CHBE250  Computer Methods in Chemical Engineering
Credits: 3  Grading Method: Regular
Prerequisite: CHBE101; and must have completed or be concurrently enrolled in MATH241.
Restriction: Must be in a major within the ENGR-Chemical & Biomolecular Engineering department.
Credit only granted for: CHBE250 or ENCH250. Formerly: ENCH250.
Algorithm development and application of software to the analysis of chemical engineering problems. File management and editing, graphics and numerical methods. Use of spreadsheets, statistics/math software and process simulators for the design of chemical process equipment.

<table>
<thead>
<tr>
<th>Section</th>
<th>Instructor</th>
<th>Seats (Total: 95, Open: 95, Waitlist: 0)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0101</td>
<td>Nam Sun Wang</td>
<td>MWF 11:00am - 11:50am  JMP 3201</td>
</tr>
<tr>
<td></td>
<td></td>
<td>F 12:00pm - 12:50pm    JMP 3201</td>
</tr>
</tbody>
</table>

CHBE301  Chemical and Biomolecular Engineering Thermodynamics I
Credits: 3  Grading Method: Regular, Pass-Fail, Audit
Prerequisite: CHBE101; and must have completed or be concurrently enrolled in CHBE250 and MATH241. Restriction: Must be in Engineering: Chemical program; and permission of ENGR-Chemical & Biomolecular Engineering department. Credit only granted for: ENCH300 or CHBE301. Formerly: ENCH300.
Principles of thermodynamics and their application to engineering problems. First and second laws of thermodynamics, properties of gases, liquids and solids, phase equilibrium, flow and non-flow systems, energy conversion, production of work from heat, thermodynamic analysis of processes, equilibrium stage operations and the thermodynamics of chemically reacting systems.

<table>
<thead>
<tr>
<th>Section</th>
<th>Instructor</th>
<th>Seats (Total: 95, Open: 95, Waitlist: 0)</th>
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</thead>
<tbody>
<tr>
<td>0101</td>
<td>Chunsheng Wang</td>
<td>TuTh 3:00pm - 4:15pm  CHE 2110</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Th 11:00am - 11:50am  CHE 2108</td>
</tr>
</tbody>
</table>

CHBE333  Chemical Engineering Seminar
Credits: 1  Grading Method: Regular, Pass-Fail, Audit
Restriction: Junior standing; and must be in a major within ENGR-Chemical & Biomolecular Engineering department; and permission of ENGR-Chemical & Biomolecular Engineering department. Credit only granted for: CHBE333 or ENCH333. Formerly: ENCH333.
To develop oral communication skills through a series of class presentations of current chemical engineering topics.

<table>
<thead>
<tr>
<th>Time</th>
<th>Instructor</th>
<th>Seats (Total:</th>
<th>Open:</th>
<th>Waitlist:</th>
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</thead>
<tbody>
<tr>
<td>W 12:00pm - 12:50pm</td>
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<tr>
<td>W 3:00pm - 3:50pm</td>
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<td>0</td>
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<tr>
<td>W 4:00pm - 4:50pm</td>
<td>TBA</td>
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**CHBE410 Statistics and Design of Experiments**

Credits: 3  
Grading Method: Regular, Pass-Fail, Audit

Prerequisite: Minimum grade of C- in CHBE250, MATH241, and MATH246. Restriction: Must be in a major within the ENGR-Chemical & Biomolecular Engineering department; and permission of ENGR-Chemical & Biomolecular Engineering department. Credit only granted for: CHBE410 or ENCH476. Formerly: ENCH476.

An introduction to probability, statistics, and design of experiments for chemical engineers.

<table>
<thead>
<tr>
<th>Time</th>
<th>Instructor</th>
<th>Seats (Total:</th>
<th>Open:</th>
<th>Waitlist:</th>
</tr>
</thead>
<tbody>
<tr>
<td>MW 5:00pm - 6:15pm</td>
<td>Jeffery Klauda</td>
<td>120</td>
<td>120</td>
<td>0</td>
</tr>
<tr>
<td>M 11:00am - 11:50am</td>
<td></td>
<td>ARM 0135</td>
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**CHBE422 Chemical and Biomolecular Engineering Transport Phenomena I**

(Perm req)  
Credits: 3  
Grading Method: Regular, Pass-Fail, Audit

Prerequisite: Minimum grade of C- in CHBE101, CHBE250, MATH241, and MATH246. Restriction: Must be in a major within the ENGR-Chemical & Biomolecular Engineering department; and permission of ENGR-Chemical & Biomolecular Engineering department. Credit only granted for: CHBE422 or ENCH422. Formerly: ENCH422.

Principals of fluid dynamics as applied to model development and process design. Mass, momentum and energy conservation. Statics and surface tension. Equation of Continuity and Navier-Stokes Equation with application to laminar flow. Dimensional analysis. Macroscopic balances, Bernoulli Equation and friction factors with application to turbulent flow.
CHBE437  
Chemical and Biomolecular Engineering Laboratory  
Grading Method: Regular, Pass-Fail, Audit  
Credits: 3  
Prerequisite: CHBE424, CHBE426, and CHBE440. Restriction: Must be in a major within ENGR-Chemical & Biomolecular Engineering department; and permission of ENGR-Chemical & Biomolecular Engineering department. Credit only granted for: CHBE437 or ENCH437. Formerly: ENCH437.  
Application of chemical engineering process and unit operation principals in small-scale semi-commercial equipment. Data from experimental observations are used to evaluate performance and efficiency of operations. Emphasis on correct presentation of results in report form.

| Section | Instructor | Seats (Total: 20, Open: 20, Waitlist: 0) | Time 
|---------|------------|---------------------------------------------|---------------------------------|
| 0101    | Audaldo Ponce, Amy Karlsson | CHE 1145 Lab  
CHE 2136 Discussion | M 1:00pm - 5:00pm  
M 10:00am - 10:50am |
| 0201    | Audaldo Ponce, Amy Karlsson | CHE 1145 Lab  
CHE 2145 Discussion | Tu 12:30pm - 4:30pm  
Tu 10:00am - 10:50am |
| 0301    | Amy Karlsson | CHE 1145 Lab  
CHE 2145 Discussion | Th 12:30pm - 4:30pm  
Th 10:00am - 10:50am |
| 0401    | Amy Karlsson, Audaldo Ponce | CHE 1145 Lab  
CHE 2108 Discussion | F 1:30pm - 5:30pm  
F 11:00am - 11:50am |

CHBE440  
Chemical Kinetics and Reactor Design  
Grading Method: Regular, Pass-Fail, Audit  
Credits: 3  
Prerequisite: Minimum grade of C- in CHBE301, MATH241, and MATH246. Restriction: Must be in Engineering: Chemical program; and permission of ENGR-Chemical & Biomolecular Engineering department. Credit only granted for: CHBE440 or ENCH440. Formerly: ENCH440.  
Fundamentals of chemical reaction kinetics and their application to the design and operation of chemical reactors. Reaction rate theory, homogeneous reactions and catalysis electrochemical reactions. Catalytic reactor design.
### CHBE442  
**Chemical and Biomolecular Systems Analysis**

Credits: 3  
**Grading Method:** Regular, Pass-Fail, Audit  

**Prerequisite:** CHBE424 and CHBE426.  Credit only granted for: CHBE442 or ENCH442.  Formerly: ENCH442.  

*Dynamic response applied to process systems. Goals and modes of control Laplace transformations, analysis and synthesis of simple control systems, closed loop response, dynamic testing.*

### CHBE444  
**Process Engineering Economics and Design I**

Credits: 3  
**Grading Method:** Regular, Pass-Fail, Audit  

**Prerequisite:** CHBE424, CHBE426, and CHBE440.  Restriction: Must be in a major within the ENGR-Chemical & Biomolecular Engineering department; and permission of ENGR-Chemical & Biomolecular Engineering department.  Credit only granted for: CHBE444 or ENCH444.  Formerly: ENCH444.  


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### CHBE451  
**Photovoltaics: Solar Energy**

Credits: 3  
**Grading Method:** Regular, Pass-Fail, Audit
Restriction: Permission of ENGR-Chemical & Biomolecular Engineering department. Credit only granted for: ENCH468L or CHBE451. Formerly: ENCH468L.

The emphasis of the class is on developing a conceptual understanding of the device physics and manufacturing processes of crystalline and thin-film photovoltaic cells, and to develop elementary computational skills necessary to quantify solar cell efficiency. The class material includes detailed, system-level energy balances necessary to understand how solar energy fits into the complete energy generation, conversion, and storage picture. Quantitative comparisons of PV technology to solar chemical conversion processes and biofuels are made.

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Instructor</th>
<th>Seats (Total: 25, Open: 25, Waitlist: 0)</th>
<th>Grading Method: Regular</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHBE468</td>
<td>Raymond Adomaitis</td>
<td>TuTh 2:00pm - 3:15pm</td>
<td>JMP 2216</td>
</tr>
</tbody>
</table>

CHBE468 Research

Credits: 1-3

Investigation of a research project under the direction of a faculty member. Comprehensive reports are required.

Contact department for information to register for this course.

CHBE469 Special Projects

Credits: 1-3

Special project under the direction of a faculty member. Comprehensive reports are required.

Contact department for information to register for this course.

CHBE484 Metabolic Pathway Engineering

Credits: 3

Prerequisite: CHBE101 and CHBE440. Restriction: Permission of ENGR-Chemical & Biomolecular Engineering department. Credit only granted for: ENCH468M or CHBE484. Formerly: ENCH468M.

The state-of-the-art in metabolic engineering, with a focus on the analysis and engineering of metabolic pathways through (chemical) engineering principles, will be covered. Topics covered include: (1) overview of biochemistry and metabolism; (2) metabolic flux analysis and isotope labeling illustrated with examples from the recent scientific literature; (3) technologies for engineering metabolic pathways; (4) metabolic control analysis and pathway regulation; (5) applications of metabolic engineering to synthesis of biofuels and therapeutics; (6) specialized and related subjects such as protein engineering and synthetic biology.

<table>
<thead>
<tr>
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<th>Instructor</th>
<th>Seats (Total: 30, Open: 30, Waitlist: 0)</th>
<th>Grading Method: Regular, Pass-Fail, Audit</th>
</tr>
</thead>
<tbody>
<tr>
<td>0101</td>
<td>Ganesh Sriram</td>
<td>MW 5:00pm - 6:15pm</td>
<td>CHE 2136</td>
</tr>
</tbody>
</table>
Heterogeneous Catalysis for Energy Applications

Credits: 3
Grading Method: Regular, Pass-Fail, Audit

Prerequisite: Minimum grade of C- in CHBE302, CHBE424, and CHBE440; and permission of instructor. Restriction: Must be in a major within the ENGR-Chemical & Biomolecular Engineering department. Credit only granted for: CHBE486 or ENCH686.

Introduction to heterogeneous catalytic science and technology for energy conversion and hydrocarbon processing. Preparation and mechanistic characterization of catalyst systems, kinetics of catalyzed reactions, adsorption and diffusion influences in heterogeneous reactions. An overview of heterogeneous catalysis in various energy-related applications, including petroleum refining, chemicals from biomass, valorization of shale gas, and CO2 utilization will be introduced.

<table>
<thead>
<tr>
<th>CRN</th>
<th>Instructor</th>
<th>Seats (Total: 40, Open: 40, Waitlist: 0)</th>
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<tbody>
<tr>
<td>0101</td>
<td>Dongxia Liu</td>
<td>TuTh 5:00pm - 6:15pm, EGR 1104</td>
</tr>
</tbody>
</table>