UNIVERSITY OF WASHINGTON

# CREATING AND CHANGING UNDERGRADUATE ACADEMIC PROGRAMS

APR 1 9 2010

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Control # Chem-E

2010 0401

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**College/Campus** College of Engineering | **Department/Unit** Chemical Engineering | **Date** April 1, 2010

## New Programs

- ☐ Leading to a Bachelor of _____ in _____ degree.
- ☐ Leading to a Bachelor of _____degree with a major in _____.
- ☒ Leading to a Nanoscience and Molecular Engineering Option within the existing major in Chemical Engineering.
- ☐ Leading to a minor in _____

## Changes to Existing Programs

- ☐ New Admission Requirements for the Major in _____ within the Bachelor of _____.
- ☒ Revised Admission Requirements for the Major in Chemical Engineering within the Bachelor of Science in Chemical Engr.
- ☒ Revised Program Requirements for the Major in Chemical Engineering within the Bachelor of Science in Chemical Engineering.
- ☐ Revised Requirements for the Option in _____within the major in _____.
- ☐ Revised Requirements for the Minor in _____.

## Other Changes

- ☐ Change name of program from _____ to _____.
- ☒ New or Revised Continuation Policy for Chemical Engineering
- ☐ Eliminate program in _____.

Proposed Effective Date: **Quarter:** ☒ Autumn ☐ Winter ☐ Spring ☐ Summer **Year:** 20 10

| Contact Person: Dave Drischell | Phone: 3-2252 | Email: rdd@uw.edu | Box: 351750 |
|---|---|---|---|

## EXPLANATION OF AND RATIONALE FOR PROPOSED CHANGE

For new program, please include any relevant supporting documentation such as student learning outcomes, projected enrollments, letters of support and departmental handouts. (*Use additional pages if necessary*).

1. The Department of Chemical Engineering will offer an "OPTION" in Nanoscience and Molecular Engineering (NME) for undergraduate majors in chemical engineering (ChemE). The Option program will emphasize with
- hands-on experience (laboratory (ChemE 455) and research projects (ChemE 499)
- interdisciplinary courses (see attachment), and
- seminars (NME 221/321/421)

nanoscience and molecular engineering principles.

With the NME Option our students will experience early in their careers to appreciate the interconnected scientific and engineering strategies that promote multifarious novel and effective technologies designed from a cognitively guided molecular perspective.

The inception of this Option program is also in conjunction with current developments on campus in the area of nanoscience and molecular engineering, and on-going negotiations with BIOEN, CHEM, EE, ME, MSE, and PHYS towards similar and linked department tailored NME Option/Minor programs.

2. Revised program requirement: CHEM E 260 is no longer offered; CHEM E 325 replaces it.

## OTHER DEPARTMENTS AFFECTED

List all departments/units/ or co-accredited programs affected by your new program or changes to your existing program and acquire the signature of the chair/director of each department/unit listed. Attach additional page(s) if necessary. *See online instructions.

| Department/Unit: | Chair/Program Director: | Date: |
|---|---|---|
| | | |

| Department/Unit: | Chair/Program Director | Date: |
|---|---|---|
| | | |

**CATALOG COPY**

Catalog Copy as currently written. Include only sections/paragraphs that would be changed if your request is approved. Please cross out or otherwise highlight any deletions.

See Attached

**PROPOSED CATALOG COPY**

Reflecting requested changes (Include exact wording as you wish it to be shown in the printed catalog. Please underline or otherwise highlight any additions. If needed, attach a separate, expanded version of the changes that might appear in department publications). **Please note:** all copy will be edited to reflect uniform style in the General Catalog.

See Attached

**APPROVALS**

| | |
|---|---|
| Chair/Program Director: | Date: 4/6/10 |
| College/School/Campus Curriculum Committee: | Date: 4/6/10 |
| Dean/Vice Chancellor: | Date: 4-9-10 |
| Faculty Council on Academic Standards/ General Faculty Organization/Faculty Assembly Chair: | Date: 4/30/2010 |

**POST TRI-CAMPUS APPROVAL (when needed)**

| Faculty Council on Academic Standards/ General Faculty Organization/Faculty Assembly Chair: | Date: |
| --- | --- |
| John L Schaufelberger | 6/11/2010 |

# Addendum
## to Explanation and Rationale for Proposed Changes

Hands-on Experience

For the NME Option the students are required to sign up for
- **CHEM E 455 - Surface and Colloid Science Laboratory** (3 credits)
  (see syllabus below) The Option is more stringent than the CHEM E major, as it requests specifically CHEM E 455 and does not consider CHEM 461.
- **CHEM E 499 - Undergraduate Research** (3 - 6 credits)
  Research conducted in ChemE fulfills the programs objective, i.e., to be of nanosciene/technology and/or molecular engineering focus.

Seminars

**NME 221/321/421** (1 credit each – credit/no credit): "Frontiers of Nanoscience and Molecular Engineering." This seminar series entails presentations of student research projects. It connects students with on-going progress in nanotechnology, and provides a platform for sophomores, juniors, and seniors to meet and share their learning experiences.

- **NME 221 – Nanoscience and Molecular Engineering Seminar I** (1 credit – credit/no credit)
  This seminar will offer students an introduction to nanoscale science and molecular engineering, familiarize them with research and educational opportunities in nanotechnology on campus, and provide an initial intellectual forum where they can share their interests in NME. This seminar is the first in a series of three. Students are required to attend the seminars and to visit a UW research laboratory or institute, interview a researcher, and write an essay on the research aspect discussed during their visit.

- **NME 321 – Nanoscience and Molecular Engineering Seminar II** (1 credit – credit/no credit)
  Having obtained an appreciation for NME in NME 221, and getting started in conducting research themselves (CHEM E 499), students will learn from examples provided throughout this seminar course on how to plan and tackle research challenges, put their work into the framework of others, and to present and interpret data. The students are required to assess in written form each presentation based on the mentioned criteria. Furthermore, an essay is required (team effort) on a contemporary societal and ethical issue in NME.

- **NME 421 – Nanoscience and Molecular Engineering Seminar III** (1 credit – credit/no credit)
  Students will present orally an aspect of their research experience. Thereby, the emphasis is on addressing properly the research objective and motivation, the set research hypothesis, and how it was tested. Findings shall be discussed within the framework of the open literature. The students are also required to compose (team effort) an essay on a contemporary societal and ethical issue in NME.

Interdisciplinary Courses

**NME 220** (former CHEM E 220 – 4 Credits) – **Introduction to Molecular and Nanoscale Principles** is required for the Option. (see syllabus/outline below)

**6 – 9 Credits of NME Engineering Elective Courses** (see Table below)

**Option: NME Engineering Electives for ChemE**:

| ***BIOEN*** | ***CHEM E*** | ***EE*** | ***ME*** | ***MSE*** |
|---|---|---|---|---|
| **BIOEN/CHEM E 490** (3) *Engineering Materials for Biomedical Applications* | **CHEM E/BIOEN 467** (3) *Biochemical Engineering* | **EE 436** (4) *Medical Instrumentation* | **ME/MSE 568** (3) *Active and sensing materials and their devices* | **MSE 333** (3) Materials Characterization |
| **BIOEN/CHEM E 491**(3): *Controlled-Release Systems: Principles and Applications* | **CHEM E / MSE 484** (3) *Electronic and Optoelectronic Polymers* | **EE/MSE 486** (3) *Semiconductor Processing* | | **MSE 481** (3) Science and Technology of Nanostructures |
| **BIOEN 492 /CHEM E 458** (3) *Surface Analysis* | **ChemE 554** (3) *Nanoscience I- Contact Mechanics and Rheology* | | | **MSE/CHEM 484** (3) Materials Chemistry |

## Current

## Bachelor of Science in Chemical Engineering

*Suggested College Courses for First Five Quarters:* MATH 124, MATH 125, MATH 126, MATH 307, MATH 308, CHEM 142 (or CHEM 144), CHEM 152 (or CHEM 154), CHEM 162 (or CHEM 164), CHEM 237, CHEM 238, PHYS 121, PHYS 122, PHYS 123, ENGL 131 (or equivalent), AMATH 301 (or CSE 142)

### *Department Admission Requirements*

Core courses within the department form a seven-quarter curriculum designed to start in spring quarter of the sophomore year (six quarters for students admitted for autumn quarter, 2010). Applicants are considered in three groups (four groups in calendar year 2010, depending on how much coursework the student has completed at time of application): Direct Freshman Admission, Early Admission, and Upper-Division Admission (in 2010, students will be admitted through the upper-division admission pathway twice, for spring and autumn quarters). Admission is competitive. Completion of minimum requirements described below does not guarantee admission. Applicants not admitted under one admission group may subsequently apply to another admission group after completing more coursework. All applicants have the right to petition and appeal the department's admission decision.

1. *Direct Freshman Admission*

   The department enrolls up to 10% of its incoming class directly from high school, prior to completion of University-level prerequisites. Students accepted to the UW who indicate chemical engineering as their preferred major on the freshman application are automatically considered. Competitive applicants have taken or are taking calculus and at least two years of laboratory science (physics, chemistry preferred) in high school. Admission is for autumn quarter only.

2. *Early Admission*

   The department enrolls up to 20% of its class from students who have taken one year of college-level coursework at the UW. The application is available at www.engr.washington.edu/uapp. Admission is for autumn quarter only. Application deadline is July 1.

   Course Requirements: MATH 124, MATH 125, MATH 126; CHEM 142 (or CHEM 144), CHEM 152 (or CHEM 154), CHEM 162 (or CHEM 164); PHYS 121; and 5 credits of English composition, chosen from C LIT 240, ENGL 104-ENGL 105, ENGL 111, ENGL 121, ENGL 131, ENGL 197, ENGL 198, ENGL 199, or ENGL 281.

   All courses must be completed prior to the July 1 application deadline.

Credit Requirements: Applicants must be completing their freshman year at the UW and must have completed a minimum15 credits taken in residence at the UW.

Grade Requirements: Minimum 2.0 grade in each prerequisite course and minimum 2.50 GPA.

3. *Upper-Division Admission*

The department enrolls the majority of its student through upper-division admission. Upper-division applicants have completed at least four quarters of equivalent college-level coursework and are on track to begin the department curriculum in spring quarter of their sophomore year. Application for the department is available at www.engr.washington.edu/uapp. Students not at UW must also apply for admission to the UW for spring quarter, following the admission rules found at admit.washington.edu.

Admission is for spring quarter only. The department application deadline is February 1. The UW application deadline is December 15.

*Course Requirements:* Minimum 55 academic credits at time of application, including the following graded credits: MATH 124, MATH 125, MATH 126, MATH 307 (18 credits); CHEM 142 (or CHEM 144), CHEM 152 (or CHEM 154), CHEM 162 (or CHEM 164) (15 credits); PHYS 121, PHYS 122 (10 credits); and one 5-credit English composition course, chosen from C LIT 240, ENGL 104-ENGL 105, ENGL 111, ENGL 121, ENGL 131, ENGL 197, ENGL 198, ENGL 199, or ENGL 281.

Applicants are advised to complete AMATH 301 (or CSE 142) by (or during) winter quarter of the sophomore year, and to complete PHYS 123 by (or during) spring of the sophomore year. Both courses must be completed no later than summer quarter following admission. It is expected that CHEM 237 (or CHEM 223) be completed no later than autumn quarter following admission. Applicants should take general education or elective courses to complete the minimum 55 graded credits.

*Credit and Grade Requirements:* 55 credits completed by application deadline, with a minimum overall 2.50 GPA and minimum 2.0 grade in all courses required for admission. Historically a substantially higher GPA in these categories is required for admission to the major. See department adviser with questions.

Factors included in the admission decision include the course record as indicated above and qualitative considerations such as difficulty of completed courses, frequency of incomplete or withdrawal grades, number of repeated courses, applicable work experience and maturity of attitude, record of honors, a demonstrated ability to take at least 12 credits per quarter, and special circumstances disclosed by the applicant.

4. *Upper-Division Admission (for autumn quarter 2010 only)*

   Historically the department has admitted its upper-division students for autumn quarter. Because this pathway is shifting in spring quarter, the department is admitting its last group of upper-division students for autumn quarter in 2010. The department application is available at www.engr.washington.edu/uapp. Students not at UW must also apply for admission to the UW for autumn quarter, following the admission rules found at admit.washington.edu.

   Admission is for autumn quarter only. The department application deadline is July 1. The UW application deadline is February 15.

   Course Requirements: MATH 124, MATH 125, MATH 126, MATH 307 (18 credits); CHEM 142 (or CHEM 144), CHEM 152 (or CHEM 154), CHEM 162 (or CHEM 164), CHEM 237 (or CHEM 223) (19); PHYS 121, PHYS 122, PHYS 123 (15); AMATH 301 or CSE 142 (4); CHEM E 260 (4); and one 5-credit English composition course chosen from C LIT 240, ENGL 104-ENGL 105, ENGL 111, ENGL 121, ENGL 131, ENGL 197, ENGL 198, ENGL 199, or ENGL 281.

   In addition, it is strongly recommended that students complete CHEM 238 or CHEM 224.

   Credit and Grade Requirements: 75 credits completed by July 1 application deadline, with minimum overall 2.50 GPA and minimum 2.0 in all courses required for admission. Historically a substantially higher GPA in these categories is required for admission. See department adviser with questions.

   Factors included in the admission decision include the course record as indicated above and qualitative considerations such as difficulty of completed courses, frequency of incomplete or withdrawal grades, number of repeated courses, applicable work experience and maturity of attitude, record of honors, a demonstrated ability to take at least 12 credits per quarter, and special circumstances disclosed by the applicant.

## ***Graduation Requirements***

180 credits, as follows:

*General Education Requirements (104 credits)*

1. *Written and Oral Communications (12 credits):* one 5-credit English composition course from the University list; HCDE 231; HCDE 333 (or department-approved alternative).
2. *Visual, Literary, & Performing Arts (VLPA) and Individuals & Societies (I&S) (24 credits*): A minimum of 10 credits required in each area.

3. *Natural World (68 credits)*
    a. Physics (15 credits): PHYS 121, PHYS 122, PHYS 123
    b. Mathematics (24 credits): MATH 124, MATH 125, MATH 126, MATH 307, MATH 308, and MATH 309 (or MATH 390 or IND E 315)
    c. Chemistry (29 credits): CHEM 142 (or CHEM 144), CHEM 152 (or CHEM 154), CHEM 162 (or CHEM 164), CHEM 237, CHEM 238, CHEM 455, CHEM 457

*Major Requirements (71 credits)*

1. *Engineering Fundamentals (8 credits):* ~~CHEM E 260;~~ AMATH 301 or CSE 142
2. *Chemical Engineering Core Courses (44 credits):* CHEM E 310, CHEM E 326, CHEM E 330, CHEM E 340, CHEM E 435, CHEM E 436, CHEM E 437, CHEM E 465, CHEM E 480, CHEM E 485, CHEM E 486
3. *Molecular and Nano-engineering (3 credits):* CHEM E 455 (highly recommended) or CHEM 461
4. *Engineering Elective Courses (16 credits)*

*Unspecified Electives (5 credits)*

A minimum 2.00 GPA in core chemical engineering courses, based on the first time each course is taken, is required for graduation.

## Proposed:

## Bachelor of Science in Chemical Engineering

*Suggested College Courses for First Five Quarters:* MATH 124, MATH 125, MATH 126, MATH 307, MATH 308, CHEM 142 (or CHEM 144), CHEM 152 (or CHEM 154), CHEM 162 (or CHEM 164), CHEM 237, CHEM 238, PHYS 121, PHYS 122, PHYS 123, ENGL 131 (or equivalent), AMATH 301 (or CSE 142)

### *Department Admission Requirements*

Core courses within the department form a seven-quarter curriculum designed to start in spring quarter of the sophomore year (six quarters for students admitted for autumn quarter, 2010). Applicants are considered in three groups (four groups in calendar year 2010, depending on how much coursework the student has completed at time of application): Direct Freshman Admission, Early Admission, and Upper-Division Admission (in 2010, students will be admitted through the upper-division admission pathway twice, for spring and autumn quarters). Admission is competitive. Completion of minimum requirements described below does not guarantee admission. Applicants not admitted under one admission group may subsequently apply to another admission group after completing more coursework. All applicants have the right to petition and appeal the department's admission decision.

**Admission to the NME Option is competitive. General admission to the NME Option is upon completion of NME 220. Admission decisions are based upon grades including NME 220 and ChemE courses taken up to this point. A small number of students may be admitted into the NME Option upon application to the department. Admission will be based on the student's academic record and prior experience/work in the field of nanoscience and/or molecular engineering. Students selecting to apply for the NME Option should indicate so in their Chemical Engineering application and discuss their interests and background in the essay.**

1. *Direct Freshman Admission*

   The department enrolls up to 10% of its incoming class directly from high school, prior to completion of University-level prerequisites. Students accepted to the UW who indicate chemical engineering as their preferred major on the freshman application are automatically considered. Competitive applicants have taken or are taking calculus and at least two years of laboratory science (physics, chemistry preferred) in high school. Admission is for autumn quarter only.

2. *Early Admission*

   The department enrolls up to 20% of its class from students who have taken one year of college-level coursework at the UW. The application is available at

www.engr.washington.edu/uapp. Admission is for autumn quarter only. Application deadline is July 1.

Course Requirements: MATH 124, MATH 125, MATH 126; CHEM 142 (or CHEM 144), CHEM 152 (or CHEM 154), CHEM 162 (or CHEM 164); PHYS 121; and 5 credits of English composition, chosen from C LIT 240, ENGL 104-ENGL 105, ENGL 111, ENGL 121, ENGL 131, ENGL 197, ENGL 198, ENGL 199, or ENGL 281.

All courses must be completed prior to the July 1 application deadline.

Credit Requirements: Applicants must be completing their freshman year at the UW and must have completed a minimum15 credits taken in residence at the UW.

Grade Requirements: Minimum 2.0 grade in each prerequisite course and minimum 2.50 GPA.

3. *Upper-Division Admission*

The department enrolls the majority of its student through upper-division admission. Upper-division applicants have completed at least four quarters of equivalent college-level coursework and are on track to begin the department curriculum in spring quarter of their sophomore year. Application for the department is available at www.engr.washington.edu/uapp. Students not at UW must also apply for admission to the UW for spring quarter, following the admission rules found at admit.washington.edu.

Admission is for spring quarter only. The department application deadline is February 1. The UW application deadline is December 15.

*Course Requirements:* Minimum 55 academic credits at time of application, including the following graded credits: MATH 124, MATH 125, MATH 126, MATH 307 (18 credits); CHEM 142 (or CHEM 144), CHEM 152 (or CHEM 154), CHEM 162 (or CHEM 164) (15 credits); PHYS 121, PHYS 122 (10 credits); and one 5-credit English composition course, chosen from C LIT 240, ENGL 104-ENGL 105, ENGL 111, ENGL 121, ENGL 131, ENGL 197, ENGL 198, ENGL 199, or ENGL 281.

Applicants are advised to complete AMATH 301 (or CSE 142) by (or during) winter quarter of the sophomore year, and to complete PHYS 123 by (or during) spring of the sophomore year. Both courses must be completed no later than summer quarter following admission. It is expected that CHEM 237 (or CHEM 223) be completed no later than autumn quarter following admission. Applicants should take general education or elective courses to complete the minimum 55 graded credits.

*Credit and Grade Requirements:* 55 credits completed by application deadline, with a minimum overall 2.50 GPA and minimum 2.0 grade in all courses required for admission. Historically a substantially higher GPA in these categories is required for admission to the major. See department adviser with questions.

Factors included in the admission decision include the course record as indicated above and qualitative considerations such as difficulty of completed courses, frequency of incomplete or withdrawal grades, number of repeated courses, applicable work experience and maturity of attitude, record of honors, a demonstrated ability to take at least 12 credits per quarter, and special circumstances disclosed by the applicant.

4. *Upper-Division Admission (for autumn quarter 2010 only)*

Historically the department has admitted its upper-division students for autumn quarter. Because this pathway is shifting in spring quarter, the department is admitting its last group of upper-division students for autumn quarter in 2010. The department application is available at www.engr.washington.edu/uapp. Students not at UW must also apply for admission to the UW for autumn quarter, following the admission rules found at admit.washington.edu.

Admission is for autumn quarter only. The department application deadline is July 1. The UW application deadline is February 15.

Course Requirements: MATH 124, MATH 125, MATH 126, MATH 307 (18 credits); CHEM 142 (or CHEM 144), CHEM 152 (or CHEM 154), CHEM 162 (or CHEM 164), CHEM 237 (or CHEM 223) (19); PHYS 121, PHYS 122, PHYS 123 (15); AMATH 301 or CSE 142 (4); CHEM E 260 (4); and one 5-credit English composition course chosen from C LIT 240, ENGL 104-ENGL 105, ENGL 111, ENGL 121, ENGL 131, ENGL 197, ENGL 198, ENGL 199, or ENGL 281.

In addition, it is strongly recommended that students complete CHEM 238 or CHEM 224.

Credit and Grade Requirements: 75 credits completed by July 1 application deadline, with minimum overall 2.50 GPA and minimum 2.0 in all courses required for admission. Historically a substantially higher GPA in these categories is required for admission. See department adviser with questions.

Factors included in the admission decision include the course record as indicated above and qualitative considerations such as difficulty of completed courses, frequency of incomplete or withdrawal grades, number of repeated courses, applicable work experience and maturity of attitude, record of honors, a demonstrated ability to take at least 12 credits per quarter, and special circumstances disclosed by the applicant.

Admission to the Nanoscience and Molecular Engineering Option is competitive. Students will be selected based

## ***Graduation Requirements***

180 credits, as follows:

*General Education Requirements (104 credits)*

1. *Written and Oral Communications (12 credits):* one 5-credit English composition course from the University list; HCDE 231; HCDE 333 (or department-approved alternative).
2. *Visual, Literary, & Performing Arts (VLPA) and Individuals & Societies (I&S) (24 credits*): A minimum of 10 credits required in each area.
3. *Natural World (68 credits)*
    a. Physics (15 credits): PHYS 121, PHYS 122, PHYS 123
    b. Mathematics (24 credits): MATH 124, MATH 125, MATH 126, MATH 307, MATH 308, and MATH 309 (or MATH 390 or IND E 315)
    c. Chemistry (29 credits): CHEM 142 (or CHEM 144), CHEM 152 (or CHEM 154), CHEM 162 (or CHEM 164), CHEM 237, CHEM 238, CHEM 455, CHEM 457

*Major Requirements (71 credits)*

1. *Engineering Fundamentals (**4** credits):* AMATH 301 or CSE 142
2. *Chemical Engineering Core Courses (**48** credits):* CHEM E 310; **CHEM E 325**; CHEM E 326; CHEM E 330; CHEM E 340; CHEM E 435; CHEM E 436; CHEM E 437; CHEM E 465; CHEM E 480; CHEM E 485; CHEM E 486
3. *Molecular and Nano-engineering (3 credits):* CHEM E 455 (highly recommended) or CHEM 461
4. *Engineering Elective Courses (16 credits)*

*Unspecified Electives (5 credits)*

***Nanoscience and Molecular Engineering Option Requirements (74 credits)***

1. *Engineering Fundamentals (4 credits):* AMATH 301 or CSE 142
2. *Chemical Engineering Core Courses (48 credits):* CHEM E 310; CHEM E 325; CHEM E 326; CHEM E 330; CHEM E 340; CHEM E 435; CHEM E 436; CHEM E 437; CHEM E 465; CHEM E 480;, CHEM E 485; CHEM E 486

3. *Nanoscience and Molecular Engineering Courses (22 credits):* CHEM E 455, CHEM E 499 (3-6 credits), NME 220, NME 221, NME 321; NME 421; minimum of two additional approved nanoscience and molecular engineering electives. See advisor for list of approved electives.

A minimum 2.00 GPA in core chemical engineering courses, based on the first time each course is taken, is required for graduation.

Approved Electives:

CHEM E 458/BIOEN 492

CHEM E/BIOEN 467

CHEM E 484

CHEM E/BIOEN 490

CHEM E/BIOEN 491

CHEM E/BIOEN 491

CHEM E 554*

------ To be verified with responsible departments ----------

CHEM 455 or CHEM 475

CHEM 484/MSE 484

CHEM 461

E E 436

E E 486

M E/MSE 568*

MSE 333

MSE 481

PHYS 421

PHYS 423

PHYS 433

**Continuation Policy**

While the University has general regulations governing scholastic eligibility for continuation, departments in the College of Engineering have adopted additional requirements in order to make the best use of the limited facilities and resources available and to provide reasonable assurance of academic success. The following criteria and procedures will be applied to all undergraduate students for determining continuance in the major program.

Basic Criteria for Continuation

1. Full-time students must complete 12 or more credits per quarter that are applicable to the B.S.Ch.E. degree. An average of 15 hours per quarter is required to complete the minimum graduation requirements in the conventional 12 quarters.
2. Part-time attendance is possible subject to approval by the chairman of the Department. Application for part-time status should be made prior to the first day of the quarter. Students who have received permission to attend part time must complete at least one course each quarter applicable to their degree.
3. A student who has withdrawn from the University or from a required chemical engineering course or who is dropped for non-payment of fees must obtain approval of the Admissions Committee of the Department before registering or maintaining preregistration for subsequent chemical engineering courses.
4. Students must obtain a minimum grade of 2.0 in CHEM E 260 (or equivalent) and CHEM E 310 to remain in the Department. Students who fail to do so will be dropped from the Department.
5. Students must maintain a quarterly GPA of 2.00. Any student whose quarterly GPA falls below 2.00 will be placed on departmental probation.
6. All students must maintain both an overall and a chemical engineering GPA of 2.00. (For chemical engineering courses which are repeated, the chemical engineering GPA will be based only on the first time the course was taken.)
7. The minimum passing grade for any course is 0.7. A student may repeat a chemical engineering course only if less than that minimum grade (i.e., a failure) is received in a departmental course.
8. **Students admitted to the Nano and Molecular Engineering Option (NME) must adhere to all of the above criteria. Since the NME core coursework is offered in specified quarters only, students must enroll in these courses to be considered making satisfactory progress. Students not making satisfactory progress toward the NME Option will be dropped from the Option.**

**Dave Drischell**

**From:** "uwcr" <uwcr@u.washington.edu>
**To:** "Dave Drischell" <rdd@u.washington.edu>
**Sent:** Tuesday, April 06, 2010 9:34 AM
**Subject:** FW: Chem E's list of approved electives for Nanoscience and Molecular Engineering Option

-----Original Message-----
From: Margo Segimoto [mailto:segimoto@u.washington.edu]
Sent: Friday, April 02, 2010 3:13 PM
To: uwcr
Subject: Re: Chem E's list of approved electives for Nanoscience and Molecular Engineering Option

Hi Jennifer:
Yes, ME 568 would be fine to add for the minor.
-Margo

Margo Segimoto
Director of Student Services
Department of Mechanical Engineering
Box 352600
University of Washington Seattle, WA 98195-2600
Telephone: 206-685-0908 FAX: 206-685-8047
http://www.me.washington.edu

----- Original Message -----
From: "uwcr" <uwcr@u.washington.edu>
To: "Leilani M. Stone" <stone@chem.washington.edu>; "Margo Segimoto" <segimoto@u.washington.edu>; <kelkins@uw.edu>; "Margaret Nims" <margot@phys.washington.edu>; "'Erin Olnon (Peinado)'" <erin82@u.washington.edu>
Cc: "Dave Drischell" <rdd@u.washington.edu>
Sent: Thursday, April 01, 2010 1:14 PM
Subject: Chem E's list of approved electives for Nanoscience and Molecular Engineering Option

> Hi everyone,
>
> I am helping CHEM E prepare the paperwork for their NME option while they
> are developing the Interdisciplinary Minor. Is it okay for students
> completing the NME option in Chem E to take one of more of the following
> courses in you department?
>
> Thanks,
>

**Dave Drischell**

**From:** "uwcr" <uwcr@u.washington.edu>
**To:** "Dave Drischell" <rdd@u.washington.edu>
**Sent:** Tuesday, April 06, 2010 9:34 AM
**Subject:** FW: Chem E's list of approved electives for Nanoscience and Molecular Engineering Option

-----Original Message-----
From: Kathleen Elkins [mailto:kelkins@uw.edu]
Sent: Thursday, April 01, 2010 1:21 PM
To: uwcr
Subject: Re: Chem E's list of approved electives for Nanoscience and Molecular Engineering Option

Hi,

Yes, if space is available after declared majors are registered.

Kathy

Kathleen A. Elkins
Academic Counselor
Materials Science and Engineering
Box 352120, 302 Roberts
Seattle, WA 98195-2120
206.616.6581; FAX 206.543.3100
kelkins@u.washington.edu
http://depts.washington.edu/mse

On 4/1/2010 1:14 PM, uwcr wrote:
> Hi everyone,
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> I am helping CHEM E prepare the paperwork for their NME option while they
> are developing the Interdisciplinary Minor. Is it okay for students
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> courses in you department?
>
> Thanks,
>
> Jennifer
>
> CHEM 455 or CHEM 475
> CHEM 484/MSE 484
> CHEM 461
> E E 436
> E E 486
> M E/MSE 568*
> MSE 333

**Dave Drischell**

**From:** "uwcr" <uwcr@u.washington.edu>
**To:** "Dave Drischell" <rdd@u.washington.edu>
**Sent:** Tuesday, April 06, 2010 9:35 AM
**Subject:** RE: Chem E's list of approved electives for Nanoscience and Molecular Engineering Option

Haven't heard back from Margot - but not expecting an issue.

Jennifer

PHYS

-----Original Message-----
From: Dave Drischell [mailto:rdd@u.washington.edu]
Sent: Tuesday, April 06, 2010 9:17 AM
To: uwcr
Subject: Re: Chem E's list of approved electives for Nanoscience and Molecular Engineering Option

did you happen to hear back from Margo, Kathy, Margot?

----- Original Message -----
From: "uwcr" <uwcr@u.washington.edu>
To: "Leilani M. Stone" <stone@chem.washington.edu>; "Margo Segimoto" <segimoto@u.washington.edu>; <kelkins@uw.edu>; "Margaret Nims" <margot@phys.washington.edu>; "'Erin Olnon (Peinado)'" <erin82@u.washington.edu>
Cc: "Dave Drischell" <rdd@u.washington.edu>
Sent: Thursday, April 01, 2010 1:14 PM
Subject: Chem E's list of approved electives for Nanoscience and Molecular Engineering Option

> Hi everyone,
>
> I am helping CHEM E prepare the paperwork for their NME option while they
> are developing the Interdisciplinary Minor. Is it okay for students
> completing the NME option in Chem E to take one of more of the following
> courses in you department?
>
> Thanks,
>
> Jennifer
>
> CHEM 455 or CHEM 475
> CHEM 484/MSE 484
> CHEM 461
> E E 436
> E E 486
> M E/MSE 568*
> MSE 333
> MSE 481

**Dave Drischell**

**From:** "Lani Stone" <stone@chem.washington.edu>
**To:** "uwcr" <uwcr@u.washington.edu>
**Cc:** "Dave Drischell" <rdd@u.washington.edu>
**Sent:** Friday, April 02, 2010 2:36 PM
**Subject:** Re: Chem E's list of approved electives for Nanoscience and Molecular Engineering Option

Hi Jennifer,
OK for the chemistry courses. CHEM E students already take CHEM 455 anyway and they used to take 461. CHEM 475 is the honors version of 455 and students need to meet special gpa criteria for that course and would need to contact advisers for registration.
Lani CHEM

uwcr wrote:
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> MSE 333
> MSE 481
> PHYS 421
> PHYS 423
> PHYS 433
>
>
>
>

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Lani Stone, Lead Academic Counselor
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303B Bagley Hall, Box 351700, University of Washington
Seattle, WA 98195-1700
tel 206.543.9343 fax 206.685.8665
email: stone@chem.washington.edu
http://depts.washington.edu/chem/

**Dave Drischell**

**From:** "uwcr" <uwcr@u.washington.edu>
**To:** "'Erin Olnon (Peinado)'" <erin82@u.washington.edu>
**Cc:** "Stephen A. Graham" <graham@ee.washington.edu>; "Rene M. Overney" <roverney@u.washington.edu>; "Dave Drischell" <rdd@u.washington.edu>
**Sent:** Monday, April 05, 2010 2:42 PM
**Subject:** RE: FW: Chem E's list of approved electives for Nanoscience and Molecular Engineering Option

Thanks

-----Original Message-----
From: Erin Olnon (Peinado) [mailto:erin82@u.washington.edu]
Sent: Monday, April 05, 2010 2:36 PM
To: 'uwcr'
Cc: 'Stephen Graham'
Subject: RE: FW: Chem E's list of approved electives for Nanoscience and Molecular Engineering Option

Jennifer,

It's fine with EE that students in the NME minor take the EE classes listed below.

Erin EE
>
>-----Original Message-----
>From: uwcr [mailto:uwcr@u.washington.edu]
>Sent: Thursday, April 01, 2010 1:14 PM
>To: Leilani M. Stone; Margo Segimoto; kelkins@uw.edu; Margaret Nims; 'Erin
>Olnon (Peinado)'
>Cc: Dave Drischell
>Subject: Chem E's list of approved electives for Nanoscience and Molecular
>Engineering Option
>
>Hi everyone,
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>I am helping CHEM E prepare the paperwork for their NME option while they
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>
>Thanks,
>
>Jennifer
>
>CHEM 455 or CHEM 475
>CHEM 484/MSE 484
>CHEM 461
>E E 436

## NME 220 Introduction to Molecular and Nanoscale Principles

Course Instructor: Professor René M. Overney
245 Benson, 206-543-4353, E-mail the instructor

Lecture/Recitation:
M/W/F: 11:30-12:20, BNS 115
F (Recitation): 12:30-1:20, BNS 115

Course Textbook: *Nanotechnology – Understanding Small Systems*
*by B. Rogers et al., CRC Press (2007)*

Prerequisites: Either CHEM 142 or CHEM 144 or CHEM 145; either MATH 126 or MATH 136; and PHYS 121

### Course Description

The course provides an introduction to nanotechnology and nanoscience based on fundamental principles. It introduces the students to macroscopic limits of material properties and molecular structures, interaction forces, molecular transport properties, thermodynamic principles, cooperative and nanoscale phenomena, and device and process technologies.

Specific Course Objectives:

- introduce theories and concepts of nanoscale systems based on fundamental principles,
- give students an appreciation for the importance of nanotechnology in science and engineering,
- provide a basis for continuing education in molecular and nanoscale science and engineering, and
- raise awareness of the technological and societal transformation anticipated through nanotechnological progress in the near future.

Within the framework of the new accreditation procedure (ABET) it is measured with weekly homework and exams, whether students master the theories and concepts of nanoscale systems.

### Course Credit

Course credit is based on the performance in Homework (10 %), Midterms (50 %) and Final Exam (40%).

Examinations:
Two one-hour exams and a two-hour comprehensive third exam. All examinations are required, and there will be no make-ups. Missing an examination or not turning one in is graded as a failure (0.0).

Homework:
Weekly, assigned on Monday and due the following Monday at the beginning of the lecture. HW is graded based on effort! To pass this course a 75 % HW score is

Chemical Engineering 220

# Introduction to Molecular and Nanoscale Principles

## Course Outline

**1. Introduction to Classification Schemes in Nanoscience and Nanotechnology**

- Nanotechnology: Historical background and expectations
- Classification of nanomaterials based on number of dimensions
  - Nanoparticles, nanopores, nanotubes, nanofilaments, nanolayers, nanofilms
- Classification of nanomanufacturing based on fabrication methods
  - Top-down and bottom-up approach
- Classification of nanoscience based on constraints
  - Small scale systems, internal macromolecular constraints, interfacial constraints
- Characterization methods
  - for structure, mobility and transition, chemical composition, and kinetic analysis

**2. Overview of finite system constraints on material properties**

- Atomistic background of condensed matter
  - from isolated atom to extended solids
  - Material structures
- Effect of dimensional constraints
  - on systems total energy and structure, thermal properties, chemical properties, mechanical properties, magnetic properties, optical properties, electronic properties

**3. Effects of small scale system constraints on material structures, conduction properties and mechanical and viscous properties**

- Conduction
  - Material classification based on electron conductivity
- Effects of dimensional constraints on conduction properties
  - Quantum confinement in semiconductor nanostructures
  - Technological device opportunities
- Background on Continuum Mechanics
  - Material classification based on stress responses
  - Introduction to solid and liquid mechanics
- Effects of dimensional constraints on structure, mechanical and viscous properties
  - Liquid structuring, stick-slip phenomena of confined liquids

**4. Molecular and interfacial interactions**

- Overview: Types of interactions – From covalent bonds to surfaces forces
- Noncovalent bonding
  - Ionic bonds, hydrophobic interactions, hydrogen bonds, dipole-dipole bonds
  - Van der Waals (London dispersion)
  - Adhesion and surface energies
- Nanocharacterization tools: Scanning force microscopy (SFM) and surface forces apparatus (SFA)
- Biological systems, colloids, self-assembling nanostructured molecular materials, and liquid crystals

**5. Thermodynamics and heat transport in small systems**

- Heat capacity
  - From its thermodynamic definition to its atomic mechanism
- Heat Transfer and Thermodynamics in Small systems

**6. Molecular organic engineering and electronic applications**

- Overview: Chemistry of carbon
- Organic semiconductors
- Charge injection and transport
- Organic light emitting materials

# CHEM E 455
# Surface and Colloid Science Laboratory

Course Description:

Laboratory techniques, equipment, and underlying fundamentals in surface and colloid science. Experiments in the measurement of surface tension, adsorption, wetting and spreading, colloid properties, material characterization, electrophoresis, and interfacial hydrodynamics.

Prerequisites: Recommended: CHEM E 326; CHEM E 330; CHEM 461.

Prerequisites by Topic:

- Chemical thermodynamics of multicomponent systems
- Fundamentals of physical chemistry
- Fundamentals of fluid mechanics

Textbook:

J. C. Berg, "An Introductions to Surfaces, Colloids and Nanoscience," 2009. Available at the UW bookstore. Soft cover version big yellow book.

Course Objectives:

To acquaint students with the basic principles of surface and colloid science and the experimental methods used in their study in the industrial and research laboratory.

Topics Covered in Lecture:

1- Surface tension and capillarity
2- Thermodynamics
3- Solid-liquid interaction
4- Structure and properties of colloidal systems
5- Electrical double layers; flocculation stability
6- Electrokinetics and rheology

Grading:

Four **individual** laboratory reports (20 pt each).

- Reports are due exactly one week after completion of the experiment.
- Missing reports don't get credit.
- One point is deducted for every day that the report is late.

Final presentation on one of the modules (20 pt). More on this latter.

Expected mean GPA: ~3.1

Class/Laboratory Schedule:

Lectures TTh (1 hr)
Laboratory: T,W or Th (4 hrs)

Relationship of Course to Program Objectives:

This course relates to program objectives in Criterion 4 as follows:

(a) an ability to apply knowledge of mathematics, science, and engineering
(b) an ability to design and conduct experiments, as well as to analyze and interpret data
(e) an ability to identify, formulate, and solve engineering problems
(k) an ability to use the techniques, skills and modern engineering tools necessary for engineering practice

Accompanying material:

(a) Textbook
(b) Lecture notes (website)
(b) Compendium of laboratory handouts (website)

Website: http://faculty.washington.edu/dpozzo/CHEME455/index.shtml

Changes to the notes and lab modules will be posted on the website. Visit this site frequently in order to have the most up-to-date version of the material.

This is an advanced class and a continually evolving syllabus. I hope that you will enjoy in participating in this development and respond positively when you are asked to change a material, protocol or other procedures than those that are prescribed in the handouts. This will also make the class more interesting for everyone.

**Tuesday 455 AA Lab Sessions**

**Safety Meeting + Group Selection** **Thursday** Oct 1 2:30-3:30 pm BSN 123 (talk to me if there are conflicts)

| | |
|---|---|
| **Group 1** | |
| Oct 6 and Oct 13 1:30-5:20 PM | "Measurement of Surface Tension by Detachment or Partial Immersion Methods" |
| Oct 20 and Oct 27 1:30-5:20 PM | "Determination of Critical Micelle Concentration by Dye Titration and Conductivity" |
| Nov 3 and Nov 10 1:30-5:20 PM | "SAXS Structure Analysis of Complex Fluids" |
| Nov 17 and Nov 24 1:30-5:20 PM | "Rheology of Complex Fluids and Soft Materials" |
| **Group 2** | |
| Oct 6 and Oct 13 1:30-5:20 PM | "Determination of Critical Micelle Concentration by Dye Titration and Conductivity" |
| Oct 20 and Oct 27 1:30-5:20 PM | "Surface Equation of State using the Langmuir-Wilhelmy Film Balance" |
| Nov 3 and Nov 10 1:30-5:20 PM | "Rheology of Complex Fluids and Soft Materials" |
| Nov 17 and Nov 24 1:30-5:20 PM | "SAXS Structure Analysis of Complex Fluids" |
| **Group 3** | |
| Oct 6 and Oct 13 1:30-5:20 PM | "Wicking Flow in Porous Media" |
| Oct 20 and Oct 27 1:30-5:20 PM | "Synthesis and characterization of nanoparticle dispersions" |
| Nov 3 and Nov 10 1:30-5:20 PM | "Adhesion Force Measurements using Scanning Force Microscopy" |
| Nov 17 and Nov 24 1:30-5:20 PM | "Colloidal Aggregation using Electrolytes" |
| **Group 4** | |
| Oct 6 and Oct 13 1:30-5:20 PM | "Synthesis and characterization of nanoparticle dispersions" |
| Oct 20 and Oct 27 1:30-5:20 PM | "Measurement of Surface Tension by Detachment or Partial Immersion Methods" |
| Nov 3 and Nov 10 1:30-5:20 PM | "Colloidal Aggregation using Electrolytes" |
| Nov 17 and Nov 24 1:30-5:20 PM | "Measurement of Zeta Potential by Micro-electrophoresis" |
| **Group 5** | |
| Oct 6 and Oct 13 1:30-5:20 PM | "Surface Equation of State using the Langmuir-Wilhelmy Film Balance" |
| Oct 20 and Oct 27 1:30-5:20 PM | "Wicking Flow in Porous Media" |
| Nov 3 and Nov 10 1:30-5:20 PM | "Measurement of Zeta Potential by Micro-electrophoresis" |
| Nov 17 and Nov 24 1:30-5:20 PM | "Adhesion Force Measurements using Scanning Force Microscopy" |

**Wednesday 455 AB Lab Sessions**

**Safety Meeting + Group Selection** — **Wednesday** Sept 30 1:30 pm BSN 123

**No Laboratory:** — **November 11**

| | |
|---|---|
| **Group 1** | |
| Oct 7 and Oct 14 1:30-5:20 PM | "Measurement of Surface Tension by Detachment or Partial Immersion Methods" |
| Oct 21 and Oct 28 1:30-5:20 PM | "Determination of Critical Micelle Concentration by Dye Titration and Conductivity" |
| **Nov 4 and Nov 18 1:30-5:20 PM (two weeks apart)** | "SAXS Structure Analysis of Complex Fluids" |
| Nov 25 and Dec 2 1:30-5:20 PM | "Rheology of Complex Fluids and Soft Materials" |
| **Group 2** | |
| Oct 7 and Oct 14 1:30-5:20 PM | "Determination of Critical Micelle Concentration by Dye Titration and Conductivity" |
| Oct 21 and Oct 28 1:30-5:20 PM | "Surface Equation of State using the Langmuir-Wilhelmy Film Balance" |
| **Nov 4 and Nov 18 1:30-5:20 PM (two weeks apart)** | "Rheology of Complex Fluids and Soft Materials" |
| Nov 25 and Dec 2 1:30-5:20 PM | "SAXS Structure Analysis of Complex Fluids" |
| **Group 3** | |
| Oct 7 and Oct 14 1:30-5:20 PM | "Wicking Flow in Porous Media" |
| Oct 21 and Oct 28 1:30-5:20 PM | "Synthesis and characterization of nanoparticle dispersions" |
| **Nov 4 and Nov 18 1:30-5:20 PM (two weeks apart)** | "Adhesion Force Measurements using Scanning Force Microscopy" |
| Nov 25 and Dec 2 1:30-5:20 PM | "Colloidal Aggregation using Electrolytes" |
| **Group 4** | |
| Oct 7 and Oct 14 1:30-5:20 PM | "Synthesis and characterization of nanoparticle dispersions" |
| Oct 21 and Oct 28 1:30-5:20 PM | "Measurement of Surface Tension by Detachment or Partial Immersion Methods" |
| **Nov 4 and Nov 18 1:30-5:20 PM (two weeks apart)** | "Colloidal Aggregation using Electrolytes" |
| Nov 25 and Dec 2 1:30-5:20 PM | "Measurement of Zeta Potential by Micro-electrophoresis" |
| **Group 5** | |
| Oct 7 and Oct 14 1:30-5:20 PM | "Surface Equation of State using the Langmuir-Wilhelmy Film Balance" |
| Oct 21 and Oct 28 1:30-5:20 PM | "Wicking Flow in Porous Media" |
| **Nov 4 and Nov 18 1:30-5:20 PM (two weeks apart)** | "Measurement of Zeta Potential by Micro-electrophoresis" |
| Nov 25 and Dec 2 1:30-5:20 PM | "Adhesion Force Measurements using Scanning Force Microscopy" |

**Thursday 455 AC Lab Sessions**

**Safety Meeting + Group Selection** — **Thursday** Oct 1 1:30 pm BSN 123

**No Laboratory:** — **Nov 20 and Nov 27**

| | |
|---|---|
| **Group 1** | |
| Oct 8 and Oct 15 1:30-5:20 PM | "Measurement of Surface Tension by Detachment or Partial Immersion Methods" |
| Oct 22 and Oct 29 1:30-5:20 PM | "Determination of Critical Micelle Concentration by Dye Titration and Conductivity" |
| Nov 5 and Nov 12 1:30-5:20 PM | "SAXS Structure Analysis of Complex Fluids" |
| **Nov 19 and Dec 3 1:30-5:20 PM (two weeks apart)** | "Rheology of Complex Fluids and Soft Materials" |
| **Group 2** | |
| Oct 8 and Oct 15 1:30-5:20 PM | "Determination of Critical Micelle Concentration by Dye Titration and Conductivity" |
| Oct 22 and Oct 29 1:30-5:20 PM | "Surface Equation of State using the Langmuir-Wilhelmy Film Balance" |
| Nov 5 and Nov 12 1:30-5:20 PM | "Rheology of Complex Fluids and Soft Materials" |
| **Nov 19 and Dec 3 1:30-5:20 PM (two weeks apart)** | "SAXS Structure Analysis of Complex Fluids" |
| **Group 3** | |
| Oct 8 and Oct 15 1:30-5:20 PM | "Wicking Flow in Porous Media" |
| Oct 22 and Oct 29 1:30-5:20 PM | "Synthesis and characterization of nanoparticle dispersions" |
| Nov 5 and Nov 12 1:30-5:20 PM | "Adhesion Force Measurements using Scanning Force Microscopy" |
| **Nov 19 and Dec 3 1:30-5:20 PM (two weeks apart)** | "Colloidal Aggregation using Electrolytes" |
| **Group 4** | |
| Oct 8 and Oct 15 1:30-5:20 PM | "Synthesis and characterization of nanoparticle dispersions" |
| Oct 22 and Oct 29 1:30-5:20 PM | "Measurement of Surface Tension by Detachment or Partial Immersion Methods" |
| Nov 5 and Nov 12 1:30-5:20 PM | "Colloidal Aggregation using Electrolytes" |
| **Nov 19 and Dec 3 1:30-5:20 PM (two weeks apart)** | "Measurement of Zeta Potential by Micro-electrophoresis" |
| **Group 5** | |
| Oct 8 and Oct 15 1:30-5:20 PM | "Surface Equation of State using the Langmuir-Wilhelmy Film Balance" |
| Oct 22 and Oct 29 1:30-5:20 PM | "Wicking Flow in Porous Media" |
| Nov 5 and Nov 12 1:30-5:20 PM | "Measurement of Zeta Potential by Micro-electrophoresis" |
| **Nov 19 and Dec 3 1:30-5:20 PM (two weeks apart)** | "Adhesion Force Measurements using Scanning Force Microscopy" |

**Seattle: Option in Nanoscience and Molecular Engineering within the Bachelor of Science in Chemical Engineering degree (NME-2010-0401)**

Tri-Campus Review Comments:

NA