TO: The Faculty of the College of Engineering  
FROM: The Faculty of Agricultural and Biological Engineering  
RE: New Course ABE 45700

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

**ABE 45700** Transport Operations in Food and Biological Engineering I  
Sem. 2, Class 3. Lab 0. Cr. 3.  
Requisites, Restrictions, and Attributes: ABE 30800

**Description:** Application of momentum and heat transfer to biological and food process engineering. Viscosity, non-Newtonian fluids, experimental methods of rheological characterization of food and biological systems; viscoelasticity; design equations for pipeflow, pumps, mixing, emulsification, extrusion, sheeting, heat exchangers, aseptic processing, sterilization, freezing, and evaporation.

**Reason:** This course is replacing ABE 45400 (4 credits) with a 3 credit version; the lab is being dropped to reduce credit hours from 4 to 3. The laboratory is being incorporated into ABE 30400. This reduction in course content and credit hours will help the program meet the 128 credit hour constraint.

Bernard A. Engel, Professor and Head  
Agricultural and Biological Engineering Department

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

ECC Minutes #13  
Date 5/10/2013  
Chairman ECC
**PURDUE UNIVERSITY**
REQUEST FOR ADDITION, EXPIRATION, OR REVISION OF AN UNDERGRADUATE COURSE
(10000-40000 LEVEL)

**DEPARTMENT**: Agricultural and Biological Engineering  
**EFFECTIVE SESSION**: Spring 2011 (2011)

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

- New course with supporting documents
- Add existing course offered at another campus
- Expiration of a course
- Change in course number
- Change in course title
- Change in course credit type
- Change in course attributes (department head signature only)
- Change in instructional hours
- Change in course description
- Change in course requisites/restrictions
- Change in semester offered (department head signature only)
- Transfer from one department to another

**PROPOSED**:
- Subject Abbreviation: ABE
- Course Number: 45700
- Long Title: Transport Operations in Food and Biological Engineering
- Short Title: Transp Oper in Food & Biological Engg

**EXISTING**:
- Subject Abbreviation
- Course Number
- Long Title
- Short Title

**TERMS OFFERED**:
- Check All That Apply:
  - [ ] Fall
  - [ ] Spring
  - [ ] Summer
- CAMPUS(ED) INVOLVED:
  - [ ] Calumet
  - [ ] Cont Ed
  - [ ] Ft. Wayne
  - [ ] Indianapolis
  - [ ] N. Central
  - [ ] Tech statewide
  - [ ] W. Lafayette

**CREDIT TYPE**:
- Fixed Credit Cr. Hrs.:
  - 3
- Variable Credit Range:
  - Minimum Cr. Hrs. (Check One):
    - [ ] To
    - [ ] Or
  - Maximum Cr. Hrs.
- Equivalent Credit:
  - [ ] Yes
  - [ ] No

**COURSE ATTRIBUTES**:
- Check All That Apply:
  - [ ] 6 Registration Approval Type
  - [ ] 7 Variable Title
  - [ ] 8 Honors
  - [ ] 9 Full Time Privilege
  - [ ] 10 Off Campus Experience

**COURSE DESCRIPTION (INCLUDE REQUISITES/RESTRICTIONS)**:
Application of momentum and heat transfer to biological and food process engineering. Viscosity, non-Newtonian fluids, experimental methods of rheological characterization of food and biological systems; viscoelasticity; design equations for pipeflow, pumps, mixing, emulsification, extrusion, sheeting, heat exchangers, aseptic processing, sterilization, freezing, and evaporation.
Requisites, Restrictions, and Attributes: ABE 30800

**COURSE LEARNING OUTCOMES**
Gain an understanding the principles, design and analysis of biological and food process engineering operations. Know the characteristics and analysis of the flow of biological fluid.
Gain an understanding of the principles, design and analysis of thermal processing operations.
Gain an understanding of the principles and analysis of freezing.

**RECEIVED**
- JUN - 6 2013
- OFFICE OF THE REGISTRAR

**RECEIVED**
- MAY 2 3 2013
- OFFICE OF THE REGISTRAR

**OFFICE OF THE REGISTRAR**

[Signatures]

[Date]: 5/17/13

[Date]: [Signature]

[Signature]: [Signature]

[Date]: 9/11/13
REQUEST FOR ADDITION, EXPIRATION, OR REVISION OF AN UNDERGRADUATE COURSE
(10000-40000 LEVEL)

DEPARTMENT: Agricultural and Biological Engineering
EFFECTIVE SESSION: Spring 2013

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

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

PROPOSED:

Subject Abbreviation: ABE
Course Number: 45700
Long Title: Transport Operations in Food and Biological Engineering I

EXISTING:

Subject Abbreviation
Course Number

TERMS OFFERED:

☐ Fall
☐ Spring
☐ Summer

CAMPUS(ES) INVOLVED:

☐ Calumet
☐ Cont Ed
☐ Ft. Wayne
☐ Indianpolis
☐ N Central
☐ Tech Statewide
☐ W. Lafayette

Abbreviated title will be entered by the Office of the Registrar if omitted. (30 CHARACTERS ONLY)

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 ☐

COURSE ATTRIBUTES: Check All That Apply

☐ 6 Registration Approval Type
☐ Department
☐ Instructor
☐ 7 Variable Title
☐ 8 Honors
☐ 9 Full Time Privilege
☐ 10 Off Campus Experience

SCHEDULE TYPE

Lecture: 50 Min Per Week
Recitation:
Presentation:
Laboratory:
Lab Prep:
Studio:
Distance:
Clinic:
Experiential:
Research:
Ind. Study:
Pract/Oberv:

MEETING PER WEEK

Weeks Offered % of Credit Allocated

Course/Defined Courses

COURSE DESCRIPTION (INCLUDE REQUISITES/RESTRICTIONS):

Application of momentum and heat transfer to biological and food process engineering. Viscosity, non-Newtonian fluids, experimental methods of rheological characterization of food and biological systems; viscoelasticity; design equations for pipeflow, pumps, mixing, emulsification, extrusion, sheeting, heat exchangers, aseptic processing, sterilization, freezing, and evaporation.

Requisites, Restrictions, and Attributes: ABE 30800

COURSE LEARNING OUTCOMES:

Gain an understanding the principles, design and analysis of biological and food process engineering operations. Know the characteristics and analysis of the flow of biological fluid. Gain an understanding of the principles, design and analysis of thermal processing operations. Gain an understanding of the principles and analysis of freezing.

Calumet Department Head Date Calumet School Dean Date
Fort Wayne Department Head Date Fort Wayne School Dean Date
Indianapolis Department Head Date Indianapolis School Dean Date
North Central Faculty Senate Chair Date Vice Chancellor for Academic Affairs Date
West Lafayette Department Head Date West Lafayette Collegiate Dean Date
West Lafayette Registrar Date

OFFICE OF THE REGISTRAR
ABE 45700  Transport Operations in Food and Biological Engineering I

COURSE CONTACT INFORMATION:

Name: Ganesan Narsimhan  
Phone Number: (765)494-1199  
E-mail Address:narsimha@purdue.edu  
Campus Address: NLSN 2247

Course Description. Application of momentum and heat transfer to biological and food process engineering. Viscosity, non-Newtonian fluids, experimental methods of rheological characterization of food and biological systems; viscoelasticity; design equations for pipe flow, pumps, mixing, emulsification, extrusion, sheeting, heat exchangers, aseptic processing, sterilization, freezing, and evaporation.

Requisites, Restrictions, and Attributes: ABE 30800

COLLEGE (AGRICULTURE) LEARNING OUTCOMES ADDRESSED BY THIS COURSE

x  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.

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

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.

Lifelong Learning: Demonstrate skills necessary for lifelong learning.

DEPARTMENTAL/PROGRAM LEARNING OUTCOMES ADDRESSED BY THIS COURSE

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

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

x  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
an ability to function on multidisciplinary teams
an ability to identify, formulate, and solve engineering problems
an understanding of professional and ethical responsibility
an ability to communicate effectively
the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context
a recognition of the need for, and an ability to engage in life-long learning
a knowledge of contemporary issues
an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice

Course outline of Topics/Syllabus
1. Non-Newtonian fluid behavior
2. Techniques for characterization of Non-Newtonian fluids
3. Design equations for pipe flow
4. Pump characteristics
5. Mixing
6. Emulsification
7. Extrusion
8. Heat exchangers
9. Thermal processing
10. Aseptic processing
11. Unsteady state heat transfer
12. Freezing

Reading List/Textbook
1. ABE 454 Class Notes from Boiler Book Store.
2. Transport Processes and Unit Operations by Christie J. Geonkopolis, Prentice Hall (Fourth edition)

Example syllabus

ABE 45700 Transport Operations in Food and Biological Engineering I

Textbook and/or other recommended material
- ABE 454 Class Notes from Boiler Book Store.
- Transport Processes and Unit Operations by Christie J. Geonkopolis, Prentice Hall (Fourth edition)
Course Learning Objectives:

Successful completion of the course will enable the students to:

1. Gain an understand the principles, design and analysis of biological and food process engineering operations
2. Know the characteristics and analysis of the flow of biological fluid
3. Gain an understanding of the principles, design and analysis of thermal processing operations.
4. Gain an understanding of the principles and analysis of freezing.

Grading:

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<table>
<thead>
<tr>
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<tbody>
<tr>
<td>Homeworks</td>
<td>40%</td>
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<tr>
<td>Quiz</td>
<td>10%</td>
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<tr>
<td>Exams</td>
<td>50%</td>
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</tbody>
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Tentative scale for grades is as follows:

- > 97.5% A+
- 92.5-97.5% A
- 90-92.5% A-
- 87.5-90% B+
- 82.5-87.5% B
- 80-82.5% B-
- 77.5-80% C+
- 72.5-77.5% C
- 70-72.5% C-
- 67.5-70% D+
- 62.5-67.5% D
- 60-62.5% D-
- < 60% F
### Weekly Syllabus

<table>
<thead>
<tr>
<th>Week</th>
<th>Topic</th>
<th>Chapter/Notes</th>
</tr>
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<tbody>
<tr>
<td>Week 1</td>
<td>Introduction, Non-Newtonian Fluids calculations</td>
<td>2.7F (G)</td>
</tr>
<tr>
<td>Week 2</td>
<td>Capillary Rheometer</td>
<td>Ch 2 and 3, Class Notes</td>
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<tr>
<td>Week 3</td>
<td>Rotational Rheometer</td>
<td>Ch 3 and 4, Class Notes</td>
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<td>Week 4</td>
<td>Viscoelasticity</td>
<td>Ch 5, Class Notes</td>
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<td>Week 5</td>
<td>Emulsification</td>
<td>Ch 6, Class Notes</td>
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<tr>
<td>Week 6</td>
<td>Pumps</td>
<td>3.3 (G)</td>
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<td></td>
<td>Exam I</td>
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<td>Week 6</td>
<td>Mixing</td>
<td>3.4, 3.5 (G)</td>
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<td>Week 7</td>
<td>Flow in packed and fluidized beds</td>
<td>3.1C, 3.1D (G)</td>
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<tr>
<td>Weeks 8,9</td>
<td>Extrusion Equipment</td>
<td>Ch 7.1, 7.2, Class Notes</td>
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<tr>
<td></td>
<td>Design Equations for Extrusion</td>
<td>Ch 7.3, Class Notes</td>
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<tr>
<td>Week 10</td>
<td>Shell and Tube Heat Exchangers</td>
<td>4.9 (G)</td>
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<td>Exam II</td>
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<td>Week 10</td>
<td>Plate Heat Exchangers</td>
<td>Handout</td>
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<td>Week 11,12</td>
<td>Sterilization</td>
<td>Class Notes, 9.12 (G)</td>
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<td>Week 13,14</td>
<td>Evaporation</td>
<td>8 (G)</td>
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<td>Week 15</td>
<td>Unsteady State Heat Transfer</td>
<td>5 (G)</td>
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<td>Week 16</td>
<td>Freezing</td>
<td>5.5 (G)</td>
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<tr>
<td></td>
<td>Review</td>
<td></td>
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