Office of the Registrar
FORM 40 REV. 9/06

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

EFD 26-06 file

DEPARTMENT: School of Chemical Engineering   EFFECTIVE SESSION: Fall 2010

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
- [ ] 5. Change in course title
- [x] 6. Change in course credit/type
- [ ] 7. Change in course attributes (department head signature only)
- [x] 8. Change in instructional hours
- [ ] 9. Change in course description
- [ ] 10. Change in course requisites
- [ ] 11. Change in semesters offered (department head signature only)
- [ ] 12. Transfer from one department to another

	PROPOSED	EXISTING
Subject Abbreviation		CHE
Course Number		34800

Long Title: Chemical Reaction Engineering

Short Title: Chem Reaction Engr

Abbreviated title will be entered by the Office of the Registrar if omitted. (22 CHARACTERS ONLY)

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

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

CREDIT TYPE
1. Fixed Credit: Cr. Hrs. 4
2. Variable Credit Range:
   Minimum Cr. Hrs
   (Check One) To [ ] Or [ ]
   Maximum Cr. Hrs
3. Equivalent Credit: Yes [ ] No [x]
4. Thesis Credit: Yes [ ] No [x]

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. Designator Required
- [ ] 6. Special Fees
- 7. Registration Approval Type: Department [ ] Instructor [ ]
- [ ] 8. Variable Title
- [ ] 9. Remedial
- [ ] 10. Honors
- [ ] 11. Full Time Privilege
- [ ] 12. Off Campus Experience

Instructional Type	Minutes Per Mtg	Meetings Per Week	Weeks Offered	% of Credit Allocated
Lecture	50	3	16	75%
Recitation	50	1	~~16~~ 12	12.5%
Presentation				
Laboratory	110	~~2~~ 1	4	12.5%
Lab Prep				
Studio				
Distance				
Clinic				
Experiential				
Research				
Ind. Study				
Pract/Observ				

Cross-Listed Courses

COURSE DESCRIPTION (INCLUDE REQUISITES):

Prerequisite: CHE 211, MA 262 Corequisite: CHM 261 For CHE students only. Application of kinetic rate equations, mass balances and energy balances to the analysis and design of chemical reactors involving homogeneous and heterogeneous chemical reactions. Chemical equilbria, kinetic rate equations for homogeneous and heterogeneously catalyzed reactions, design of ideal isothermal reactors, effects of non-isothermal operation, effects of diffusion in porous catalysts and non-ideal mixing in continuous flow reactors.

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 Department Head	Date	North Central Chancellor	Date
Varma (signature) West Lafayette Department Head	10-7-09	(signature) West Lafayette College/School Dean	10/16/2009

(signature) West Lafayette Registrar — Date 12/18/09

OFFICE OF THE REGISTRAR

12/18/09

Office of the Registrar
FORM 40 REV. 9/06

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

CFD 26-06

DEPARTMENT: School of Chemical Engineering — EFFECTIVE SESSION: Fall 2010

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
- ☐ 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
- ☐ 11. Change in semesters offered (department head signature only)
- ☐ 12. Transfer from one department to another

	PROPOSED	EXISTING
Subject Abbreviation		CHE
Course Number		34800

Long Title: Chemical Reaction Engineering

Short Title: Chem Reaction Engr

Abbreviated title will be entered by the Office of the Registrar if omitted. (22 CHARACTERS ONLY)

TERMS OFFERED — Check All That Apply: ☐ Summer ☑ Fall ☑ Spring

CAMPUS(ES) INVOLVED: ☐ Calumet ☐ Cont Ed ☐ Ft. Wayne ☐ Indianapolis ☐ N. Central ☐ Tech Statewide ☑ W. Lafayette

CREDIT TYPE
1. Fixed Credit: Cr. Hrs. 4
2. Variable Credit Range:
   Minimum Cr. Hrs
   (Check One) To ☐ Or ☐
   Maximum Cr. Hrs
3. Equivalent Credit: Yes ☐ No ☑
4. Thesis 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. Designator Required
- ☐ 6. Special Fees
- 7. Registration Approval Type: Department ☐ Instructor ☐
- ☐ 8. Variable Title
- ☐ 9. Remedial
- ☐ 10. Honors
- ☐ 11. Full Time Privilege
- ☐ 12. Off Campus Experience

Instructional Type	Minutes Per Mtg	Meetings Per Week	Weeks Offered	% of Credit Allocated
Lecture	50	3	16	75%
Recitation	50	1	6	12.5%
Presentation				
Laboratory	110	2	4	12.5%
Lab Prep				
Studio				
Distance				
Clinic				
Experiential				
Research				
Ind. Study				
Pract/Observ				

Cross-Listed Courses

COURSE DESCRIPTION (INCLUDE REQUISITES):
Prerequisite: CHE 211, MA 262 Corequisite: CHM 261 For CHE students only. Application of kinetic rate equations, mass balances and energy balances to the analysis and design of chemical reactors involving homogeneous and heterogeneous chemical reactions. Chemical equilbria, kinetic rate equations for homogeneous and heterogeneously catalyzed reactions, design of ideal isothermal reactors, effects of non-isothermal operation, effects of diffusion in porous catalysts and non-ideal mixing in continuous flow reactors.

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 Department Head — Date — North Central Chancellor — Date

[signature] Varma. — 10-7-09 — [signature] — 10/16/2009

West Lafayette Department Head — Date — West Lafayette College/School Dean — Date — West Lafayette Registrar — Date

OFFICE OF THE REGISTRAR

To: Faculty of the College of Engineering

From: Faculty of the School of Chemical Engineering

RE: Curriculum Change for the B.S. degree in Chemical Engineering

The faculty of the School of Chemical Engineering has approved the following changes in the curriculum for the B.S. degree in Chemical Engineering effective for students entering Purdue in the fall semester 2008. These changes will allow for the incorporation of the Fundamentals Lab components into the required courses CHE 348, 377, and 378 and also to allow changes in the number of credit hours in CHE 211, 348, 377 and 378. This action is now submitted to the Engineering Faculty with a recommendation for approval. Attached you will find the current plan of study followed by the proposed plan of study with the changes in bold print. Because only 3 credits from ENGL 106 or 108 will count toward graduation, this hour is no longer needed. This reduces the total hours needed for graduation to 130 hours.

Change 1: Addition of 1 credit hour to CHE 211

From:

CHE 211 Introductory Chemical Engineering Thermodynamics
Sem 1, 2, Class 3, cr. 3
Prerequisites: CHE 205, MA 261
Basic principles and concepts of thermodynamics applied to chemical engineering problems; use of basic thermodynamic functions of enthalpy, entropy, free energy to solutions, phase equilibria, and chemical equilibria; thermodynamic processes and efficiencies; equations of state; and relation of macroscopic to molecular properties.

To:

CHE 211 Introductory Chemical Engineering Thermodynamics
Sem 1, 2, Class 3, **Rec 1, cr. 4**
Prerequisites: CHE 205, MA 261
Basic principles and concepts of thermodynamics applied to chemical engineering problems; use of basic thermodynamic functions of enthalpy, entropy, free energy to solutions, phase equilibria, and chemical equilibria; thermodynamic processes and efficiencies; equations of state; and relation of macroscopic to molecular properties.

Rationale: This will allow for a recitation in this course to accommodate more problem solving experience early in the program.

Change 2: Addition of 1 credit hour to CHE 377

From:

CHE 377 Momentum Transfer
Sem 1, 2, Class 3, cr. 3
Prerequisite: CHE 205
Corequisites: CHE 211, MA 303
Differential (microscopic) and integral (macroscopic) mass, momentum, and energy balances. Newtonian and non-Newtonian fluids. Fluid statics. One-dimensional steady and transient laminar flows. Turbulence. Dimensional analysis and similarity. Friction factors and drag coefficients. Applications to engineering analysis of practical problems. Introduction to numerical analysis and visualization of flows.

To:

CHE 377 Momentum Transfer
Sem 1, 2, Class 3, **lab 2, cr. 4**
Prerequisite: CHE 205
Corequisites: CHE 211, MA 303
Differential (microscopic) and integral (macroscopic) mass, momentum, and energy balances. Newtonian and non-Newtonian fluids. Fluid statics. One-dimensional steady and transient laminar flows. Turbulence. Dimensional analysis and similarity. Friction factors and drag coefficients. Applications to engineering analysis of practical problems. Introduction to numerical analysis and visualization of flows.

Rationale: The additional credit hour is to allot 2 hours per week of time for inclusion of Fundamentals Lab components.

Change 3: Addition of 1 credit hour to CHE 348
From:

CHE 348 Chemical Reaction Engineering
Sem 1, 2, Class 3, cr. 3
Prerequisites: CHE 211, MA 262
Corequisite: CHM 261
Application of kinetic rate equations, mass balances and energy balances to the analysis and design of chemical reactors involving homogeneous and heterogeneous chemical reactions. Chemical equilibria, kinetic rate equations for homogeneous and heterogeneously catalyzed reactions, design of ideal isothermal reactors, effects of non-isothermal operation, effects of diffusion in porous catalysts and non-ideal mixing in continuous flow reactors.

To:

CHE 348 Chemical Reaction Engineering
Sem 1, 2, Class 3, **lab 2, cr. 4**
Prerequisites: CHE 211, MA 262
Corequisite: CHM 261
Application of kinetic rate equations, mass balances and energy balances to the analysis and design of chemical reactors involving homogeneous and heterogeneous chemical reactions. Chemical equilibria, kinetic rate equations for homogeneous and heterogeneously catalyzed reactions, design of ideal isothermal reactors, effects of non-isothermal operation, effects of diffusion in porous catalysts and non-ideal mixing in continuous flow reactors.

Rationale: The additional credit hour is to allot 2 hours per week of time for inclusion of Fundamentals Lab components.

Change 4: Addition of 1 credit hour to CHE 378
From:

CHE 378 Heat and Mass Transfer
Sem 1, 2, Class 3, cr. 3
Prerequisites: CHE 211, CHE 377

Macroscopic and differential energy balances. Heat transfer coefficients for free and forced convection and phase change. Conductive and radiative heat transfer. Applications to heat transfer equipment design and compressible fluid flow. Macroscopic and differential species balances. Mass transfer coefficients and analogies. Mass transfer with and without chemical reaction. Mass transfer equipment design.

To:

CHE 378 Heat and Mass Transfer
Sem 1, 2, Class 3, **lab 2, cr. 4**
Prerequisites: CHE 211, CHE 377

Macroscopic and differential energy balances. Heat transfer coefficients for free and forced convection and phase change. Conductive and radiative heat transfer. Applications to heat transfer equipment design and compressible fluid flow. Macroscopic and differential species balances. Mass transfer coefficients and analogies. Mass transfer with and without chemical reaction. Mass transfer equipment design.

Rationale: The additional credit hour is to allot 2 hours per week of time for inclusion of Fundamentals Lab components.

Change 5: Removal of IE 343, Engineering Economics (3 cr.) from required curriculum

Rationale: Relevant information will be taught in CHE 449 (see below).

Change 6: New Design Course numbered CHE 449

CHE 449 Fundamental Process Design
Sem 1, Class 3, cr. 3
Prerequisites: CHE 378
Corequisites: CHE 306, CHE 348
Use of process and product synthesis methods and concepts; detailed design of unit operation equipment, the economics of chemical plants and flow sheet optimization methods.

Rationale: In order to incorporate chemical engineering-appropriate cost analysis information into the senior design course, as well as further expand the information taught in senior design, it will now be a two course sequence with CHE 449 taught in the fall and CHE 450 still in the spring.

Change 7: Removal of 1 credit hour from CHE 450
From:

CHE 450 Design And Analysis Of Processing Systems
Sem 2, Class 2, computer lab. 2, cr. 3
Prerequisites: CHE 306, 348, 378
Corequisite: CHE 435
Use of flowsheet balance calculations, chemical kinetics and thermodynamics, and transfer operations in designing chemical processing systems. Analysis of design alternatives using case studies and optimization methods.

To:

CHE 450 Design And Analysis Of Processing Systems
Sem 2, Class 1, computer lab. 2, **cr. 2**
Prerequisites: CHE 449
Corequisite: CHE 435
Synthesize, develop, and evaluate a preliminary design of a chemical process that meets market requirements for a specific product. Analysis of design alternatives using case studies and optimization methods.

Rationale: With reinstatement of CHE 449, there will now be a two semester design course sequence in which material previously covered in CHE 450 will be covered. There is only a need for this course to be 2 credit hours.

Change 8: Removal of CHM 376, Physical Chemistry Laboratory (2 cr.) from required curriculum

Rationale: With the implementation of the Fundamentals Lab components, students will gain much more lab experience within the CHE courses than ever before. Some of the topics covered in CHM 376 will be addressed in the lab.

Change 9: Removal of 1 credit free elective

Rationale: Because only 3 credits from ENGL 106 or 108 will count toward graduation, this hour is no longer needed. This reduces the total hours needed for graduation to 130 hours.

A. Varma, Head
School of Chemical Engineering
Date: 2/1/07

APPROVED FOR THE FACULTY OF THE SCHOOLS OF ENGINEERING BY THE ENGINEERING CURRICULUM COMMITTEE
ECC Minutes #25
Date 5/9/08
Chairman ECC Michael Jefferson

CURRENT PLAN OF STUDY

SCHOOL OF CHEMICAL ENGINEERING

Purdue University

Students beginning Fall 2006

Total Credit Hours - 131

FRESHMAN YEAR

First Semester

(4)	CHM	123 or 115[a]	Gen. Chemistry
(4)	ENGL	106 or 108 (3)[b]	English Comp I
(1)	ENGR	100	Freshman Engr Lec
(3)	ENGR	126	Intro to Engr Prb Solv&Comp
(4)	MA	165 or 161[c]	Geom & Calc I
15			

Second Semester

(4)	CHM	124 or 116	Gen. Chemistry
(3)	COM	114	Fund. of Commun
(4)	MA	166 or 162	Geom & Calc II
(4)	PHYS	172	Mechanics
15			

SOPHOMORE YEAR

Third Semester

(0)	CHE	200	Chem Engr Seminar
(3)	CHE	205[d]	Chemical Engr Calc
(3)	CHM	261	Organic Chemistry I
(1)	CHM	263	Organic Chem Lab I
(4)	MA	261	Multivar Calculus
(3)	PHYS	241	Electricity & Optics
(3)	Gen-Ed Elective		
17			

Fourth Semester

(3)	CHE	211	Chem Engr Thermo
(3)	CHE	320	Statistical Modeling
(3)	CHM	262	Organic Chemistry II
(1)	CHM	264	Organic Chm Lab II
(4)	MA	262	Linear Algebra & Diff Eq.
(3)	Gen-Ed Elective		
17			

JUNIOR YEAR

Fifth Semester

(3)	CHE	306	Staged Separations
(3)	CHE	377	Momentum Transfer
(3)	CHM	370	Physical Chemistry
(2)	CHM	376	Physical Chem Lab
(3)	BIOL	295E	Biology of the Living Cell
(3)	MA	303	Diff Eqs for Engr
17			

Sixth Semester

(0)	CHE	300	Chem Engr Seminar
(3)	CHE	330	Prin of Molec Engr
(3)	CHE	348	Chem Reaction Engr
(3)	CHE	378	Heat & Mass Transfr
(3)	I E	343	Engr Economics
(3)	Gen-Ed Elective		
(3)	Engineering Elective		
18			

SENIOR YEAR

Seventh Semester

(0)	CHE	400	Chem Engr Seminar
(3)	CHE	434	Chemical Engr Lab I
(3)	CHE	456	Process Dyn & C'trol
(3)	Gen-Ed Elective		
(3)	Technical Elective		
(3)	CHE Elective		
15			

Eighth Semester

(3)	CHE	435	Chem Engr Lab II
(3)	CHE	450	Des. & Anal. Proc. Sys
(3)	Gen-Ed Elective		
(3)	Gen-Ed Elective		
(3)	CHE Elective		
(1)	Free Elective		
16			

a ChE prefers that students take the CHM 123/124 sequence. Students who have taken CHM 115/116 will also be accepted into the School of Chemical Engineering.

b If ENGL 108 is taken, must take 1 cr. of free elective for a total of 4 hours.

c The MA 165/166 (4 cr. each) sequence is preferred; however, the MA161/162 (5 cr. each) sequence may be taken. If MA 161 and/or 162 is taken, these courses will be accepted as only 4 credit hours each toward meeting the graduation requirements for ChE.

d A "C" or better must be earned in CHE 205 to continue to enroll in CHE courses.

REVISED 3/18/08

PROPOSED PLAN OF STUDY

SCHOOL OF CHEMICAL ENGINEERING

Purdue University

Students entering Purdue Fall 2008 and after

Total Credit Hours - 130

FRESHMAN YEAR

First Semester

(4)	CHM	123 or 115[a]	Gen. Chemistry
(3)	ENGL	106 or 108 (3)	English Comp I
(1)	ENGR	100	Freshman Engr Lec
(3)	ENGR	126	Intro to Engr Prb Solv&Comp
(4)	MA	165 or 161[b]	Geom & Calc I
16			

Second Semester

(4)	CHM	124 or 116	Gen. Chemistry
(3)	COM	114	Fund. of Commun
(4)	MA	166 or 162	Geom & Calc II
(4)	PHYS	172	Mechanics
15			

SOPHOMORE YEAR

Third Semester

(0)	CHE	200	Chem Engr Seminar
(3)	CHE	205[c]	Chemical Engr Calc
(3)	CHM	261	Organic Chemistry I
(1)	CHM	263	Organic Chem Lab I
(4)	MA	261	Multivar Calculus
(3)	PHYS	241	Electricity & Optics
(3)	Gen-Ed Elective		
17			

Fourth Semester

(4)	CHE	211	Chem Engr Thermo
(3)	CHE	320	Statistical Modeling
(3)	CHM	262	Organic Chemistry II
(1)	CHM	264	Organic Chm Lab II
(4)	MA	262	Linear Algebra & Diff Eq.
(3)	Gen-Ed Elective		
18			

JUNIOR YEAR

Fifth Semester

(3)	CHE	306	Staged Separations
(4)	CHE	377	Momentum Transfer
(3)	CHM	370	Physical Chemistry
(3)	BIOL	295E	Biology of the Living Cell
(3)	MA	303	Diff Eqs for Engr
16			

Sixth Semester

(0)	CHE	300	Chem Engr Seminar
(3)	CHE	330	Prin of Molec Engr
(4)	CHE	348	Chem Reaction Engr
(4)	CHE	378	Heat & Mass Transfr
(3)	Gen-Ed Elective		
(3)	Engineering Elective		
17			

SENIOR YEAR

Seventh Semester

(0)	CHE	400	Chem Engr Seminar
(3)	CHE	434	Chemical Engr Lab I
(3)	CHE	456	Process Dyn & C'trol
(3)	**CHE**	**449**	**Fund. Process Des.**
(3)	Gen-Ed Elective		
(3)	CHE Elective		
15			

Eighth Semester

(3)	CHE	435	Chem Engr Lab II
(2)	CHE	450	Des. & Anal. Proc. Sys
(3)	Gen-Ed Elective		
(3)	Gen-Ed Elective		
(3)	CHE Elective		
(3)	**Technical Elective**		
17			

[a] ChE prefers that students take the CHM 123/124 sequence. Students who have taken CHM 115/116 will also be accepted into the School of Chemical Engineering.

[b] The MA 165/166 (4 cr. each) sequence is preferred; however, the MA161/162 (5 cr. each) sequence may be taken. If MA 161 and/or 162 is taken, these courses will be accepted as only 4 credit hours each toward meeting the graduation requirements for ChE.

[c] A "C" or better must be earned in CHE 205 to continue to enroll in CHE courses.

REVISED 3/7/06

Supporting Documentation – CHE 211

Level: Undergraduate
Course Instructor: You-Yeon Won

Textbook: Introduction to Chemical Engineering Thermodynamics J. M. Smith, H. C Van Ness, and M. M. Abbott, 7th Edition, McGraw-Hill, 2005.

Course Outline:

Week(s)	*Topics*
1	Course introduction, The first law and other basic concepts
2	Volumetric properties of pure fluids
3	Heat effect
4	The second law of thermodynamics
5-6	Thermodynamic properties of fluids
7	Applications of thermodynamics to flow processes, Production of power from heat, Refrigeration and liquefaction
8	Vapor/liquid equilibrium
9-10	Solution thermodynamics: theory
11	Solution thermodynamics: applications
12	Chemical reaction equilibria
13-14	Phase equilibrium and stability
15	Review and problem solving

Recitations: Each week students will meet for a 1 hour recitation period. These will be run by the TAs and will focus on reinforcing concepts, solving problems, and preparing for exams.

Course Objectives: Develop a fundamental understanding of the key principles of macroscopic thermodynamics and apply this understanding to solve problems of practical importance in chemical engineering and allied fields.

Course Outcomes: (numbers in parentheses refer to related educational outcomes of our undergraduate chemical engineering program shown in a separate handout)

1. Understand the concepts of work and heat and their interconnection (1).
2. Use the First Law of thermodynamics and energy balances in the analysis of closed and open systems (1, 3).

3. Use the Second Law of thermodynamics and the application of the concept of entropy in the analysis of reversible and irreversible processes (1).
4. Derive and apply thermodynamic relations and relationships between thermodynamic potentials (1).
5. Analyze thermodynamic power and refrigeration cycles (1, 3).
6. Predict, understand and apply the properties and phase equilibrium behavior of ideal and non-ideal fluids (1).
7. Understand the concepts of fugacity and chemical potential (1).
8. Apply thermodynamic principles to chemical reactions and equilibrium (1).
9. Practice clear, effective and concise written and oral communication of problem solutions (7).
10. Use computational tools in the solution of thermodynamics problems (5).

Assessment Methods for Outcomes: Each of the outcomes will be assessed by giving the students appropriate assignments and by quizzes and exams.

Supporting Documentation – CHE 348

Level: Undergraduate
Instructor: Chelsey D. Baertsch

Textbook: Elements of Chemical Reaction Engineering (4th ed.), H. Scott Fogler, Prentice Hall, 2006.

Course Outline:

Week(s)	*Topics*
1	Course introduction, definitions, general mole balance
2	PFR, CSTR, and batch reactors
3	Definition of conversion, application of design equation
4	Kinetics, reversible reactions, stoichiometric table for batch and flow systems
5-6	Solving problems without using conversion, membrane and semibatch reactor
7-9	Data analysis and parameter estimation
10	Multiple reactions, algorithm for solution of complex reactions
11	Quasi-state state approximation, enzymatic reactions
12-13	Heterogeneous catalysis, definitions, kinetics, mechanisms
14	Non-isothermal reactors, derivation of energy balance equation
15	Diffusion and reaction in porous catalysts

Fundamentals Laboratory:
There will be 5 lab sessions (each session is two hours) for this class. The lab experience will consist of 4 required experiments as follow:

1) Chemical kinetics - students will study a transient gas - solid reaction that produces CO_2 as a product, and will monitor CO_2 production as a function of time. From this data, they will be able to test models for chemical reaction rates that they learn in class, and will learn how to extract reaction rate constants

2) Isothermal reactor - students will study the same chemical reaction system as in 1. It will be maintained at constant temperature by removing heat from the reactor. Students will measure the rate of heat removal and compare this with the theoretical amount they would expect to see released during the reaction.

3) Nonisothermal Effects in Chemical Reactors - students will study the same chemical reaction system as in 1, but temperature will not be maintained constant. Students will study effects of the changing temperatures on the reactor and reaction dynamics

4) Effectiveness Factors - students will study the same chemical reaction system as in 1, but the internal surface area/volume ratio of the solid catalyst will be varied, and students will see how an effectiveness factor is used to describe the effects of these changes on the reaction rates

Recitations:
In the weeks when the labs are not in session, one-hour long recitation sessions led by the TAs will be held. These will focus on reinforcing concepts, solving problems, and preparing for exams.

Course Objectives:
Students should gain sufficient understanding of rates of chemical reactions and heat and mass transfer to be able to couple that knowledge with material and energy balances to model any systems in which chemical reactions are taking place.

Course Outcomes (numbers in parentheses refer to related program educational outcomes)

1. Derive and apply design equations for CSTR, PFR, PBR, and batch reactors using either concentration or conversion (1).
2. Combine material and energy balances with kinetic data to design isothermal and non-isothermal reactors (1).
3. Derive rate expressions from elementary steps for both homogeneous and heterogeneous reactions (1).
4. Be able to include equilibrium constraints on reaction analysis (1).
5. Derive intra-particle and inter-particle effectiveness factors governing diffusion/reaction coupling in heterogeneously catalyzed reactions and apply those concepts to the design of isothermal reactors and the prediction of their behavior (1).
6. Research technical literature and apply materials from previous courses to solve open-ended reactor problems (1, 9).
7. Apply appropriate computational tools for the solution of chemical reaction engineering problems (5).
8. Work professionally and ethically in teams to obtain, analyze, and report on chemical reaction kinetics (2, 3, 4, 5, 6, 7).

Assessment Methods for Course Outcomes: Each of the outcomes will be assessed by giving the students the appropriate homework problems, exams, team projects, peer evaluation, and lab reports.

Supporting Documentation – CHE 377

Level: Undergraduate
Course Instructor: Steve Beaudoin

Textbook: Introduction to Fluid Mechanics, Stephen Whitaker, Krieger Publishing Company, ISBN 0-89464-785-7.

Course Outline:

Week(s)	*Topics*
1	Course introduction, definitions
2	Behavior of stationary fluids
3-7	Microscopic momentum balances
8-10	Macroscopic momentum balances
11-12	Momentum balances in idealized piping systems
13	Mass conservation
14	Particle settling
15	Flowmeters

Fundamentals Laboratory:
There will be 5 lab sessions (each session is two hours) for this class. The lab experience will consist of 4 required experiments as follow:

1) Viscosity in Laminar Flow - students will study the rate of motion of a metal sphere falling through oils of different viscosity and will learn of the role of viscosity and drag in fluid motion

2) Pressure Drop and Flow Rate Measurements - students will study the rate of flow and the pressure drop when water flows through a cylindrical pipe and will use their data to validate momentum balance models

3) Turbulent Pipe Flow - students will study pressure drop and fluid flow rates for motion of water through a cylindrical pipe in the turbulent flow regime and will learn how the flow regime changes the friction between the water and the pipe walls

4) Pump Characteristics and a Pipe Network - students will learn how to characterize the performance of a pump and how changes in the flow impedances in a piping network will influence the flowrates, pressure drops, and pump work required to pump water through a piping system

Recitations:
In the weeks when the labs are not in session, one-hour long recitation sessions led by the TAs will be held. These will focus on reinforcing concepts, solving problems, and preparing for exams.

Course Objectives

Develop a fundamental understanding of fluid mechanics through theoretical analysis and observation of physical phenomena and apply these concepts using logical problem-solving techniques to chemical engineering (or related) situations).

Course Outcomes (numbers in parentheses refer to related program educational objective)

1. Perform macroscopic and differential mass, momentum, and mechanical energy balances (1).
2. Apply momentum balances to fluid statics (1).
3. Apply mass, momentum, and energy balances to laminar and turbulent flow of incompressible fluids in conduits and past submerged bodies (1).
4. Understand and apply dimensional analysis and kinematic similarity to engineering design (1, 3).
5. Design of fluid transfer equipment (pipelines, agitated vessels, pumps, etc.) and analysis of its operation (1, 2, 3)

Assessment Methods for Course Outcomes: Each of the outcomes will be assessed by giving the students the appropriate homework problems, exams, team projects, peer evaluation, and lab reports.

Supporting Documentation – CHE 378

Level: Undergraduate
Course Instructor: Dave Corti

Textbook: An Introduction to Mass and Heat Transfer, S. Middleman, John Wiley & Sons, Inc., 1998, ISBN 0-471-11176-7.

Course Outline:

Week(s)	*Topics*
1	Course Introduction
2-4	Steady-State Heat Transfer by Conduction
5-6	Transient Heat Transfer by Conduction
7	Fundamentals of Diffusive Mass Transfer
8	Steady and Quasi-Steady-State Mass Transfer
9-10	Unsteady State (Transient) Mass Transfer
11-12	Convective Heat and Mass Transfer
13	Simple Heat Exchangers
14-15	Continuous Gas/Liquid Contactors

Fundamentals Laboratory:
There will be 5 lab sessions (each session is two hours) for this class. The lab experience will consist of 4 required experiments as follow:

1) Heat Conduction - students will study a system of a cold reservoir and a hot reservoir connected by a highly conductive and then a highly insulating rod. The students will measure the rate at which energy must be put into the hot reservoir to maintain a steady state temperature difference between the two reservoirs, and will learn how quickly the two different rods conduct heat

2) Heat exchange - students will study a system in which an inner tube of flowing steam passes through an outer tube of flowing cold water, and will measure the rates at which the temperatures of the two streams change. Students will compute the rate of heat exchange as a function of the system operating conditions

3) Diffusive Mass Transfer - students will study the rate of CO_2 diffusion from a well mixed reservoir through a circular pipe into a well mixed reservoir of N_2

4) Convective Mass Transfer - students will study the rate of dis
well mixed solution. The limiting step of the dissolution is the c
into solution

Recitations:
In the weeks when the labs are not in session, one-hour long recitation sessions led by the TAs will be held. These will focus on reinforcing concepts, solving problems, and preparing for exams.

Supplemental Reading:
Fundamentals of Heat and Mass Transfer, 5th Edition, F.P. Incropera and D.P. DeWitt, John Wiley & Sons, Inc., 2002

Diffusion: Mass Transfer in Fluid Systems, 2nd Edition, E.L. Cussler, Cambridge University Press, 1997.

Course Objectives:
Develop a sound fundamental understanding of heat and mass transfer through theoretical analyses and consideration of the physical phenomena. Integrate the concepts of momentum, heat and mass transfer to acquire an understanding of the interrelation of these physical phenomena. Apply the concepts to solve problems of practical importance in chemical engineering and allied fields. Continue the development of problem-solving and self-learning skills.

A majority of the concepts presented in this course form the basis for a large number of chemical engineering unit operations, some of which are developed further in, for example, CHE 434 (Chemical Engineering Laboratory I). Thus, the material covered in this course is an essential component of the chemical engineering practice and is essential that you have a clear understanding of this material.

Course Outcomes (numbers in parentheses refer to related program educational objective)

1. Perform microscopic and macroscopic mass, thermal energy, and species mass balances (1).
2. Understand the mechanisms of heat transfer – conduction, convection, and radiation (1).
3. Apply thermal energy balances and Fourier's Law to steady state and transient conduction (1).
4. Apply thermal energy balances and Newton's Law of Cooling to convective heat transfer (1).
5. Design of heat transfer equipment and analysis of its operation (1, 2, 3).
6. Apply species mass balances and Fick's Law to steady state and transient diffusion (1).
7. Apply species mass balances and relevant rate equations to convective mass transfer (1).
8. Understand and apply the analogies between transport of momentum, heat, and mass (1, 9).
9. Design of continuous mass transfer equipment and analysis of its operation (1, 2, 3).

Assessment Methods for Course Outcomes: Each of the outcomes will be assessed by giving the students the appropriate homework problems, exams, team projects, peer evaluation, and lab reports.

Supporting Documentation – CHE 449

Level: Undergraduate
Course Instructors: Professors R. Agrawal, J. Pekny, G. Reklaitis, and V. Venkatasubramanian

Textbook: Product and Process Design Principles – Synthesis, Analysis and Evaluation, W. D. Seider, J. D. Seader & D. R. Lewin, J. Wiley & Sons, 2004.

Course Outline

Week(s)	*Topic*
1-3	Process and Product Synthesis methods, concepts and heuristics
4-5	Process synthesis incl. introduction to algorithmic methods
6-7	Design of major unit operation equipment
8-9	Cost accounting and capital cost estimation
10-11	Flow sheet optimization methods
12	Design of batch and continuous processes
13-14	ASPEN simulation methods
15	Review

Course Objectives
To understand process and product synthesis methods and concepts; detailed design of unit operation equipment, the economics of chemical plants and flow sheet optimization methods.

Course Outcomes (numbers in parentheses refer to related program educational objective)

1. Apply systematic strategies for synthesizing chemical process designs that involve conventional unit operations (1, 3).
2. Understand the difference between steady state and batch chemical processes and the implication on their design and operation (1, 3).
3. Know where and how to obtain information on industrial chemical processes, process operating parameters, equipment costs, cost of chemicals and materials, and associated safety and environmental hazards (6, 8, 9).
4. Understand the role of physical property estimates on process design and be able to use appropriate physical property estimation methods in unit operations design (1, 2, 3, 5).
5. Estimate the capital and operating cost of a process and to assess its profitability (1, 8).
6. Perform detailed hands-on work with tools that ultimately lead to the design of a chemical plant (1, 5).

Assessment of Course Outcomes: Each of the outcomes will be assessed by giving the students appropriate assignments and exams.

Supporting Documentation – CHE 450

Level: Undergraduate
Course Instructors: Professors R. Agrawal, J. Pekny, G. Reklaitis, and V. Venkatasubramanian

Textbook: Product and Process Design Principles – Synthesis, Analysis and Evaluation, W. D. Seider, J. D. Seader & D. R. Lewin, J. Wiley & Sons, 2004.

Course Outline:

Week(s)	*Topics*
1	Course Introduction
2-3	Adv. material & energy balances for process flow sheets with recycle
4-6	Synthesis and design of process flow sheets
7-8	Advanced equipment costing
9-10	Process flow sheet economic evaluation
11-15	Advanced Aspen simulation methods

Course Objectives:

Synthesize, develop, and evaluate a preliminary design of a chemical process that meets market requirements for a specific product.

Course Outcomes: (numbers in parentheses refer to related program educational objective)

1. Apply systematic strategies for synthesizing chemical process designs that involve conventional unit operations (1, 3).
2. Create process flow sheet through conceptualization, process synthesis, process design and assessment (1, 3, 5).
3. Know where and how to obtain information on industrial chemical processes, process operating parameters, equipment costs, cost of chemicals and materials, and associated safety and environmental hazards (8, 9).
4. Estimate the capital and operating cost of a process and to assess its profitability (1,8).
5. Communicate project progress and final results in a professional manner orally and in written form (7).
6. Work effectively in a team to execute open-ended design projects with time-bound deliverables in a professional and ethical manner (1, 3, 4, 6, 9).

Assessment Methods for Course Outcomes: Each of the outcomes will be assessed by giving the students the appropriate homework problems, exams, team projects, and peer evaluation

Office of the Registrar
FORM 40 REV. 9/06

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

DEPARTMENT: School of Chemical Engineering   EFFECTIVE SESSION: Fall 2010

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
- [ ] 5. Change in course title
- [x] 6. Change in course credit/type
- [ ] 7. Change in course attributes (department head signature only)
- [x] 8. Change in instructional hours
- [ ] 9. Change in course description
- [ ] 10. Change in course requisites
- [ ] 11. Change in semesters offered (department head signature only)
- [ ] 12. Transfer from one department to another

PROPOSED:
Subject Abbreviation:
Course Number:

EXISTING:
Subject Abbreviation: CHE
Course Number: 37700

Long Title: Momentum Transfer
Short Title: Momentum Transfer
Abbreviated title will be entered by the Office of the Registrar if omitted. (22 CHARACTERS ONLY)

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

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

CREDIT TYPE
1. Fixed Credit: Cr. Hrs. 4
2. Variable Credit Range:
   Minimum Cr. Hrs
   (Check One) To [ ] Or [ ]
   Maximum Cr. Hrs
3. Equivalent Credit: Yes [ ] No [x]
4. Thesis Credit: Yes [ ] No [x]

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. Designator Required [ ]
6. Special Fees [ ]
7. Registration Approval Type: Department [ ] Instructor [ ]
8. Variable Title [ ]
9. Remedial [ ]
10. Honors [ ]
11. Full Time Privilege [ ]
12. Off Campus Experience [ ]

Instructional Type	Minutes Per Mtg	Meetings Per Week	Weeks Offered	% of Credit Allocated
Lecture	50	3	16	75%
Recitation	50	1	~~16~~ 12	12.5%
Presentation				
Laboratory	110	~~2~~ 1	4	12.50%
Lab Prep				
Studio				
Distance				
Clinic				
Experiential				
Research				
Ind. Study				
Pract/Observ				

Cross-Listed Courses

COURSE DESCRIPTION (INCLUDE REQUISITES):
Prerequisite: CHE 205 Corequisites: CHE 211, MA 303 For CHE students only. Differential (microscopic) and integral (macroscopic) mass, momentum, and energy balances. Newtonian and non-Newtonian fluids, fluid statics, one-dimensional steady and transient laminar flows, turbulence, dimensional analysis and similarity, friction factors and drag coefficients. Applications to engineering, analysis of practicacl problems, and introduction to numerical analysis and visualization of flows.

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 Department Head — Date — North Central Chancellor — Date

[signature] 10-7-09 — [signature] 10/8/2009 — [signature] 12/18/09
West Lafayette Department Head — Date — West Lafayette College/School Dean — Date — West Lafayette Registrar — Date

OFFICE OF THE REGISTRAR

12/18/09

Office of the Registrar
FORM 40 REV. 9/06

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

DEPARTMENT: School of Chemical Engineering
EFFECTIVE SESSION: Spring 2011

UCTIONS: 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
- [ ] 5. Change in course title
- [x] 6. Change in course credit/type
- [ ] 7. Change in course attributes (department head signature only)
- [x] 8. Change in instructional hours
- [ ] 9. Change in course description
- [ ] 10. Change in course requisites
- [ ] 11. Change in semesters offered (department head signature only)
- [ ] 12. Transfer from one department to another

PROPOSED:
Subject Abbreviation:
Course Number:

EXISTING:
Subject Abbreviation: CHE
Course Number: 37800

Long Title: Heat and Mass Tranfser
Short Title: Heat and Mass Transfer
Abbreviated title will be entered by the Office of the Registrar if omitted. (22 CHARACTERS ONLY)

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

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

CREDIT TYPE
1. Fixed Credit: Cr. Hrs. 4
2. Variable Credit Range:
   Minimum Cr. Hrs
   (Check One) To [ ] Or [ ]
   Maximum Cr. Hrs
3. Equivalent Credit: Yes [ ] No [x]
4. Thesis Credit: Yes [ ] No [x]

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. Designator Required
- [ ] 6. Special Fees
- 7. Registration Approval Type: Department [ ] Instructor [ ]
- [ ] 8. Variable Title
- [ ] 9. Remedial
- [ ] 10. Honors
- [ ] 11. Full Time Privilege
- [ ] 12. Off Campus Experience

Instructional Type	Minutes Per Mtg	Meetings Per Week	Weeks Offered	% of Credit Allocated
Lecture	50	3	16	75%
Recitation	50	1	16	12.5%
Presentation				
Laboratory	110	1	4	12.5%
Lab Prep				
Studio				
Distance				
Clinic				
Experiential				
Research				
Ind. Study				
Pract/Observ				

Cross-Listed Courses

COURSE DESCRIPTION (INCLUDE REQUISITES):
Prerequisite: CHE 211, CHE 377 For CHE students only. Macroscopic and differnetial energy balances. Heat transfer coefficients for free and forced convection and phase change. Conductive and radiative heat transfer. Applications to heat transfer equipment design and coptessible fluid flow. Macroscopic and differential species balances. Mass transer coefficients and analogies. Mass transfer with and without chemical reaction. Mass transfer equipment design.

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 Department Head — Date — North Central Chancellor — Date

West Lafayette Department Head: [signature] Date: 10-2-09 — West Lafayette College/School Dean: [signature] Date: 10/8/2009 — West Lafayette Registrar: [signature] Date: 12/2/09

OFFICE OF THE REGISTRAR

12/21/09

Office of the Registrar
FORM 40 REV. 9/06

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

File

DEPARTMENT: School of Chemical Engineering
EFFECTIVE SESSION: Spring 2010

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
- [ ] 5. Change in course title
- [x] 6. Change in course credit/type
- [ ] 7. Change in course attributes (department head signature only)
- [x] 8. Change in instructional hours
- [ ] 9. Change in course description
- [ ] 10. Change in course requisites
- [ ] 11. Change in semesters offered (department head signature only)
- [ ] 12. Transfer from one department to another

PROPOSED:
Subject Abbreviation:
Course Number:

EXISTING:
Subject Abbreviation: CHE
Course Number: 21100

Long Title: Introductory Chemical Engineering Thermodynamics
Short Title: CH Engr Thermodynamics
Abbreviated title will be entered by the Office of the Registrar if omitted. (22 CHARACTERS ONLY)

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

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

CREDIT TYPE
1. Fixed Credit: Cr. Hrs. 4
2. Variable Credit Range:
   Minimum Cr. Hrs
   (Check One) To [ ] Or [ ]
   Maximum Cr. Hrs
3. Equivalent Credit: Yes [ ] No [x]
4. Thesis Credit: Yes [ ] No [x]

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. Designator Required
- [ ] 6. Special Fees
- 7. Registration Approval Type: Department [ ] Instructor [ ]
- [ ] 8. Variable Title
- [ ] 9. Remedial
- [ ] 10. Honors
- [ ] 11. Full Time Privilege
- [ ] 12. Off Campus Experience

Instructional Type	Minutes Per Mtg	Meetings Per Week	Weeks Offered	% of Credit Allocated
Lecture	50	3	16	75%
Recitation	50	1	16	25%
Presentation				
Laboratory				
Lab Prep				
Studio				
Distance				
Clinic				
Experiential				
Research				
Ind. Study				
Pract/Observ				

Cross-Listed Courses

COURSE DESCRIPTION (INCLUDE REQUISITES):
Pre-requisites: CHE 205, MA 261 For CHE students only. Basic Principles and concepts of thermodynamics applied to chemical engineering problems; use of basic thermodynamic functions of enthalpy, entropy, free energy to solutions, phase equilibria,, and chemical equilibria; thermodynamic processes and efficiencies; equations of state; and relation of macroscopic to molecular properties.

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 Department Head — Date — North Central Chancellor — Date

[signature] 10-7-09 — [signature] 10/8/2009 — [signature] 10/14/09
West Lafayette Department Head — Date — West Lafayette College/School Dean — Date — West Lafayette Registrar — Date

OFFICE OF THE REGISTRAR

10/13/09