TO: The Faculty of the College of Engineering

FROM: The Faculty of Agricultural and Biological Engineering

RE: New Course ABE 30700

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 30700 Momentum Transfer in Food and Biological Systems
Sem. 1, Class 3. Lab 0. Cr. 3.
Requisites, Restrictions, and Attributes: ABE 20200, MA 26500, MA 26600

Description: Fluid statics, Newton's law of viscosity, shell momentum balances, equations of continuity and motion, one dimensional flow problems, flow through porous media, velocity distributions with more than one independent variables, two dimensional flow through a channel, stream function, velocity potential, dimensional analysis, boundary layer, turbulent flow, Reynolds stress, form and skin friction, application of macroscopic momentum and mechanical energy balances to engineering problems.

Typically offered Fall. 3 credit hours. Prerequisite: ABE 20200, MA 26500, MA 26600

Reason: This course replaces CHE 37700 in the Biological Engineering plan of study. Development of a new laboratory course that complements this and two other courses along with increases in the number of students in the Biological Engineering program made it desirable for the Department faculty to teach the subject.

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

EFD 25-13

Office of the Registrar
FORM 40 REV. 10/10

PURDUE UNIVERSITY
REQUEST FOR ADDITION, EXPIRATION,
OR REVISION OF AN UNDERGRADUATE COURSE
(10000-40000 LEVEL)

DEPARTMENT: Agricultural and Biological Engineering EFFECTIVE SESSION: ~~Spring 2013~~ (20140)

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

- [x] 1. New course with supporting documents
- [ ] 2. Add existing course offered at another campus
- [ ] 3. Expiration of a course
- [ ] 4. Change in course number
- [ ] 5. Change in course title
- [ ] 6. Change in course credit/type
- [ ] 7. Change in course attributes (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:		EXISTING:	
Subject Abbreviation	ABE	Subject Abbreviation	
Course Number	30700	Course Number	
Long Title	Momentum Transfer in Food and Biological Systems		
Short Title	Momentum Trans Food & Bio Sys		

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

TERMS OFFERED
Check All That Apply:
[x] Fall [ ] Spring [ ] Summer

CAMPUS(ES) INVOLVED
[ ] Calumet [ ] N. Central
[ ] Cont Ed [x] Tech Statewide
[ ] Ft. Wayne [x] W. Lafayette
[ ] Indianapolis

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

Schedule Type	Minutes Per Mtg	Meetings Per Week	Weeks Offered	% of Credit Allocated
Lecture	50	3		
Recitation				
Presentation				
Laboratory				
Lab Prep				
Studio				
Distance				
Clinic				
Experiential				
Research				
Ind. Study				
Pract/Observ				

RECEIVED
JUN - 6 2013
OFFICE OF THE REGISTRAR

Cross-Listed Courses
~~RECEIVED~~
MAY 23 2013
OFFICE OF THE REGISTRAR

COURSE DESCRIPTION (INCLUDE REQUISITES/RESTRICTIONS):

Fluid statics, Newton's law of viscosity, shell momentum balances, equations of continuity and motion, one dimensional flow problems, flow through porous media, velocity distributions with more than one independent variables, two dimensional flow through a channel, stream function, velocity potential, dimensional analysis, boundary layer, turbulent flow, Reynolds stress, form and skin friction, application of macroscopic momentum and mechanical energy balances to engineering problems.
Typically offered Fall. 3 credit hours. Prerequisite: ABE 20200, MA 26500, MA 26600

*COURSE LEARNING OUTCOMES

Know the principles of fluid statics.
Know the principles of dimensional analysis for analysis of flow problems.
Know the characteristics and analysis of the flow of food and biological fluids.
Gain an understanding the principles of turbulent flow.
Know how to apply macroscopic mass and momentum balances to flow problems in food and biological systems.

	Date		Date
Calumet Department Head		Calumet School Dean	
Fort Wayne Department Head		Fort Wayne School Dean	
Indianapolis Department Head		Indianapolis School Dean	
North Central Faculty Senate Chair		Vice Chancellor for Academic Affairs	
West Lafayette Department Head	5/17/13	West Lafayette College/School Dean	5-17-13
		West Lafayette Registrar	6/10/13

OFFICE OF THE REGISTRAR

6/7/13

Office of the Registrar
FORM 40 REV. 10/10

PURDUE UNIVERSITY
REQUEST FOR ADDITION, EXPIRATION,
OR REVISION OF AN UNDERGRADUATE COURSE
(10000-40000 LEVEL)

EFD 25-13

DEPARTMENT: Agricultural and Biological Engineering
EFFECTIVE SESSION: Spring 2013

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

- [x] 1. New course with supporting documents
- [ ] 2. Add existing course offered at another campus
- [ ] 3. Expiration of a course
- [ ] 4. Change in course number
- [ ] 5. Change in course title
- [ ] 6. Change in course credit/type
- [ ] 7. Change in course attributes (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:		EXISTING:	
Subject Abbreviation	ABE	Subject Abbreviation	
Course Number	30700	Course Number	
Long Title	Momentum Transfer in Food and Biological Systems		
Short Title			

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

TERMS OFFERED
Check All That Apply:
- [x] Fall
- [ ] Spring
- [ ] Summer

CAMPUS(ES) INVOLVED
- [ ] Calumet
- [ ] Cont Ed
- [ ] Ft. Wayne
- [ ] Indianapolis
- [ ] N. Central
- [ ] Tech Statewide
- [x] W. Lafayette

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

COURSE ATTRIBUTES: Check All That Apply
1. Pass/Not Pass Only [ ]
2. Satisfactory/Unsatisfactory Only [ ]
3. Repeatable [ ]
   Maximum Repeatable Credit: [ ]
4. Credit by Examination [ ]
5. Special Fees [ ]
6. Registration Approval Type
   Department [ ] Instructor [ ]
7. Variable Title [ ]
8. Honors [ ]
9. Full Time Privilege [ ]
10. Off Campus Experience [ ]

Schedule Type	Minutes Per Mtg	Meetings Per Week	Weeks Offered	% of Credit Allocated
Lecture	50	3		
Recitation				
Presentation				
Laboratory				
Lab Prep				
Studio				
Distance				
Clinic				
Experiential				
Research				
Ind. Study				
Pract/Observ				

Cross-Listed Courses

COURSE DESCRIPTION (INCLUDE REQUISITES/RESTRICTIONS):

Fluid statics, Newton's law of viscosity, shell momentum balances, equations of continuity and motion, one dimensional flow problems, flow through porous media, velocity distributions with more than one independent variables, two dimensional flow through a channel, stream function, velocity potential, dimensional analysis, boundary layer, turbulent flow, Reynolds stress, form and skin friction, application of macroscopic momentum and mechanical energy balances to engineering problems.
Typically offered Fall. 3 credit hours. Prerequisite: ABE 20200, MA 26500, MA 26600

*COURSE LEARNING OUTCOMES

Know the principles of fluid statics.
Know the principles of dimensional analysis for analysis of flow problems.
Know the characteristics and analysis of the flow of food and biological fluids.
Gain an understanding the principles of turbulent flow.
Know how to apply macroscopic mass and momentum balances to flow problems in food and biological systems.

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 College/School Dean	Date
		West Lafayette Registrar	Date

5/13/13

OFFICE OF THE REGISTRAR

ABE 30700 Momentum Transfer in Food and Biological Systems

COURSE CONTACT INFORMATION:

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

COLLEGE 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.
- _____ 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
- x 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

Course Learning Objectives:

Successful completion of the course will enable the students to:

1. Know the principles of fluid statics.
2. Know the principles of dimensional analysis for analysis of flow problems.
3. Know the characteristics and analysis of the flow of food and biological fluids.
4. Gain an understanding the principles of turbulent flow.
5. Know how to apply macroscopic mass and momentum balances to flow problems in food and biological systems.

Course Topics/Practices:

1. Fluid statics
2. Shell momentum balances
3. Design equations for pipe flow
4. Equation of continuity and motion
5. Velocity profile for one dimensional flow problems
6. Velocity profile for unsteady state and two dimensional flow problems
7. Dimensionless analysis
8. Turbulent flow
9. Boundary layer
10. Form and skin friction
11. Macroscopic balances for flow problems

Reading List/Textbook

Transport Phenomena 2nd edition, by R.B. Bird, W.E. Stewart and E.N. Lightfoot, (John Wiley and Sons).

Library Resources

Introduction to Fluid Mechanics, by Whitaker (Prentice Hall)

Transport Phenomena in Biological Systems, 2nd edition, by G.A. Trukskey, F. Yuan, and D.F. Katz, (Pearson Prentice Hall)

Example syllabus

ABE 30700 Momentum Transfer in Food and Biological Systems

Textbook and/or other recommended material

Transport Phenomena 2nd edition, by R.B. Bird, W.E. Stewart and E.N. Lightfoot, (John Wiley and Sons).

Course Learning Objectives:

Successful completion of the course will enable the students to:

1. Know the principles of fluid statics.
2. Know the principles of dimensional analysis for analysis of flow problems.
3. Know the characteristics and analysis of the flow of food and biological fluids.
4. Gain an understanding the principles of turbulent flow.
5. Know how to apply macroscopic mass and momentum balances to flow problems in food and biological systems.

Grading Procedure:

Grading:		
	Homeworks	45%
	Quiz	5%
	Exams	50%

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 for Lecture

Dates	Topic	Reading Assignment
Week 1	Fluid statics	2.1, 2.2 W
Week 2	Manometers, buoyancy forces	2.4, 2.7 W
Week 2	Newtons Law of Viscosity	1.1,1.2 BSL
Week 3	Convective momentum transport	1.7 BSL
Week 3	Shell Momentum Balances	2.1 BSL
Weeks 4,5	Shell Momentum Balances	2.2, 2.3 BSL
	Flow through falling film, tube and other examples	
Week 5	Divergence Theorem	3.3,3.4 W
	Reynolds Transport Theorem	
Week 6	Equation of continuity	3.1,3.2 BSL
	Equation of motion	
Weeks 7,8	One dimensional flow problems using equation of continuity- flow through pipes, couette flow, sedimentation of a sphere	3.6 BSL
	Exam I	
Weeks 8, 9	One dimensional flow problems using equation of continuity, lubrication flow, pulsating flow through an tube, viscosity of suspensions, Darcy's law for flow through porous media	3.6 BSL 5.2, 8.3 TYK
Week 9	Dimensional analysis	3.7 BSL
Weeks 9,10	Velocity distribution with more than one independent variable	4.1 BSL
	Unsteady flow near a moving plate, unsteady flow through a pipe, flow past a plate-boundary layer	
	Exam II	

Week 11	Stream function and velocity potential	4.2,4.3 BSL
Weeks 11,12	Velocity profile in a boundary layer	4.4 BSL
Week 13	Turbulent flow, Reynolds stress	5 BSL
		6 W
Week 14	Form and skin friction	6 BSL
Weeks 14,15	Macroscopic balances- frictional losses for pipeflow, flow of a liquid through an orifice, sudden expansion, liquid ejector pump	7 BSL
Week 16	Constitutive equation for Non-Newtonian fluids	
	Review	