS:

Students completing this course should be able to: 1. recognize the advantages and disadvantages of thermochemical processing compared to biochemical processing, 2. identify important classes of thermochemical processes, 3. perform mass and energy balances on thermochemical processes, and 4. develop designs for thermochemical reactors.

PREEQUISITES: BAE 503, BAE 504, consent of instructor

STUDENT LEARNING OUTCOMES:

After completing this course, the student will be able to:

1. Identify the differences between Thermochemical processing of coal and biomass,
2. Describe the various means for Thermochemical processing biomass,
3. Describe the necessary pre-processing and post-processing steps necessary.

GRADING:

Undergraduate students: Mid-Term Exams: 40%, Final Exam: 30%, Homework: 30%

Graduate students: Mid-Term Exams: 30%, Final Exam: 20%, Homework: 30%, Project 20%

GRADING SCALE FOR UNDERGRADUATES:

The scale for grades is as shown in percentage of total points.

A=90-100%

B=80-89%

C=70-79%

D=60-69%

E=<60%

GRADING SCALE FOR GRADUATE STUDENTS:

The scale for grades is as shown in percentage of total points.

A=90-100%

B=80-89%

C=70-79%

E=<70%

TEXT (As needed):

- Crocker et al., Thermochemical Conversion of Biomass to Liquid Fuels and Chemicals (Rsc Energy), Royal Society of Chemistry; 1st Edition. Edition, 2010.
- Brown, R. C. Biorenewable Resources, Blackwell Publishing, Ames, Iowa, 2003.
- Klass, D. L. Biomass for Renewable Energy, Fuels, and Chemicals, Academic Press, San Diego, CA, 1998.
- Rezaiyan, J., Cheremisinoof, N. P. Gasification Technologies: A Primer for Engineers and Scientists.
- Probst, R. F., Hicks, R. E., Synthetic Fuels, Dover Publishing, 1982.
- Huber, G. W., Iboora, S. Corma, A. Synthesis of Transportation Fuels from Biomass: Chemistry, Catalysts, and Engineering, Chem. Rev. 2006, 106, 4044-4098.

ASSIGNMENTS: Reading assignments will be given throughout the semester. The purpose of these assignments is to enhance class discussions; thus, the assignments should be read prior to the first discussion of the particular subject. There will be at least two mid-terms. Homework will be assigned when appropriate. Obtaining and critiquing journal articles will be necessary throughout the semester and journal assignments will be collected and graded as homework assignments. There will be additional reading assignments for graduate students.

MID-TERM GRADE: Mid-term grades will be posted in myUK by the deadline established in the Academic Calendar (<http://www.uky.edu/Registrar/AcademicCalendar.htm>)

EXCUSED ABSENCES:

Students need to notify the professor of absences prior to class when possible. S.R. 5.2.4.2 defines the following as acceptable reasons for excused absences: (a) serious illness, (b) illness or death of family member, (c) University-related trips, (d) major religious holidays, and (e) other circumstances found to fit "reasonable cause for nonattendance" by the professor.

Students anticipating an absence for a major religious holiday are responsible for notifying the instructor in writing of anticipated absences due to their observance of such holidays no later than the last day in the semester to add a class. Information regarding dates of major religious holidays may be obtained through the religious liaison, Mr. Jake Karnes (859-257-2754).

Students are expected to withdraw from the class if more than 20% of the classes scheduled for the semester are missed (excused or unexcused) per university policy.

VERIFICATION OF ABSENCES:

Students may be asked to verify their absences in order for them to be considered excused. Senate Rule 5.2.4.2 states that faculty have the right to request “appropriate verification” when students claim an excused absence because of illness or death in the family. Appropriate notification of absences due to university-related trips is required prior to the absence.

ACADEMIC INTEGRITY:

Per university policy, students shall not plagiarize, cheat, or falsify or misuse academic records. Students are expected to adhere to University policy on cheating and plagiarism in all courses. The minimum penalty for a first offense is a zero on the assignment on which the offense occurred. If the offense is considered severe or the student has other academic offenses on their record, more serious penalties, up to suspension from the university may be imposed.

Plagiarism and cheating are serious breaches of academic conduct. Each student is advised to become familiar with the various forms of academic dishonesty as explained in the Code of Student Rights and Responsibilities. Complete information can be found at the following website: <http://www.uky.edu/Ombud>. A plea of ignorance is not acceptable as a defense against the charge of academic dishonesty. It is important that you review this information as all ideas borrowed from others need to be properly credited.

Part II of Student Rights and Responsibilities (available online <http://www.uky.edu/StudentAffairs/Code/part2.html>) states that all academic work, written or otherwise, submitted by students to their instructors or other academic supervisors, is expected to be the result of their own thought, research, or self-expression. In cases where students feel unsure about the question of plagiarism involving their own work, they are obliged to consult their instructors on the matter before submission.

When students submit work purporting to be their own, but which in any way borrows ideas, organization, wording or anything else from another source without appropriate acknowledgement of the fact, the students are guilty of plagiarism. Plagiarism includes reproducing someone else’s work, whether it be a published article, chapter of a book, a paper from a friend or some file, or something similar to this. Plagiarism also includes the practice of employing or allowing another person to alter or revise the work which a student submits as his/her own, whoever that other person may be.

Students may discuss assignments among themselves or with an instructor or tutor, but when the actual work is done, it must be done by the student, and the student alone. When a student’s assignment involves research in outside sources of information, the student must carefully acknowledge exactly what, where and how he/she employed them. If the words of

someone else are used, the student must put quotation marks around the passage in question and add an appropriate indication of its origin. Making simple changes while leaving the organization, content and phraseology intact is plagiaristic. However, nothing in these Rules shall apply to those ideas which are so generally and freely circulated as to be a part of the public domain (Section 6.3.1).

Please note: Any assignment you turn in may be submitted to an electronic database to check for plagiarism.

ACCOMMODATIONS DUE TO DISABILITY:

If you have a documented disability that requires academic accommodations, please see me as soon as possible during scheduled office hours. In order to receive accommodations in this course, you must provide me with a Letter of Accommodation from the Disability Resource Center (Room 2, Alumni Gym, 257-2754, email address: jkarnes@email.uky.edu) for coordination of campus disability services available to students with disabilities.

CLASSROOM CONDUCT: Cell phones should be silent (no talking or texting) during class and recitation periods. I typically distribute handouts at the beginning of class. If you are late to class, it is your responsibility to come to the front of the class and pick up handouts, if you miss a day it is your responsibility to get a copy of the handout.

LIST OF TOPICS:

	Wk	Topic	Reading
Jan	1	Introduction	Biofuels Review (Huber); Biomass Resources (Brown); Properties of Biomass (Brown)
	2	Chemical kinetics	Kinetics Notes (Crofcheck); Water-Gas Shift (Fogler)
	3	Reactor design	Reactor Design (Brown)
Feb	4	Fluidized bed hydrodynamics	Fluidized Beds (Brown)
Exam 1			
	5	Combustion	Chapter 3 (Crocker); Biomass Power (Brown); Combustion Review (Williams); Particle Combustion (Brown)
	6	Gasification	Chapter 4 (Crocker); Gasification Catalysts (Sutton)
	7	Gasification	
Mar	8	Fast Pyrolysis	Chapter 7 (Crocker); Blasi Modeling Fast Pyrolysis Biorenewable Resources (Chapter 2, Brown, 2003); Fast Pyrolysis Review (Bridgwater); Pyrolysis for Bio oil Review (Mohan); Pyrolysis of Wood Biomass for Bio-oil – A Critical Review
	9	Fast Pyrolysis	
Exam 2			
	10	Bio-oil upgrading	Bio-oil Upgrading Bridgwater, 1994
	11	Syngas upgrading	Chapter 5 (Crocker); Chapter 6 (Crocker); NREL Report SynGas; NREL Syngas Upgrading; Syngas Cleaning Review (Sharma)
Apr	12	Hydrothermal technology	Chapter 8 (Crocker); 2005 MSE Paper (Crofcheck)
	13	Catalytic processing technology	Misc Journal Articles
	14	Biorefineries	Misc Journal Articles
Exam 3			
	15	Review & CAER Tour	
Final Exam			