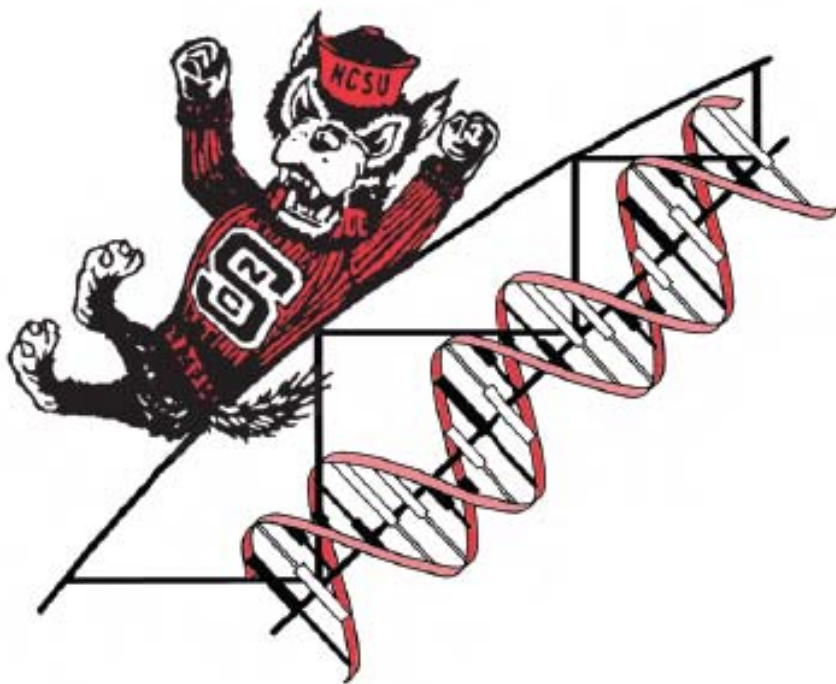


**NC STATE UNIVERSITY**

# **ADVISING HANDBOOK**

## **DEPARTMENT OF CHEMICAL AND BIOMOLECULAR ENGINEERING**

August, 2009



Dear Student:

Welcome to the Department of Chemical and Biomolecular Engineering! The Advising Handbook is intended to be your comprehensive reference for information about the Department and its undergraduate academic programs. The Handbook contains information about courses and curricula, academic policies and procedures, scholarships, the Co-operative Education Program, and student activities in the department. In addition, there is helpful information about professional development topics such as resumes, cover letters, and interviewing. To make the best use of this information, you should consult the Handbook at least once each semester prior to meeting with your academic advisor during the registration advising period. On the last page there is space for you to list your professional and personal goals while at NC State. We encourage you to take the time to reflect on your own goals and to document them – this is the first step toward reaching them!

One copy of the Handbook is provided to each student after they've been accepted as a degree candidate (matriculated) in the department. Since you'll receive only one copy of the Handbook, we recommend that you keep it with your other reference books and that you treat as the valuable resource it is. Please send any comments or suggestions for improvements to the Handbook to Dr. Lisa Bullard.

Dr. Peter S. Fedkiw  
Department Head

Dr. Lisa G. Bullard  
Director of Undergraduate Studies

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## A Survival Guide to Chemical and Biomolecular Engineering

Dr. Lisa G. Bullard  
Department of Chemical and Biomolecular Engineering  
North Carolina State University

As you prepare to take your first chemical engineering course, you may be feeling a bit smug, or perhaps a bit nervous, or both. You managed to navigate your one-person kayak through the relatively smooth waters of the freshman year, easily maneuvering around the rocks of calculus, chemistry, and physics by spending about 30-45 minutes (usually 30) on any given homework assignment and studying the night before a test, usually for an hour and a half at the most. The terrain was familiar based on your strong high school preparation. Group work was not necessary (hence your one-person kayak); you may have noticed your fellow kayakers paddling along, some falling by the wayside, but most keeping pace with the group.

Now you and some others have made your way to what looks to be a large, remote island. As you climb out and gaze at the island, you see in the distance that there are spectacular, steep cliffs. Some have beautiful waterfalls cascading down. You can see beautiful flowers and exotic plants before you. All of a sudden some natives emerge from the forest to greet you and your fellow travelers. They look a little strange and they are speaking a language that you don't understand. They hold out some sort of tools in an effort to be friendly (you hope), but you have no idea what they are or how to use them. You realize that you've developed strong paddling skills in order to get here, but you have no idea what lies ahead of you and how to reach those spectacular cliffs.

Welcome to Chemical and Biomolecular Engineering.

Taking the first course in your major – any major – is an exciting but scary step into the unknown. There's the excitement of feeling like you're FINALLY getting into your chosen field, accompanied by the nagging feeling that you're not sure what it really is or what you'll end up doing with it. After teaching the first course in Chemical Engineering – CHE 205 – several times, I've observed that the course is a big shock for many students. They spend several weeks or perhaps the whole semester discovering ways in which CHE 205 is different from courses they've taken before, and trying to figure out how to be successful. Some students quickly get “the lay of the land” and adapt their study habits to achieve success. Other students fight it kicking and screaming all semester, and either give up or barely limp through, feeling battered and betrayed at the end of the semester.

In an effort to equip and inform you from Day 1, I asked some current and former undergraduate and graduate students to share advice and observations that might help you avoid the mistakes they made when they took the course. I hope that you'll take their advice to heart, since they have successfully scaled the high cliffs and stand looking back on the journey with valuable perspective on the potential pitfalls along the way. Comments in italics come directly from students – they say it best.

- **Develop a strong work ethic.** This theme was echoed in almost every student response.

*There is no such thing as a lazy (successful) chemical engineer.*

*You do not have to be brilliant to be a CHE, but you do have to have the dedication, persistence, and downright stubbornness to keep working at it until you get it. Along the way you will doubt yourself. Those who really want it will succeed.*

*Most importantly, CHE 205 requires time, lots of time. Time spent reading the text, reviewing notes, speaking to the professor, working on the problem sets solely, working on the problem sets collectively, speaking to the TA, and going to problem session. One is also required to quickly develop a work ethic that has never been required before, because in high school they never studied and did well and freshmen year was hard but they still managed to do well with simply doing the homework and studying right before the test. This approach will not prove successful in chemical engineering.*

- **Get used to working in groups.**

*I recommend that everybody taking these classes should have a group of people that they can study with. Everyone approaches complex problems differently, so working with a team may allow someone to see an aspect of the problem that they would otherwise not consider.*

At the beginning of CHE 205, you may think you have it all under control. Don't learn the hard way that a study group is a great source for understanding CHE material. In addition, you may be the resource someone else needs to understand a topic. Working in groups has mutual benefits. Remember, the group members need and value your input as much as you need and value theirs.

*I did everything short of going to the bathroom with my group. Learning how to band together as a class, going beyond our groups to tackle the difficult homework sets became the essence of what we learned in CHE205: hard work, cooperation, and the satisfaction of a team victory.*

*Once you start working in CHE205 groups, never work on problem sets alone again. Set aside the required time during your week, every week, to do group work. Make it a high priority.*

- **...But don't rely on group work (or other resources) to carry you through.**

*My instructors always emphasized working in groups, but being able to do the problems independently. Unfortunately, I didn't fully appreciate that advice until later on. The problems never look that difficult when you see the solutions your group members or instructors develop. The solutions are usually straightforward and relatively short. However, the amount of trial and error and flipping through notes and books that it takes to develop those answers seems endless if you actually complete all the problems on your own. So when you sit down and take your first exam, you need to be able come up with these "short" answers on your own from all the information you have been taught up until that point. This can be difficult or impossible if you have relied on your group to carry you along.*

*There are many resources out there where you can get the answer to most homework problems in CHE 205. By copying those answers, you are cheating yourself of the experience to figure out how to solve that problem. Getting the correct answer to a problem is not worth risking your academic integrity or your opportunity to continue being a Chemical Engineering student.*

*If you ever feel tempted to copy or cheat, take a minute and pause. More often than not, it's because you're stressed out or pressed for time. Walk away from the books, take a breather, and really think about how much it's worth to you. I bet you will reconsider. Your professors will be much more proud of you turning an assignment in late and completed well, rather than on-time and dishonestly.*

- **Get organized.**

*Get organized and stay organized. I began each semester with everything in order and color-coded. As the semester progressed and the workload increased, before I realized what was happening, my organized notebooks and folders were in disarray. I soon learned the importance of setting aside just a few minutes one day a week to re-organize. It's much easier to maintain organization!*

*You should be able to pick up notes from classes a year ago and be able to read and understand them. You should also be able to look at a problem you worked and know what you were doing. Beginning to use calendar software during my junior year was the single most powerful self-investment I made during CHE. It made assignment deadlines easy to make, extracurricular activities easy to manage, and allowed me to do more than I ever thought possible with my time.*

- **Embrace CHE as a new community.**

*Learn to love the AIChE Lounge and to join AIChE as early as possible. There is always someone there to help you if you need help, or if you just want someone to talk with. I think that is one reason that I like being a CHE so much — we all stick together and work with each other and generally care about each other. I would recommend that students visit the lounge if they have a problem they can't solve, generally there will be someone from their class or a helpful upperclassman that has been through it and knows their pain.*

*The best friendships of my life were found in the ChE lounge.*

*CHE is more than a major, it is a lifestyle.*

*If you look around the room in your CHE 205 class, you'll see people that will become a significant part of life in the coming three years. You may not realize it now, but you will be spending a large amount of time with them. They will inevitably become your friends as you share pains and triumphs in the coming years. Take some time to get to know them. Go out to dinner together and talk about something other than CHE.*

*Making friends with my assigned group teammates in CHE205 helped me to meet people in other teams, and thus make more friends. As the problems became increasingly difficult, we all had to reach out to other teams and the TA's for help with them. By the end of CHE205, the difficulty of the homework sets began to bring the whole class together. Little did we know, but this same cycle would repeat for every CHE class we took from there forward—with less individual struggling and more teamwork at each turn. By the end of this road, we all graduated with a feeling of camaraderie and friendship that we will all cherish for a very long time.*

*Putting together a major event for the department and College of Engineering helped solidify my place in this community. It opened doors for me, and I made friends that I will keep for life. My words of advice are only two: be proactive. If you knock on doors and ask good questions, you will find good neighbors and better answers. Don't wait for someone else to make the change you want to see.*

*Those who journeyed with me through CHE will be the people that I can call on in the future—they are my friends for life.*

- **Recognize that you have to train your brain to think differently.**

*Many students think the way to do well is to understand a little bit or memorize. In CHE, memorizing stuff is not important, but the way you THINK is. This retraining the brain to think like an engineer is trivial for some people, not hard for others, and nearly impossible for others that just don't understand how to apply concepts.*

*If something isn't clicking for you, let another show you how to make it click. Sit down with someone who is "getting it," and have them explain to you how they tackle a problem. Don't try to understand the details or the calculations. Just focus on the way they visualize the big picture, break it down, and then build it up again. Soon, analysis and synthesis will become your natural ways of solving problems, too—and you will be headed in the right direction.*

- **Get used to the idea that you will never see multiple choice tests again.**

*Studying tips [From a former TA]:*

- *Make a 'per exam' cheat sheet (cheat sheet for Exam 1, then 2, then 3) and figure out what you think will be most fruitful to put onto your "torpedo." Do not make the torpedo so confusing you cannot use it.*
- *Practice. In ALL of your further CHE courses, practice in doing various types of problems is the key to doing well. You will encounter problems in tests that make you go to the next level and expand on what you already know.*
- *Make your review problems that you do logical, neat and organized so you can always follow through what you did as a "summary" of the problem. You may get lucky and do a practice problem that the professor uses as an exam problem – it's been known to happen!*
- *Do not get into the habit of plugging and chugging. It will not serve you well. Understand what is going on, make a reasonable analysis of the problem, and try to figure out what you should be getting. Doing this through the review problems will make them sink in and you will then remember what to do on the final.*
- *Memorizing and solving calculations is work for a computer. Understanding the significance of the calculations, and then organizing a way to solve them, is work for an engineer.*

*You have to invest the time before the test to know exactly how to find what you need in the book, and where it is. Putting tabs in your book might look geeky, but it will save you time in looking up commonly used tables and equations. And actually reading the book just might help, too.*

- **Chemical engineering is not chemistry.**

*Engineering is different from purely scientific fields. Where chemists and physicists seek new scientific principles without bound, engineers realize and accept limitations and concentrate on what is practical. Upcoming students should be ready to be trained in this way of solving problems. An engineering education seems to be more of a way of looking at the world and putting it to use than looking at the world and trying to explain it.*

*Chemistry is a cornerstone of a chemical engineer's toolbox, and will be important knowledge for your future career. By the time that you graduate, however, you will realize that it is just one tool among many; physics, mathematics, economics, creativity, problem solving...*

*The Chemist creates or discovers new chemistries, and the Chemical Engineer finds a way to use them for mankind's gain.*

- **You can't get away with procrastination.**

*I think that time management is the biggest thing that a student must learn when coming into the CHE curriculum. In other classes, it is often easy to wait until the last day to do an assignment, and still end up with a good grade. In CHE, it is a necessity to start the work early. There are too many concepts that will escape your grasp if you don't start early because the problems take a large amount of time, and you will never finish them in one sitting. Scheduling time to ask questions (with a teacher or TA) is also a must. It is inevitable that there will be a time when you get stuck on a problem, and none of your classmates are able to figure it out either. Basically, I believe it is impossible to procrastinate and be successful in the CHE curriculum.*

*Get together with two or three other people far in advance of the homework due date, and work single problems as a team. Never divide up the work. No, it is not the most efficient way to complete the assignment. But, working together on a problem is more fun. You also get "stuck" less often, and almost undoubtedly will understand all of the material upon finishing the homework. In the end, paying it forward will be worth the time you save in reworking wrong problems and cramming for tests. You will soon see: the best students are the ones who figure out that CHE is all about "down payments." They are also the cheeriest in your morning classes, and happiest at the end of tests.*

*Teach each other, together, and I promise you it will pay dividends.*

- **Follow instructions.**

*The syllabus will probably say something like: "Use green engineering paper (available in the Student Supply Store), one side of each page; begin each problem on a new page, and box the final answers. Each completed assignment should be in one person's handwriting. Staple the pages and fold them vertically when you hand them in, putting the names and roles of the participating group members and the problem set number and date on the outside." Follow these instructions – to the letter. You can believe that the TA's will take off points for not stapling, writing on the back, etc. You may think these things are silly but if that's what the prof asks for, do it. One day your client will ask for something just so – and that's what they expect, too.*

*If the homework is due at the beginning of class, then it had better be there. Set two alarms, get your roommate to wake you up, whatever, but don't be late or the rest of your group will hate you forever (deservedly). If in doubt, put it under the instructor's door the night before (or at 3AM when you finish it).*

*Writing legibly is a must. You can't get partial credit if no one can decipher your scribbles.*

- **Ask for help.**

*Get help when you need it. If you are unsure or completely lost, get help from other students in the class, the TA or the professor. Engineering classes are built upon information from your previous classes and previous lectures. If you get lost at one point, it is likely that you will be lost for the rest of the class and possibly longer. Don't make it harder on yourself; there is no shame in getting help. Don't be embarrassed to go to the Engineering Tutorial Center and get a personal or group tutor – that's why they are there!*

*Get to know your professors by going to see them during office hours. Having the professors get to know you early on at the start of the ChE curriculum can support you and encourage you to try things like research or internships that perhaps you wouldn't be aware of. It's also helpful when it comes time to ask for a recommendation letter.*

- **Choose a major for the right reasons.**

*[From a former CHE 205 TA]: There was one commonality with the students who REALLY struggled in the class. During an informal talk with some of these students, I asked them why they chose chemical engineering. And all of them (these are the ones who get D's and F's in CHE 205) told me that they chose chemical engineering because of the money or job opportunities. In contrast to that, the ones who did well tended to respond that they chose chemical engineering because they liked math and science. The students who were really struggling hated every moment of the science, math and engineering courses.*

- **Become comfortable making assumptions.**

*Now I have learned to list all the assumptions I am making when solving a problem. It is difficult to learn when you can make certain assumptions and when you can't. Making an assumption when describing a system might make my life easier while solving the problem, but it might not provide an accurate enough picture for the process, depending on the accuracy required. The more problems I work through, the more I know when it is okay to simplify a component/idea to get a solution.*

*In all the other classes I'd had, there were definite right and wrong answers to a given question; however, in CHE, there may be a number of different ways to arrive at an answer that might be considered correct. This took some getting used to.*

- **Don't be devastated if you aren't at the top of the class.**

*The majority of people in CHE were at the top of the class at some point during their academic career. Whether it was high school or freshmen courses, chances are you were too. You are now among the best, the competition is a little tougher, and the course material is going to be more difficult. You may not be at the top of the class, but always put forth your best effort. You may not always be satisfied with the result, but you'll know you did everything you could do.*

*School and grades had been one of the most important things to me in my life up to this point, perhaps, sadly, the most important thing to me. (I say sadly because many parts of life are more important than grades, which are, after all, subjective and superficial. I now believe my spiritual state, my relationships with other people, actually learning, which is different from making good grades, and my health are more important).*

*I finished my freshman year with a 4.0 GPA. I had thoughts creeping in telling me that I may be the smartest person in the world. Then I took CHE 205. I spent a LOT of time on the homework, and I made a ~70 on the first test. Since I thought I may be the smartest person in the world, I had figured my grades in my major should be even better than what I had been making. This idea was supported by the fact that I did not think I had tried really hard to do well before, even in the classes that I did do well. Actually, I was somewhat of a slacker and a procrastinator. I began to realize that I had this attitude: I had to achieve perfection in order to have joy. I thought such a frame of mind was necessary to keep me motivated and doing well. Instead, not being content with anything less than perfection almost destroyed me. Having successfully completed the curriculum and obtained my degree, I now encourage you to study CHE for the sake of learning, not for the sake of being the best.*

- **Keep your eye on the goal.**

*Listening to people talk about "real" chemical engineering and learning more about different industries and the application of chemical engineering principles can be quite helpful. Because chemical engineers go into such a broad array of fields, I think that it is all the more important that students begin considering where they might like to go early on by learning about what's out there (through attending lectures, conversations with professors/advisors, etc). When I was a junior in college, I felt a certain sense of shame because I could not name 10 chemical engineering-related companies, when in fact there are hundreds of companies which hire ChemE's.*

[From an alumnus]: *Encourage the students to view the course as representative of things that real chemical engineers do. Because of this, the hard work is very worthwhile, far beyond the value of getting a good grade. Some graduates (like those who go to medical school) will not use the material very much, but for many others it will be the very core of the value they present to their future employers. Particularly for people in process engineering, in research and development, or for others in the process industries, they will return to the content of this course over and over again. My group essentially applies all the classical chemical engineering approach using the latest advances, but all our work has CHE 205 as a foundation. We use these ideas continuously to the point of them being second nature to us*

[From an alumnus]: *Embrace ChE with all its good and bad. We all love the title and the smugness we get from telling people "I'm an engineer, a CHEMICAL engineer." Kind of like "Bond, James Bond..." I feel good about it because I survived it, because I sacrificed to get it, and because I wanted it more than anything else - other than my family.*

*This is my philosophy of, reflection on, and motivation for problem solving, which I believe to be the most valuable thing I learned as a CHE:*

- *First, embrace the idea that there are always multiple ways to solve any problem.*
- *Then, recognize the difference between easy problems and hard ones. Easy problems have one solution, and it's straightforward. Hard problems have more than one solution, and no one has found any of them yet.*
- *Now, reflect on how many hard problems you have solved in your life.*
- *Get excited about the hard problems out there—they're waiting for you.*

At this point, you may be thinking one of two things: (1) "This isn't so bad, I think I can probably handle it if I just discipline myself to follow some of these common sense tips;" or (2) "Why would anyone want to survive such a hellish major...and where do I submit my drop form?" If you're inclined to (2), let me offer some words of advice before you run screaming to Registration and Records.

First, chemical engineering is an exciting career field and is worth investing your time and effort. You will be able to work in a number of different industries including pharmaceuticals, petrochemicals, electronic materials, paper, textiles, consumer products, and more. You will have the skills to perform many different job functions, including research and development, process engineering, project management, sales, marketing, environmental assessment, quality assurance, technical support, information technology, and management.

Many companies specifically target chemical engineers as new hires because they have found them to have a broad skill set and a strong work ethic. Chemical engineers traditionally have the highest starting salaries of all engineering disciplines, and the job market is always more stable for them than for most other branches of engineering. This is no coincidence—employers assign high value to a chemical

engineering degree. It's also no coincidence, therefore, that the curriculum is extremely challenging, and your strong work ethic and broad skill set will take much investment on your part.

Second, others no smarter than you—and many not as smart—have trod this path before and lived to tell about it. Chemical Engineering alumni frequently cite the importance of problem-solving and teamwork skills that were developed during the chemical engineering curriculum and in CHE 205 in particular.<sup>[1]</sup> And all those horror stories about 50% of the class getting F's are not true – just look at recent grade distributions. In my Fall 2002 section of CHE 205, 70% of the class – those who stuck it out – got A's or B's.

Lastly, if you think you're the only one with doubts, think again. The quotation that follows is from an article about the "Impostor Phenomenon," which is like a tape that people play inside their heads.

*If you're an engineering student looking around at your classmates, the tape goes something like this: "These people are good—they understand all this stuff. They really belong here...but I don't. Over the years I've somehow managed to fool them all—my family, my friends, my teachers. They all think I'm smart enough to be here, but I know better...and the very next hard test or hard question I get in class will finally reveal me as the impostor I am." And what would happen next is too horrible to contemplate, so at that point you just rewind and replay the tape. What you don't know is that almost everyone else in the class is playing the same tape, and the student in the front row with the straight A average is playing it louder than anyone else. Furthermore, the tape is usually wrong. If you survived your first year of engineering school, you almost certainly have what it takes to be an engineer. Just remember all your predecessors who had the same self-doubts you have now and did just fine. You do belong here, and you'll get through it just like they did. Try to relax and enjoy the trip.*

So anchor your kayak, strap on your backpack, and let's begin. Contrary to rumors you might hear, the natives are not hostile, and some of your fellow travelers actually look somewhat friendly. There may be some spine-tingling adventures ahead, some precarious positions to get through, and a few death-defying moments, but I assure you that the view from the heights is worth the climb.

## **Acknowledgments**

I appreciate the input and feedback from current and former NCSU undergraduate and graduate students and faculty.

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[1] R.M. Felder, "The Alumni Speak," *Chem. Engr. Education*, 34(3), 238–239 (2000).  
<http://www.ncsu.edu/felder-public/Columns/alumni.html>

## WHO TO SEE FOR:

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### Advisor:

CHU's, Honors Program, BS/MS CHE  
CHE Double Majors, CHE Minor

Dr. Lisa Bullard  
EB1 2012, 515-7455  
lisa\_bullard@ncsu.edu

Biomolecular concentration

Dr. Robert Kelly  
Partners 2, Suite 3313, 515-6396  
rmkelly@eos.ncsu.edu

Biomanufacturing Sciences concentration

Dr. Henry Lamb  
EB1 1056, 515-6395  
lamb@eos.ncsu.edu

Nanoscience concentration

Dr. Greg Parsons  
EB1 2032, 515-7553  
gnp@eos.ncsu.edu

Green Chemistry and Engineering concentration

Dr. Steven Peretti  
EB1 2042, 515-6397  
peretti@eos.ncsu.edu

Undergraduate Secretary

Ms. Gwen Johnson  
EB1 2007, 515-4251  
gwen@eos.ncsu.edu

Graduate Secretary

Ms. Sandra Bailey  
EB1 2007, 515-6367  
sbailey@unity.ncsu.edu

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**Blue Cards** (Graduation Check-Out)

Turn in to Dr. Bullard

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### Change from credit to audit, to credit only (pass/fail), or drop a course:

a. before 2-week deadline

use MyPack portal

b. after first six weeks

Dr. Bullard

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**Cooperative Education (Co-op)**

Cooperative Education Office  
Clark Hall, 515-4424

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### Curriculum change within College of Engineering:

Obtain Request for Permanent Change in Degree form from:

Mrs. Mazie Lewis  
118 Page Hall, 515-2315

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## WHO TO SEE FOR:

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### Fundamentals of Engineering (FE) Exam (Seniors):

a. date, place, requirements

NC State Board of  
Registration for PE and  
Land Surveyors  
781-9499 or 781-9547  
<http://www.ncbels.org/>

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**Independent Study (correspondence courses), non-degree programs, evening programs**

Lifelong Education  
McKimmon Center,  
515-2261

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**Inter-institutional forms for the Cooperative Raleigh College (CRC) signature:**

Mr. Gary Weinberg  
120 Page, 515-2342

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### Jobs: Summer and/or part-time:

a. work/study on campus

Financial Aid  
2005 Harris, 515-2421

b. off campus

University Career Center  
2100 Pullen Hall, 515-2396

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**Masters in CHE:**

Dr. Saad Khan

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**Senior Re-examination:**

Dr. Bullard

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### Scholarship information

a. College of Engineering  
Scholarship eligibility forms due March 1 of each year  
<http://www.engr.ncsu.edu/students/eligibility/eligibilityForm.php>

Ms. Kay Leager  
120 Page Hall, 515-9645

b. Department of Chemical and Biomolecular Engineering

Dr. Bullard

**WHO TO SEE FOR:**

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**Transfer out of College of Engineering:**

Dean's Office in the college you want to transfer to.

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**Transfer credit for courses completed at other institutions:  
(prior approval by Dr. Bullard required)**

Mr. Gary Weinberg  
120 Page, 515-2342

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**Withdrawal from NCSU (drop all courses)**

Counseling Center  
2000 Harris Hall, 515-2423

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**CHEMICAL AND BIOMOLECULAR ENGINEERING  
FACULTY AND UNDERGRADUATE STAFF**

**Dr. Lisa G. Bullard**, Teaching Associate Professor and Director of Undergraduate Programs (515-7455); Ph.D., Chemical Engineering, Carnegie Mellon University (1991); [lisa\_bullard@ncsu.edu] EB1 2012.

**Dr. Ruben G. Carbonell**, KoSa Professor; Chemical Engineering Director, William R. Kenan, Jr., Institute for Engineering, Technology & Science; Co-Director, NSF Science and Technology Center for Environmentally Responsible Solvents and Processes; Director of the Kenan Center for the Utilization of CO<sub>2</sub> in Manufacturing (515-5118 or 513-0050); Ph.D., Chemical Engineering, Princeton University (1973); Biochemical engineering; molecular recognition; bioseparations; immunodiagnostics; colloid and interface science; transport phenomena, compressed fluid processes. [ruben@ncsu.edu] Partner's Building 1, Centennial Campus, Suite 3200/EB1 2038.

**Dr. Joe DeSimone**, William R. Kenan, Jr. Distinguished Professor of Chemistry; Chemical Engineering Director, NSF Science and Technology Center for Environmentally Responsible Solvents and Processes; Co-Director of the Kenan Center for the Utilization of CO<sub>2</sub> in Manufacturing. (962-5468); Ph.D., Virginia Polytechnic and State University (1990); polymer synthesis in supercritical fluids; surfactant design for applications in interfacial chemistry. [desimone@unc.edu].

**Dr. Michael Dickey**, Assistant Professor (513-2917); Ph.D., Chemical Engineering, University of Texas at Austin (2006). Alternative micro- and nano-fabrication, Microfluidics, Electronic materials, and Photo-curable materials for nanotechnology [mdickey@ncsu.edu]. EB1 2088G.

**Dr. Peter S. Fedkiw**, Department Head and Professor (515-3572); Ph.D., Chemical Engineering, University of California, Berkeley (1978); Electrochemical reaction engineering; Electrocatalysis; Environmental applications of electrochemistry. [fedkiw@eos.ncsu.edu] EB1 2006.

**Dr. Richard M. Felder**, Celanese Emeritus Professor (515-2327); Ph.D., Chemical Engineering, Princeton (1966); Learning and teaching styles in engineering education. [rmfelder@mindspring.com] EB1 2088D.

**Dr. Michael C. Flickinger**, Professor (515-2000); Ph.D., Pharmaceutical Biochemistry, University of Wisconsin, Madison (1977), Post Doctoral, Chemical Engineering, Purdue University; Bioprocess and cell culture engineering, biocatalytic coatings, bioprocess intensification and miniaturization, bioseparation media, bionanotechnology. [Michael\_Flickinger@ncsu.edu] BTEC

**Dr. Jan Genzer**, Celanese Professor (515-2069); Ph.D., Materials Science and Engineering, University of Pennsylvania (1996); polymer characteristics at surfaces and interfaces. [jgenzer@unity.ncsu.edu] EB1 2088H.

**Dr. Christine S. Grant**, Professor (515-2317); Ph.D., Chemical Engineering, Georgia Institute of Technology (1989); Surface and interfacial science, mass transfer, environmental engineering. [grant@eos.ncsu.edu] EB1 2088B.

**Dr. Keith E. Gubbins**, H. Clark Distinguished University Professor (513-2262); Ph.D., Chemical Engineering, London University (1962); Molecular simulation and statistical mechanics applied to chemical engineering problems, phase equilibria and surface property prediction. [keg@ncsu.edu] EB1 2088A.

**Dr. Carol K. Hall**, Alcoa Professor and Camille Dreyfus Distinguished University Professor (515-3571); Ph.D., Physics, S.U.N.Y. Stony Brook (1972); Molecular thermodynamics and computer simulation, equations of state, polymer modeling, bioseparations, protein folding. [hall@turbo.che.ncsu.edu] EB1 2024.

**Dr. Jason M. Haugh**, Associate Professor (513-3851); Ph. D. Chemical Engineering, MIT (1999); Biomedical and biochemical engineering; signal transduction networks; mammalian cell engineering. [jason\_haugh@ncsu.edu] EB1 2026.

**Dr. Wesley A. Henderson**, Assistant Professor (513-2917); Ph.D., Materials Science & Engineering, University of Minnesota (2002); Ionic liquids; Electrolytes for energy technologies (batteries, fuel cells, electrochemical capacitors); Biomass processing for biofuels. [whender@ncsu.edu] EB1 2088-F.

**Dr. Harold B. Hopfenberg**, Camille Dreyfus Emeritus Professor (515-2318); PhD, Chemical Engineering, MIT (1965); Membrane separations and the study of aging phenomena in organic glasses, controlled drug delivery systems for human and veterinary medicine, and barrier plastics for specialty packaging of anhydrobiotic organisms. [hbg@ncsu.edu] EB1 1060.

**Dr. Robert M. Kelly**, Alcoa Professor (515-6396); PhD., Chemical Engineering, North Carolina State University (1981); Biochemical engineering, biocatalysis at extremely high temperatures, microbial physiology, enzyme engineering. [rmkelly@eos.ncsu.edu] Partners 2, Centennial Campus, Suite 3313/EB1 2014.

**Dr. Saad A. Khan**, Alcoa Professor and Director of Graduate Programs (515-4519); Ph.D., Chemical Engineering, MIT (1985); Polymer Science; Rheology of Complex Fluids; Sol-Gel Rheology. [khan@eos.ncsu.edu] EB1 2034.

**Dr. H. Henry Lamb**, Professor (515-6395); Ph.D., Chemical Engineering, University of Delaware (1988); Catalysis, surface organometallic chemistry, electronic materials processing, surface science. [lamb@eos.ncsu.edu] EB1 1056.

**Dr. P. K. Lim**, Professor (515-2328); Ph.D., Chemical Engineering, University of Illinois (1979); Interfacial phenomena, homogeneous catalysis, free radical chemistry. [lim@eos.ncsu.edu] EB1 2040.

**Dr. David F. Ollis**, Distinguished Professor (515-2329); Ph.D. Chemical Engineering, Stanford (1969); Biochemical Engineering, Photochemical Engineering. [ollis@eos.ncsu.edu] EB1 2016.

**Dr. Gregory N. Parsons**, Alcoa Professor (515-7553); Ph.D., Physics, North Carolina State University (1990); Surface reactions and chemical processes in electronic materials synthesis; Bonding structure and electronic properties of inorganic semiconductors and insulators; Physics of thin film devices. [gnp@eos.ncsu.edu] EB1 2032.

**Dr. Steven W. Peretti**, Associate Professor (515-6397); Ph.D., Chemical Engineering, California Institute of Technology; Metabolic Characterization and Manipulation. [peretti@eos.ncsu.edu] EB1 2042.

**Dr. Balaji Rao**, Assistant Professor; (513-0129); Ph.D., Chemical Engineering, MIT (2004); Molecular and cell bioengineering; molecular control of cellular processes; stem cell bioengineering. [bmrao@ncsu.edu] EB1 2088C.

**Dr. George W. Roberts**, Emeritus Professor (515-7328); Sc.D., Chemical Engineering, MIT (1965); Chemical reaction engineering, applied catalysis, chemical reactor analysis and design, pollution prevention and control, alternate fuels. [groberts@eos.ncsu.edu] EB1 2100C.

**Dr. Richard J. Spontak**, Professor (515-4200); Ph.D., Chemical Engineering, University of California, Berkeley (1988); Morphological Design and Characterization of Microstructured Polymer Systems; Polymer Physics; Polymer Thermodynamics. [Rich\_Spontak@ncsu.edu] EB1 2088E.

**Dr. Orlin D. Velev**, INVISTA Professor (513-4318); Ph.D., Physical Chemistry, Sofia University, Bulgaria (1996); Colloidal science and engineering, colloidal interactions, self-assembly and crystallization; assembly of nano- and microstructures with photonic, optical and electrical functionality; protein interactions and phase equilibria, biosensors. [odvelev@unity.ncsu.edu] EB1 2030.

**Dr. Phillip R. Westmoreland**, Professor and Executive Director, NCSU Institute for Computational Science and Engineering (515-7121); Ph.D., Chemical Engineering, Massachusetts Institute of Technology (1986); Energy and the environment, biofuels, chemical kinetics, computational chemistry, molecular-beam mass spectrometry. [phil.westmoreland@ncsu.edu] EB1 2036.

## **CHEMICAL AND BIOMOLECULAR ENGINEERING STAFF**

**Ms. Sandra Bailey**, Administrative Support Specialist, Graduate Students (515-6367), [sbailey@unity.ncsu.edu], EB1 2007

**Ms. Saundra Doby**, Administrative Support Specialist (515-3999), [sdoby@unity.ncsu.edu], EB1 2001

**Ms. Angela Efimenko**, [aefimen@ncsu.edu], EB1 2011

**Ms. Diane Harper**, Administrative Support Associate (515-6394), [dharper@unity.ncsu.edu], EB1 2003

**Ms. Sheila Hayes**, Environmental Health and Safety Technician (515-3615), [smhayes@unity.ncsu.edu], EB1 2005

**Ms. Gwen Johnson**, Administrative Support Associate, Undergraduates (515-4251), [gwen@eos.ncsu.edu], EB1 2007

**Ms. Shirley Kow**, Technology Support Specialist (515-2425), [skow@eos.ncsu.edu], EB1 1058

**Deborah McGuinn**, Research Technician (515-7054), [deborah\_mcginn@ncsu.edu], EB1

**Ms. June McKoy**, University Program Associate (513-7763), [june\_mckoy@ncsu.edu], EB1 2009

**Ms. Rajani Verghese**, Business Officer (515-6391), [rcverghe@unity.ncsu.edu], EB1 2008.

**Ms. Clarice Whitmarsh**, Accounting Technician (513-2177), [cawhitma@ncsu.edu], EB1 2005

**Mr. Kit Yeung**, Specialty Trades Technician (515-7005), [kyeung@eos.ncsu.edu], EB1 B014

**Ms. Letha Young**, Executive Assistant BTEC (513-8234), [layoung2@ncsu.edu], Research II Suite 200

**CHEMICAL AND BIOMOLECULAR ENGINEERING COURSES** - A brief description of selected CHE courses follows, along with the course prerequisites and scheduling information. Students should note that all prerequisites in Chemical Engineering are strictly enforced. It is the student's responsibility to check prerequisites and see the instructor or Dr. Bullard if there is a question about prerequisites.

**Failure to complete prerequisites prior to enrolling in a CHE course may result in the student's administrative disenrollment from the CHE course after the deadline to enroll in other courses has passed.**

**CHE 205** Chemical Process Principles. Preqs: Grade of C- or better in MA 241, PY 205, CH 201. 4(3-2) F,S. Engineering methods of treating material balances, stoichiometry, phase equilibrium calculations, thermophysics, thermochemistry and the first law of thermodynamics.

**CHE 225** Chemical Process Systems. Preqs: C- or better in both CHE 205 and MA 242. Coreq: MA 341. 3(3-0) S,Sum. Introduction to mathematical and computational tools for analyzing chemical engineering problems. Sequential modular and equation-based simulation of steady-state chemical processes using advanced spreadsheet methods and multivariate root-finding algorithms. Material and energy balances on transient processes and their solution using analytical and numerical methods. Introduction to microscopic material and energy balances using the "shell balance" approach to develop the governing differential equations. Solutions to steady-state boundary value problems in heat conduction and Fickian diffusion.

**CHE 311** Transport Processes I. Preqs: C- or better in both CHE 225 and MA 341. 3(3-0) F,S. Fundamental aspects of momentum and heat transfer, and the use of these fundamentals in solving problems in transport operations.

**CHE 312** Transport Processes II. Preq: C- or better in CHE 311. 3(3-0) F,S. Fundamental aspects of mass transfer and the use of these basic principles in solving problems in transport operations.

**CHE 315** Chemical Process Thermodynamics. Preq: C- or better in CHE 225. 3(3-0) F,S. Laws of thermodynamics and their application to chemical engineering problems, both in theory and in practice. Criteria of equilibrium in physical and chemical changes. Behavior of real fluids, including mixtures.

**CHE 316** Thermodynamics of Chemical and Phase Equilibria. Preq: C- or better in CHE 315. 3(3-0) F,S. Systematic study of chemical reaction equilibria and phase equilibrium. Use of fugacity, activity and chemical potential concepts for predicting the effect of such variables as temperature, pressure on equilibrium compositions. Methods for measuring and estimating thermodynamic properties important to equilibrium calculation in real systems.

**CHE 330** Chemical Engineering Lab I. Preq: CHE 311, 3(1-4) F,S, Sum. Laboratory experiments in unit operations of heat transfer and fluid flow. Laboratory safety, technical report writing, statistics, experimental design, error analysis, and instrumentation.

**CHE 331** Chemical Engineering Lab II. Preqs: CHE 312, CHE 330. 2(0-4) F,S, Sum. Laboratory experiments in mass transfer and reaction kinetics. Experimental planning, technical report writing and oral presentations are emphasized.

**CHE 395** Professional Development Seminar. 1(1,0) F, S. Professional development and topics of current interest in chemical engineering.

**CHE 435** Process System Analysis and Control. Preq: CHE 312. 3(3-0) F,S. Dynamic analysis and continuous control of chemical engineering processes. Process modeling; stability analysis, design and selection of control schemes. Solution of differential equations using Laplace transform techniques.

**CHE 446** Design and Analysis of Chemical Reactors. Preq: CHE 316. 3(3-0) F. Characterization and measurement of the rates of homogeneous and heterogeneous reactions. Design and analysis of chemical reactors.

**CHE 450** Chemical Engineering Design I. Preq: CHE 312. 3(3-0) F. Applications of cost accounting, cost estimation for new equipment, manufacturing cost and measures of profitability. Use of computer simulation design and cost programs. Procedures for sizing unit operations commonly encountered in the chemical process industry. Heuristics for selection of separation processes and heat exchanger network synthesis.

**CHE 451** Chemical Engineering Design II. Preqs: CHE 450, CHE 446. 3(2-2) S. Chemical process design and optimization. The interplay of economic and technical factors in process development, site selection, project design, and production management. Comprehensive design problems.

**CHE 455** Polymer Technology and Engineering. Prereq: MSE 425. 3(3-0) F Covers classes of commercially important polymers, advanced topics in the phase behavior, viscoelasticity, fracture, and ultimate properties of polymers; polymer rheology, processing, and permeability; and the design of polymeric materials.

**CHE 460** Chemical Processing of Electronic Materials. Preqs: CHE 312, CHE 446. **Credit for both CHE 460 and CHE 560 is not allowed.** 3(3-0) S. Plasma and thermal inorganic chemical processes in semiconductor device fabrication. Thin films and electronic devices. Kinetics and chemical transport in electronic materials synthesis, modification and etching. Plasma physics and chemistry, reactors and process diagnostics.

**CHE 461** Polymer Science and Technology. Preqs: CH 223, CHE 316. **Credit for both CHE 461 and CHE 543 is not allowed.** 3(3-0) F(Alternate years). Concepts and techniques for polymerization of macromolecules. Structure, properties, and applications of commercially important polymers.

**CHE 462** Colloidal and Nanoscale Engineering. 3(3-0), S (alternate years). The first part of this course will present the fundamentals of nanoscale colloidal processes, including interactions and self-assembly of particles, surfactants and biomolecules. The applications of these fundamentals to the nanotechnology and engineering on the nanoscale will be discussed. Nanoscience has led to the development of many new technologies with relevance to chemical engineering, including microfluidics, lab-on-a-chip, bioarrays and bioassays. These emerging technologies will be presented and discussed in the second half of this course.

**CHE 463 (BEC 463)** Fermentation of Recombinant Microorganisms Preq: BIT 410 or BIT 810 or MB 409 or BCH 454. 2(2-5-0) F,S. Introduction to fermentation and protein chemistry. Theory behind laboratory techniques and overview of industrial scale expression systems. Laboratory sessions involve use of microbial expression vectors, fermentation systems, and large-scale purification of recombinant protein. Half semester course, first part.

**CHE 464 (BIT 464)** Protein Purification. Preq: BIT 410 or MB 409 or BCH 454, 2(2-5-0) S, Alt. Yrs. (even). Comparison of several different chromatography techniques for protein purification. Construction of purification tables and SDS-and native-PAGE analysis. Cost-benefit analysis of industrial-scale procedures. Half semester course, second part.

**CHE 467** Polymer Rheology. Preq: CHE 311 or equivalent. **Credit for both CHE 467 and CHE 567 is not allowed.** 3(3-0) S(Alternate years). Theoretical principles and experimental techniques associated with flow and deformation of polymer systems. Systems include: meffs and solutions, suspension, gels, emulsions, and thixotropic mixtures.

**CHE 469** Polymers, Surfactants, and Colloidal Materials. Preqs: CH 223, CHE 316. **Credit for both CHE 469 and CHE 769 is not allowed.** 3(3-0) S(Alternate years). Relationships between molecular structure and bulk properties of nonmetallic materials applied to commercial products and chemical engineering processes. Applications of surface and colloidal chemistry and polymer science to product development and process improvement.

**CHE 475** Advances in Pollution Prevention: Environmental Management for the Future. Preqs: MA 341, PY 208. **Credit for both CHE 475 and CHE 575 is not allowed.** 3(3-0) S. Design of industrial processes which minimize or eliminate wastes. Regulations and the corporate organization of current pollution prevention efforts. Current pollution prevention research. Product life cycle analysis and the application to design of more efficient processes.

**CHE 476** Life Cycle and Sustainability Concepts for the Environment. Preq: Junior standing. 3(3-0) F. Students in this course will learn the principles and constraints of the emerging life cycle field applied to manufacturing and environmental issues. The goal is to provide a basic understanding, an exposure to the current state-of-the-art, and experience in life cycle development. The content and participation in this course should provide the student with new and versatile principles for the management of manufacturing, environment, and the supply chain. The applications to and principle of sustainability will also be taught.

**CHE 495** Honors Thesis Preparation. Preq: CHE 497 and senior level standing. 1(1-0). Development and presentation of Honors Thesis in Chemical Engineering and discussion of graduate school selection and preparation.

**CHE 497** Chemical Engineering Projects I. Preq: Senior standing. 3(0-12) F,S,Sum. Introduction to chemical engineering research through experimental, theoretical and literature studies. Oral and written presentation of reports. Requires 150 hours of work and a final written report. Students should contact faculty directly regarding project availability.

**CHE 498** Chemical Engineering Projects II. Preq: Senior standing. (1-3) Variable Credit. F,S,Sum. Projects in research, design or development in various areas of chemical engineering. Requires 50 hours of work per credit hour and a final written report. Students should contact faculty directly regarding project availability.

**CHE 525** Process System Analysis and Control. Preq: CHE 312. **Credit for both CHE 435 and CHE 525 is not allowed.** 3(3-0) S. Dynamic analysis and continuous control of chemical engineering processes. Process modeling; stability analysis, design and selection of control schemes. Solution of differential equations using Laplace transform techniques.

**CHE 543** Polymer Science and Technology. Preqs: CH 223, CHE 316. **Credit for both CHE 461 and CHE 543 is not allowed.** 3(3-0) F. Concepts and techniques for polymerization of macromolecules. Structure, properties, and applications of commercially important polymers.

**CHE 546** Design and Analysis of Chemical Reactors. Preq: CHE 316. **Credit for both CHE 446 and CHE 546 is not allowed.** 3(3-0) F. Characterization and measurement of rates of homogeneous and heterogeneous reactions. Design and analysis of chemical reactors.

**CHE 551** Biochemical Engineering. Preqs: CHE 312, 446. 3(3-0) S. Enzyme and microbial kinetics and reactor design for processes involving enzymes and single and mixed cultures. Samples drawn from full range of applications: food processing, single cell proteins, tissue culture and vaccines, monoclonal antibodies, recombinant DNA and hybridomas, artificial organs, biological waste treatment and environmental processes.

**CHE 560** Chemical Processing of Electronic Materials. Preqs: CHE 312, CHE 446. **Credit for both CHE 460 and CHE 560 is not allowed.** 3(3-0) S. Plasma and thermal inorganic chemical processes in semiconductor device fabrication. Thin films and electronic devices. Kinetics and chemical transport in electronic materials synthesis, modification and etching. Plasma physics and chemistry, reactors and process diagnostics.

**CHE 711** Chemical Engineering Process Modeling (CHE Honors Program Students Only) Preqs: CHE 311H, CHE 312H, MA 341. 3(3-0) F. Applications of methods of mathematical analysis to formulation and solution of problems in transport phenomena, process dynamics and chemical reaction engineering.

**CHE 713** Thermodynamics I (CHE Honors Program Students Only) Preqs: CHE 315, CHE 316. 3(3-0) F. In-depth coverage of chemical engineering thermodynamics principles. Application of non-ideal fluid-phase chemical potentials to problems in phase and chemical reaction equilibria. Relations of molecular structure and intermolecular forces to macroscopic thermodynamic properties.

**CHE 715** Transport Phenomena (CHE Honors Program Students Only) Preq: Che 311. 3(3-0) F. A theoretical, unified study of transport of momentum, energy and matter. Introduction to diffusional operations including coupled heat and mass transfer in light of the theory.

**CHE 717** Chemical Reaction Engineering (CHE Honors Program Students Only) Preq: CHE 446/546. 3(3-0) S. Rates and mechanisms of homogeneous and heterogeneous reactions. Design, analysis and scale-up of batch and continuous chemical reactors.

**CHEMICAL ENGINEERING CURRICULA** - Students may choose one of several parallel curricula in the department: the standard chemical engineering curriculum, the Biomolecular concentration, the Biomanufacturing Sciences concentration, the Nanoscience concentration, the Green Chemistry and Engineering concentration, or the CHE Honors Program. The Biomolecular concentration is designed for students who wish to develop expertise in biochemical engineering and in the biological sciences; the Biomanufacturing Sciences concentration is designed for students who are interested in industrial applications in the pharmaceutical and biomanufacturing sector; the Nanoscience concentration is designed for students interested in technology associated with microelectronics and/or polymers manufacturing; and the Green Chemistry and Engineering concentration is designed for students interested in pollution prevention, life cycle analysis, and waste minimization.

The CHE Honors Program is open to students by invitation, based upon their CHE and overall grade point averages at the completion of CHE 225, and is designed to serve as a preparation for graduate study in chemical engineering. Candidates for admission to the CHE Honors Program must have earned a minimum over-all grade point average of 3.50, and a minimum major grade point average of 3.5 based on taking CHE 205 and CHE 225. Students must graduate with a total GPA of at least 3.25.

Upon initial matriculation into chemical engineering, students are normally enrolled in the standard CHE curriculum unless they request otherwise at the time of matriculation. Students must contact Dr. Bullard to request the change to a concentration so that their curriculum display can be modified.

## Bachelor of Science in Chemical Engineering (14CHE097Z)

<b>Fall Semester</b>	<b>Credit</b>	<b>Spring Semester</b>	<b>Credit</b>
CH 101 Chemistry, A Molecular Science <sup>1</sup>	3	CH 201 Chemistry – Quantitative Sci.	3
CH 102 General Chemistry Lab1	1	CH 202 Quantitative Chem Lab	1
E 101 Introduction to Engr & Prob Solv <sup>1</sup>	1	MA 241 Calculus II <sup>1</sup>	4
E 115 Intro to Computing Environ	1	PY 205 Physics for Engr & Sc I <sup>1</sup>	4
ENG 101 Academic Writing and Research <sup>1</sup>	4	EC 205 Econ (or EC 201 or ARE 201)*	3
MA 141 Calculus I <sup>1</sup>	4	Phys Ed/Healthy Living Elective*	<u>1</u>
PE 1** Fitness & Wellness Course*	<u>1</u>		<b>16</b>
	<b>15</b>		

<b>Fall Semester</b>	<b>Credit</b>	<b>Spring Semester</b>	<b>Credit</b>
CH 221 Organic Chemistry I	3	CH 223 Organic Chemistry II	3
CH 222 Organic Chemistry I Lab	1	CH 224 Organic Chemistry II Lab	1
CHE 205 Chemical Proc Prin	4	CHE 225 Chemical Proc Systems	3
MA 242 Calculus III	4	MA 341 Applied Differential Eq	3
GEP Requirement*	<u>3</u>	PY 208 Physics Engr & Scientists II	4
	<b>15</b>	GEP Requirement*	<u>3</u>
			<b>17</b>

<b>Fall Semester</b>	<b>Credit</b>	<b>Spring Semester</b>	<b>Credit</b>
CH 315 Quantitative Analysis	4	CH *** Chemistry Elective <sup>2</sup>	4
CHE 311 Transport Processes I	3	CHE 312 Transport Processes II	3
CHE 315 Chem Process Thermo	3	CHE 316 Thermo of Chem & Phase Eq	3
ECE 331 Prin Electrical Engr <b>OR</b>	3	CHE 330 Chem Engr Lab I	4
MSE 201 Struct & Prop Engr Mat	3	Free Elective	<u>3</u>
GEP Requirement*	3		<b>17</b>
CHE 395 Professional Dev Seminar	<u>1</u>		
	<b>17</b>		

<b>Fall Semester</b>	<b>Credit</b>	<b>Spring Semester</b>	<b>Credit</b>
CHE 331 Chem Engr Lab II	2	CHE 435 Proc System Analy & Control	3
CHE 446 Des & Analy Chem Reactors	3	CHE 451 CHE Design II	3
CHE 450 CHE Design I	3	Technical Elective <sup>3</sup>	3
Technical Elective <sup>3</sup>	3	GEP Requirement*	3
GEP Requirement*	<u>3</u>	GEP IP Requirement*	<u>2-3</u>
	<b>14</b>		<b>14-15</b>

Minimum Credit Hours Required for Graduation: **125**

### **Major/Program requirements and footnotes:**

1 Must be completed with grade of (C-) or higher for matriculation.

2 Chemistry electives include: CH 437: Physical Chemistry, CH 401/402: Inorganic Chemistry; CH/TC 461: Introduction to Fiber Forming Polymers (fall only); CH 415/416: Analytical Chemistry II; BCH 451: Biochemistry; FS 402: Food Chemistry (fall only); CH 610: Special Topics in Chemistry; CH 615: Chemical Separations (note: an additional hour of CH 499 would also be required to total 4 hours).

3 Technical Electives: BAE 422, CE 373, CE 476, CE 477, CE 479, CE 484, ECE 331, ISE 311, ISE 443, (CHE 460 and higher electives), MAE 206, MAE 208, MAE 314, MAE 406, MAE 421, MSE 201, NE 404, NE 419, TC 401, TE 466, PSE 425

### **\*General Education Program (GEP) requirements:**

To complete the requirements for graduation and the General Education Program, the following credit hours and co-requisites must be satisfied. University approved GEP course lists for each category can be found at <http://www.ncsu.edu/uap/academic-standards/> .

**PHYSICAL EDUCATION** - 2 hours to be selected from the approved GEP Physical Education list.

a. One fitness and wellness course (any PE 100-level course).

b. One additional credit hour of PE activity courses.

**HUMANITIES** - 6 credits to be selected in two different disciplines (two different course prefixes) from the approved GEP Humanities list.

**SOCIAL SCIENCES** - 3 credits to be selected in a discipline other than economics from the approved GEP Social Sciences list. EC 205 (or EC 201 or ARE 201) taken as part of the Major requirements satisfies 3 credit hours of the 6 credit hours needed to fulfill the GEP Social Sciences requirement.

**ADDITIONAL BREADTH** - 3 credits to be selected from the approved GEP Humanities, Social Sciences or Visual and Performing Arts lists.

**INTERDISCIPLINARY PERSPECTIVES** - 5 credits to be selected from the approved GEP Interdisciplinary Perspectives list.

### **Co-requisites:**

U.S. Diversity and Global Knowledge co-requisites must be satisfied to complete the General Education requirements. Choose course(s) that are identified on the approved GEP course lists as meeting the U.S. Diversity and Global Knowledge co-requisites.

Foreign Language proficiency at the FL\_102 level will be required for graduation.

**Bachelor of Science in Chemical Engineering**  
**Biomolecular Engineering Concentration (14CHE097B)**

<b>Fall Semester</b>	<b>Credit</b>	<b>Spring Semester</b>	<b>Credit</b>
CH 101 Chemistry, A Molecular Science <sup>1</sup>	3	CH 201 Chemistry – Quantitative Sci.	3
CH 102 General Chemistry Lab <sup>1</sup>	1	CH 202 Quantitative Chem Lab	1
E 101 Introduction to Engr & Prob Solv <sup>1</sup>	1	MA 241 Calculus II <sup>1</sup>	4
E 115 Intro to Computing Environ	1	PY 205 Physics for Engr & Sc I <sup>1</sup>	4
ENG 101 Academic Writing and Research <sup>1</sup>	4	EC 205 Econ (or EC 201 or ARE 201)*	3
MA 141 Calculus I <sup>1</sup>	4	PE *** Phys Ed/Healthy Living Elective*	<u>1</u>
PE 1** Fitness & Wellness Course*	<u>1</u>		<b>16</b>
	<b>15</b>		

<b>Fall Semester</b>	<b>Credit</b>	<b>Spring Semester</b>	<b>Credit</b>
CH 221 Organic Chemistry I	3	CH 223 Organic Chemistry II	3
CH 222 Organic Chemistry I Lab	1	CH 224 Organic Chemistry II Lab	1
CHE 205 Chemical Proc Prin	4	CHE 225 Chemical Proc Systems	3
MA 242 Calculus III	4	MA 341 Applied Differential Eq	3
PY 208 Physics Engr & Scientists II	<u>4</u>	BIO 183 Intro Biol: Cellular & Molecular	4
	<b>16</b>	GEP Requirement*	<u>3</u>
			<b>17</b>

<b>Fall Semester</b>	<b>Credit</b>	<b>Spring Semester</b>	<b>Credit</b>
BCH 451 Intro Biochemistry	4	BIT *** BIT Lab Modules <sup>2</sup>	4
CHE 311 Transport Processes I	3	CHE 312 Transport Processes II	3
CHE 315 Chem Process Thermo	3	CHE 316 Thermo of Chem & Phase Eq	3
BIT 410 Manipulation ReDNA (4 cr.)	4	CHE 330 Chem Engr Lab I	4
GEP Requirement*	3	Free Elective	<u>3</u>
CHE 395 Professional Dev Seminar	<u>1</u>		<b>17</b>
	<b>18</b>		

<b>Fall Semester</b>	<b>Credit</b>	<b>Spring Semester</b>	<b>Credit</b>
CHE 447 Bioreactor Engineering	3	CHE 435 Proc System Analy & Control	3
CHE 450 CHE Design I	3	CHE 451 CHE Design II	3
CHE 497 Chemical Engr Projects	3	CHE 551 Biochemical Engineering	3
GEP Requirement*	3	GEP Requirement*	3
Biotech Minor Grp E (GEP IP req*) <sup>3</sup>	<u>3</u>	GEP Requirement*	<u>2-3</u>
	<b>15</b>		<b>14-15</b>

Minimum Credit Hours Required for Graduation\*: 128

### **Major/Program requirements and footnotes:**

<sup>1</sup> Must be completed with grade of (C-) or higher for matriculation.

<sup>2</sup> Students must take two 2-hour BIT lab modules from the following list: CHE/BEC 463; BIT 462, 464,466, 467, 468, 481, and 569. In addition, selected BIT 495 Special Topics courses may be approved

<sup>3</sup> Biotech Minor Group E must be selected from: IDS 201, 303; STS 302, 304, 320; STS(PHI) 325

### • **General Education Program (GEP) requirements:**

To complete the requirements for graduation and the General Education Program, the following credit hours and co-requisites must be satisfied. University approved GEP course lists for each category can be found at <http://www.ncsu.edu/uap/academic-standards/gep/courselists/index.html>

**PHYSICAL EDUCATION** - 2 hours to be selected from the approved GEP Physical Education list.

a. One fitness and wellness course (any PE 100-level course).

b. One additional credit hour of PE activity courses.

**HUMANITIES** - 6 credits to be selected in two different disciplines (two different course prefixes) from the approved GEP Humanities list.

**SOCIAL SCIENCES** - 3 credits to be selected in a discipline other than economics from the approved GEP Social Sciences list. EC 205 (or EC 201 or ARE 201) taken as part of the Major requirements satisfies 3 credit hours of the 6 credit hours needed to fulfill the GEP Social Sciences requirement.

**ADDITIONAL BREADTH** - 3 credits to be selected from the approved GEP Humanities, Social Sciences or Visual and Performing Arts lists.

**INTERDISCIPLINARY PERSPECTIVES** - 2 credits to be selected from the approved GEP Interdisciplinary Perspectives list. Course chosen to meet the Biotech Minor Grp E requirement in the Major satisfies 3 credit hours of the 5 credit hours needed to fulfill the GEP Interdisciplinary Perspectives requirement.

### **Co-requisites:**

U.S. Diversity and Global Knowledge co-requisites must be satisfied to complete the General Education requirements. Choose course(s) that are identified on the approved GEP course lists as meeting the U.S. Diversity and Global Knowledge co-requisites.

Foreign Language proficiency at the FL\_102 level will be required for graduation.

**B. S. in Chemical Engineering**  
**Biomanufacturing Sciences Concentration (14CHE097F)**

<b>Fall Semester</b>	<b>Credit</b>	<b>Spring Semester</b>	<b>Credit</b>
CH 101 Chemistry, A Molecular Science <sup>1</sup>	3	CH 201 Chemistry – Quantitative Sci.	3
CH 102 General Chemistry Lab <sup>1</sup>	1	CH 202 Quantitative Chem Lab	1
E 101 Introduction to Engr & Prob Solv <sup>1</sup>	1	MA 241 Calculus II <sup>1</sup>	4
E 115 Intro to Computing Environ	1	PY 205 Physics for Engr & Sc I <sup>1</sup>	4
ENG 101 Academic Writing and Research <sup>1</sup>	4	EC 205 Econ (or EC 201 or ARE 201)*	3
MA 141 Calculus I <sup>1</sup>	4	Phys Ed/Healthy Living Elective*	<u>1</u>
PE 1** Fitness & Wellness Course*	<u>1</u>		<b>16</b>
	<b>15</b>		

<b>Fall Semester</b>	<b>Credit</b>	<b>Spring Semester</b>	<b>Credit</b>
BEC 220 Intro Biomanufacturing	1	BIO 183 Intro Bio: Cellular & Molecular	4
CH 221 Organic Chemistry I	3	CH 223 Organic Chemistry II	3
CH 222 Organic Chemistry I Lab	1	CH 224 Organic Chemistry II Lab	1
CHE 205 Chemical Proc Prin	4	CHE 225 Chemical Proc Systems	3
MA 242 Calculus III	4	MA 341 Applied Differential Eq	3
PY 208 Physics Engr & Scientists II	<u>4</u>	GEP Requirement*	<u>3</u>
	<b>17</b>		<b>17</b>

<b>Fall Semester</b>	<b>Credit</b>	<b>Spring Semester</b>	<b>Credit</b>
BCH 451 Intro Biochemistry	4	BBS 426 Industrial Micro & Bioman Lab	2
BEC 320 Fund of Microbial Cell Culture	2	BEC 330 Prin & Applications of Biosep	2
BEC 420 Fund of Micro Cell Culture	2	CHE 312 Transport Processes II	3
CHE 311 Transport Processes I	3	CHE 316 Thermo of Chem & Phase Eq	3
CHE 315 Chem Process Thermo	3	Free Elective	3
GEP Requirement*	<u>3</u>	GEP Requirement*	<u>3</u>
	<b>17</b>		<b>16</b>

<b>Fall Semester</b>	<b>Credit</b>	<b>Spring Semester</b>	<b>Credit</b>
BEC 436 Downstream Proc of Biomat Biomanufacturing Elective <sup>2</sup>	2	BEC 480 Large Scale Fermentation <b>OR</b>	2
CHE 395 Professional Dev Seminar	1	BEC 485 Large Scale Recov & Purif	
CHE 447 Bioreactor Engineering	3	CHE 435 Proc System Analy & Control	3
CHE 450 CHE Design I	3	CHE 451 CHE Design II	3
GEP Requirement*	<u>3</u>	Bioethics Course (GEP IP Req*) <sup>4</sup>	3
	<b>14</b>	GEP Requirement*	<u>2-3</u>
			<b>13-14</b>

Minimum Credit Hours Required for Graduation\*: 125

**Major/Program requirements and footnotes:**

<sup>1</sup> Must be completed with grade of (C-) or higher for matriculation.

<sup>2</sup> The Biomanufacturing elective course must be selected from the following list: BEC 440, 442, 462, 463, 480, 485, 497; BIT 466, 470. NOTE: Course selected from the eighth semester choice of either BEC 480/485 cannot be used to satisfy this requirement (i.e. counted twice).

<sup>3</sup> The bioethics course must be selected from: IDS 201, 303; STS 302, 304, 320; STS(PHI) 325

**\* General Education Program (GEP) requirements:**

To complete the requirements for graduation and the General Education Program, the following credit hours and co-requisites must be satisfied. University approved GEP course lists for each category can be found at <http://www.ncsu.edu/uap/academic-standards/gep/courselists/index.html>.

**PHYSICAL EDUCATION** - 2 hours to be selected from the approved GEP Physical Education list.

a. One fitness and wellness course (any PE 100-level course).

b. One additional credit hour of PE activity courses.

**HUMANITIES** - 6 credits to be selected in two different disciplines (two different course prefixes) from the approved GEP Humanities list.

**SOCIAL SCIENCES** - 3 credits to be selected in a discipline other than economics from the approved GEP Social Sciences list. EC 205 (or EC 201 or ARE 201) taken as part of the Major requirements satisfies 3 credit hours of the 6 credit hours needed to fulfill the GEP Social Sciences requirement.

**ADDITIONAL BREADTH** - 3 credits to be selected from the approved GEP Humanities, Social Sciences or Visual and Performing Arts lists.

**INTERDISCIPLINARY PERSPECTIVES** - 2 credits to be selected from the approved GEP Interdisciplinary Perspectives list. Course chosen to meet the Bioethics course requirement in the Major satisfies 3 credit hours of the 5 credit hours needed to fulfill the GEP Interdisciplinary Perspectives requirement.

**Co-requisites:**

U.S. Diversity and Global Knowledge co-requisites must be satisfied to complete the General Education requirements. Choose course(s) that are identified on the approved GEP course lists as meeting the U.S. Diversity and Global Knowledge co-requisites.

Foreign Language proficiency at the FL\_102 level will be required for graduation.

**Bachelor of Science in Chemical Engineering**  
**Green Chemistry and Engineering Concentration (14CHE097R)**

<b>Fall Semester</b>	<b>Credit</b>	<b>Spring Semester</b>	<b>Credit</b>
CH 101 Chemistry, A Molecular Science <sup>1</sup>	3	CH 201 Chemistry – Quantitative Sci.	3
CH 102 General Chemistry Lab <sup>1</sup>	1	CH 202 Quantitative Chem Lab	1
E 101 Introduction to Engr & Prob Solv <sup>1</sup>	1	MA 241 Calculus II <sup>1</sup>	4
E 115 Intro to Computing Environ	1	PY 205 Physics for Engr & Sc I <sup>1</sup>	4
ENG 101 Academic Writing and Research <sup>1</sup>	4	EC 205 Econ (or EC 201 or ARE 201)*	3
MA 141 Calculus I <sup>1</sup>	4	Phys Ed/Healthy Living Elective*	<u>1</u>
PE 1** Fitness & Wellness Course*	<u>1</u>		<b>16</b>
	<b>15</b>		

<b>Fall Semester</b>	<b>Credit</b>	<b>Spring Semester</b>	<b>Credit</b>
CH 221 Organic Chemistry I	3	CH 223 Organic Chemistry II	3
CH 222 Organic Chemistry I Lab	1	CH 224 Organic Chemistry II Lab	1
CHE 205 Chemical Proc Prin	4	CHE 225 Chemical Proc Systems	3
MA 242 Calculus III	4	MA 341 Applied Differential Eq	3
GEP Requirement*	<u>3</u>	PY 208 Physics Engr & Scientists II	4
	<b>15</b>	GEP Requirement*	<u>3</u>
			<b>17</b>

<b>Fall Semester</b>	<b>Credit</b>	<b>Spring Semester</b>	<b>Credit</b>
CH 315 Quantitative Analysis	4	CH *** Chemistry Elective <sup>3</sup>	4
CHE 311 Transport Processes I	3	CHE 312 Transport Processes II	3
CHE 315 Chem Process Thermo	3	CHE 316 Thermo of Chem & Phase Eq	3
ECE 331 Prin Electrical Engr <b>OR</b>	3	CHE 330 Chem Engr Lab I	4
MSE 201 Struct & Prop Engr Mat	3	GEP Requirement*	<u>3</u>
Free Elective	<u>3</u>		<b>17</b>
	<b>16</b>		

<b>Fall Semester</b>	<b>Credit</b>	<b>Spring Semester</b>	<b>Credit</b>
CHE 331 Chem Engr Lab II	2	CHE 435 Proc System Analy & Control	3
CHE 446 Des & Analy Chem Reactors	3	CHE 451 CHE Design II	3
CHE 450 CHE Design I	3	CHE 475 Advances in Pollution Prevention	3
Concentration Elective <sup>4</sup>	3	Free Elective	3
GEP Requirement*	3	GEP Requirement*	<u>2-3</u>
CHE 395 Professional Dev Seminar	<u>1</u>		<b>14-15</b>
	<b>15</b>		

Minimum Credit Hours Required for Graduation\*: 125

### **Major/Program requirements and footnotes:**

<sup>1</sup> Must be completed with grade of (C-) or better for matriculation.

<sup>2</sup> Chemistry electives include: CH 437: Physical Chemistry, CH 401/402: Inorganic Chemistry; CH/TC 461: Introduction to Fiber Forming Polymers (fall only); CH 415/416: Analytical Chemistry II; BCH 451: Biochemistry; FS 402: Food Chemistry (fall only) CH 610: Special Topics in Chemistry; CH 615: Chemical Separations (note: an additional hour of CH 499 would also be required to total 4 hours).

<sup>3</sup> Concentration electives include: (A) CE 373; Principles of Environmental Engineering; (B) CE 476: Air Pollution Control; (C) CE 484: Water and Waste Systems; (D) CE 456: Air Quality; (E) CE 477: Solid Waste Management; (F) TC 401: Environmental Aspects of the Textile Industry; (G) PSE 425: Bioenergy and Biomaterials Engineering

### **\*General Education Program (GEP) requirements:**

To complete the requirements for graduation and the General Education Program, the following credit hours and co-requisites must be satisfied. University approved GEP course lists for each category can be found at <http://www.ncsu.edu/uap/academic-standards/> .

**PHYSICAL EDUCATION** - 2 hours to be selected from the approved GEP Physical Education list.

a. One fitness and wellness course (any PE 100-level course).

b. One additional credit hour of PE activity courses.

**HUMANITIES** - 6 credits to be selected in two different disciplines (two different course prefixes) from the approved GEP Humanities list.

**SOCIAL SCIENCES** - 3 credits to be selected in a discipline other than economics from the approved GEP Social Sciences list. EC 205 (or EC 201 or ARE 201) taken as part of the Major requirements satisfies 3 credit hours of the 6 credit hours needed to fulfill the GEP Social Sciences requirement.

**ADDITIONAL BREADTH** - 3 credits to be selected from the approved GEP Humanities, Social Sciences or Visual and Performing Arts lists.

**INTERDISCIPLINARY PERSPECTIVES** - 5 credits to be selected from the approved GEP Interdisciplinary Perspectives list.

### **Co-requisites:**

U.S. Diversity and Global Knowledge co-requisites must be satisfied to complete the General Education requirements. Choose course(s) that are identified on the approved GEP course lists as meeting the U.S. Diversity and Global Knowledge co-requisites.

Foreign Language proficiency at the FL\_102 level will be required for graduation.

**Bachelor of Science in Chemical Engineering**  
**Honors Program (14CHE097H)**

<b>Fall Semester</b>	<b>Credit</b>	<b>Spring Semester</b>	<b>Credit</b>
CH 101 Chemistry, A Molecular Science <sup>1</sup>	3	CH 201 Chemistry – Quantitative Sci.	3
CH 102 General Chemistry Lab <sup>1</sup>	1	CH 202 Quantitative Chem Lab	1
E 101 Introduction to Engr & Prob Solv <sup>1</sup>	1	MA 241 Calculus II <sup>1</sup>	4
E 115 Intro to Computing Environ	1	PY 205 Physics for Engr & Sc I <sup>1</sup>	4
ENG 101 Academic Writing and Research <sup>1</sup>	4	EC 205 Econ (or EC 201 or ARE 201)*	3
MA 141 Calculus I <sup>1</sup>	4	Phys Ed/Healthy Living Elective*	<u>1</u>
PE 1** Fitness & Wellness Course*	<u>1</u>		<b>16</b>
	<b>15</b>		

<b>Fall Semester</b>	<b>Credit</b>	<b>Spring Semester</b>	<b>Credit</b>
CH 221 Organic Chemistry I	3	CH 223 Organic Chemistry II	3
CH 222 Organic Chemistry I Lab	1	CH 224 Organic Chemistry II Lab	1
CHE 205 Chemical Proc Prin	4	CHE 225 Chemical Proc Systems	3
MA 242 Calculus III	4	MA 341 Applied Differential Eq	3
GEP Requirement*	<u>3</u>	PY 208 Physics Engr & Scientists II	4
	<b>15</b>	GEP Requirement*	<u>3</u>
			<b>17</b>

<b>Fall Semester</b>	<b>Credit</b>	<b>Spring Semester</b>	<b>Credit</b>
CH 315 Quantitative Analysis	4	CHE *** Chemistry Elective <sup>3</sup>	4
CHE 311H Transport Processes I	3	CHE 312H Transport Processes II	3
CHE 315 Chem Process Thermo	3	CHE 316 Thermo of Chem & Phase Eq	3
Mathematics Elective <sup>2</sup>	3	CHE 330 Chem Engr Lab I	4
GEP Requirement*	3	ENG 333 Comm for Science and Research	<u>3</u>
CHE 395 Professional Dev Seminar	<u>1</u>		<b>17</b>
	<b>17</b>		

<b>Fall Semester</b>	<b>Credit</b>	<b>Spring Semester</b>	<b>Credit</b>
CHE 446 Des & Analy Chem Reactors	3	CHE 435 Proc System Analy & Control	3
CHE 450 CHE Design I	3	CHE 451 CHE Design II	3
CHE 497 Chemical Engr Projects	3	CHE *** Honors Electives <sup>5</sup>	3
CHE 7** CHE Elective <sup>4</sup>	3	GEP Requirement*	3
GEP Requirement*	<u>3</u>	GEP IP Requirement*	2-3
	<b>15</b>	CHE 495 Honors Thesis Prep <sup>6</sup>	<u>1</u>
			<b>15-16</b>

Minimum Credit Hours Required for Graduation: 127

**Major/Program requirements and footnotes:**

<sup>1</sup> Must be completed with grade of (C-) or higher for matriculation.

<sup>2</sup> Math electives include: MA 401, 402, 405, 427, 501.

<sup>3</sup> Chemistry electives include: CH 437: Physical Chemistry, CH 401/402: Inorganic Chemistry; CH/TC 461:

Introduction to Fiber Forming Polymers (fall only); FS 402: Food Chemistry (fall only); CH 415/416: Analytical Chemistry II; BCH 451: Biochemistry; CH 610: Special Topics in Chemistry; CH 615: Chemical Separations (note: an additional hour of CH 499 would also be required to total 4 hours).

<sup>4</sup> CHE 7xx includes CHE 711, 713, 715, 717.

<sup>5</sup> Honors electives include CHE 460 and above, CHE 5xx, CHE 7xx.

<sup>6</sup> An honors thesis is required for completion of the Honors Program.

**\* General Education Program (GEP) requirements:**

To complete the requirements for graduation and the General Education Program, the following credit hours and co-requisites must be satisfied. University approved GEP course lists for each category can be found at <http://www.ncsu.edu/uap/academic-standards/>.

**PHYSICAL EDUCATION** - 2 hours to be selected from the approved GEP Physical Education list.

a. One fitness and wellness course (any PE 100-level course).

b. One additional credit hour of PE activity courses.

**HUMANITIES** - 6 credits to be selected in two different disciplines (two different course prefixes) from the approved GEP Humanities list.

**SOCIAL SCIENCES** - 3 credits to be selected in a discipline other than economics from the approved GEP Social Sciences list. EC 205 (or EC 201 or ARE 201) taken as part of the Major requirements satisfies 3 credit hours of the 6 credit hours needed to fulfill the GEP Social Sciences requirement.

**ADDITIONAL BREADTH** - 3 credits to be selected from the approved GEP Humanities, Social Sciences or Visual and Performing Arts lists.

**INTERDISCIPLINARY PERSPECTIVES** - 5 credits to be selected from the approved GEP Interdisciplinary Perspectives list.

**Co-requisites:**

U.S. Diversity and Global Knowledge co-requisites must be satisfied to complete the General Education requirements. Choose course(s) that are identified on the approved GEP course lists as meeting the U.S. Diversity and Global Knowledge co-requisites.

Foreign Language proficiency at the FL\_102 level will be required for graduation.

**Bachelor of Science in Chemical Engineering**  
**Nanoscience concentration (14CHE097E)**

<b>Fall Semester</b>	<b>Credit</b>	<b>Spring Semester</b>	<b>Credit</b>
CH 101 Chemistry, A Molecular Science <sup>1</sup>	3	CH 201 Chemistry – Quantitative Sci.	3
CH 102 General Chemistry Lab <sup>1</sup>	1	CH 202 Quantitative Chem Lab	1
E 101 Introduction to Engr & Prob Solv <sup>1</sup>	1	MA 241 Calculus II <sup>1</sup>	4
E 115 Intro to Computing Environ	1	PY 205 Physics for Engr & Sc I <sup>1</sup>	4
ENG 101 Academic Writing and Research <sup>1</sup>	4	EC 205 Econ (or EC 201 or ARE 201)*	3
MA 141 Calculus I <sup>1</sup>	4	Phys Ed/Healthy Living Elective*	<u>1</u>
PE 10* Fitness & Wellness Course*	<u>1</u>		<b>16</b>
	<b>15</b>		

<b>Fall Semester</b>	<b>Credit</b>	<b>Spring Semester</b>	<b>Credit</b>
CH 221 Organic Chemistry I	3	CH 223 Organic Chemistry II	3
CH 222 Organic Chemistry I Lab	1	CH 224 Organic Chemistry II Lab	1
CHE 205 Chemical Proc Prin	4	CHE 225 Chemical Proc Systems	3
MA 242 Calculus III	4	MA 341 Applied Differential Eq	3
PY 208 Physics Engr & Scientists II	<u>4</u>	MSE 201 Struct & Prop Engr Mat	3
	<b>16</b>	GEP Requirement*	<u>3</u>
			<b>16</b>

<b>Fall Semester</b>	<b>Credit</b>	<b>Spring Semester</b>	<b>Credit</b>
CH *** Chemistry Elective <sup>2</sup>	4	CH 437 Phys Chem for Engrs	4
CHE 311 Transport Processes I	3	CHE 312 Transport Processes II	3
CHE 315 Chem Process Thermo	3	CHE 316 Thermo of Chem & Phase Eq	3
GEP Requirement*	3	CHE 330 Chem Engr Lab I	4
GEP Requirement*	3	Free Elective	<u>3</u>
CHE 395 Professional Dev Seminar	<u>1</u>		<b>17</b>
	<b>17</b>		

<b>Fall Semester</b>	<b>Credit</b>	<b>Spring Semester</b>	<b>Credit</b>
CHE 331 Chem Engr Lab II	2	CHE 435 Proc System Analy & Control	3
CHE 446 Des & Analy Chem Reactors	3	CHE 451 CHE Design II	3
CHE 450 CHE Design I	3	Nanoscience Elective <sup>4</sup>	3
Nanoscience Elective <sup>3</sup>	3	GEP Requirement*	3
Free Elective	<u>3</u>	GEP Requirement*	<u>2-3</u>
	<b>14</b>		<b>14-15</b>

Minimum Credit Hours Required for Graduation: 125

**Major/Program requirements and footnotes:**

**1** Must be completed with grade of (C-) or higher for matriculation.

**2** Chemistry electives include: (A) CH 315: Quantitative Analysis; (B) CH 401/402: Inorganic Chemistry; (C) CH/TC 461: Introduction to Fiber Forming Polymers (fall only); (D) CH 415/416: Analytical Chemistry II; (E) BCH 451: Biochemistry; (F) CH 610: Special Topics in Chemistry; (G) CH 615: Chemical Separations (note: an

additional hour of CH 499 would also be required to total 4 hours); (H) FS 402: Food Chemistry (fall only)

3 Nanosciences Electives include: CHE/MSE 455: Polymer Technology and Engineering, CH 460: Chemical Properties of Electronic Materials, CHE 461: Polymer Sciences and Technology, CHE 462: Colloid Science and Macromolecular Physics, CHE 467: Rheology, CHE 597D: Colloidal and Macromolecular Physics, CHE 597J: Polymers at Interfaces and in Confined Geometries, ECE 331: Principles of Electrical Engineering I, CH 795M: Special Topics in Chemistry, MSE 425: Polymer Science & Technology, MSE 331: Elec Properties of Materials, MSE 460: Microelectronic Materials, PY 407: Introduction to Modern Physics. Additional nanoscience electives may be approved on a case-by-case basis as new courses are introduced.

**\*General Education Program (GEP) requirements:**

To complete the requirements for graduation and the General Education Program, the following credit hours and co-requisites must be satisfied. University approved GEP course lists for each category can be found at <http://www.ncsu.edu/uap/academic-standards/>.

**PHYSICAL EDUCATION** - 2 hours to be selected from the approved GEP Physical Education list.

a. One fitness and wellness course (any PE 100-level course).

b. One additional credit hour of PE activity courses.

**HUMANITIES** - 6 credits to be selected in two different disciplines (two different course prefixes) from the approved GEP Humanities list.

**SOCIAL SCIENCES** - 3 credits to be selected in a discipline other than economics from the approved GEP Social Sciences list. EC 205 (or EC 201 or ARE 201) taken as part of the Major requirements satisfies 3 credit hours of the 6 credit hours needed to fulfill the GEP Social Sciences requirement.

**ADDITIONAL BREADTH** - 3 credits to be selected from the approved GEP Humanities, Social Sciences or Visual and Performing Arts lists.

**INTERDISCIPLINARY PERSPECTIVES** - 5 credits to be selected from the approved GEP Interdisciplinary Perspectives list.

**Co-requisites:**

U.S. Diversity and Global Knowledge co-requisites must be satisfied to complete the General Education requirements. Choose course(s) that are identified on the approved GEP course lists as meeting the U.S. Diversity and Global Knowledge co-requisites.

Foreign Language proficiency at the FL\_102 level will be required for graduation.

**Accelerated Master's Degree (BS/MS in CHE)**

<b>Fall Semester</b>	<b>Credit</b>	<b>Spring Semester</b>	<b>Credit</b>
CH 101 Chemistry, A Molecular Science <sup>1</sup>	3	CH 201 Chemistry – Quantitative Sci.	3
CH 102 General Chemistry Lab1	1	CH 202 Quantitative Chem Lab	1
E 101 Introduction to Engr & Prob Solv <sup>1</sup>	1	MA 241 Calculus II <sup>1</sup>	4
E 115 Intro to Computing Environ	1	PY 205 Physics for Engr & Sc I <sup>1</sup>	4
ENG 101 Academic Writing and Research <sup>1</sup>	4	EC 205 Econ (or EC 201 or ARE 201)*	3
MA 141 Calculus I <sup>1</sup>	4	Phys Ed/Healthy Living Elective*	<u>1</u>
PE 1** Fitness & Wellness Course*	<u>1</u>		<b>16</b>
	<b>15</b>		

<b>Fall Semester</b>	<b>Credit</b>	<b>Spring Semester</b>	<b>Credit</b>
CH 221 Organic Chemistry I	3	CH 223 Organic Chemistry II	3
CH 222 Organic Chemistry I Lab	1	CH 224 Organic Chemistry II Lab	1
CHE 205 Chemical Proc Prin	4	CH 225 Chemical Proc Systems	3
MA 242 Calculus III	4	MA 341 Applied Differential Eq	3
GEP Requirement*	<u>3</u>	PY 208 Physics Engr & Scientists II	4
	<b>15</b>	GEP Requirement*	<u>3</u>
			<b>17</b>

<b>Fall Semester</b>	<b>Credit</b>	<b>Spring Semester</b>	<b>Credit</b>
CH 315 Quantitative Analysis	4	CH *** Chemistry Elective <sup>2</sup>	4
CHE 311 Transport Processes I	3	CHE 312 Transport Processes II	3
CHE 315 Chem Process Thermo	3	CHE 316 Thermo of Chem & Phase Eq	3
ECE 331 Prin Electrical Engr <b>OR</b>	3	CHE 330 Chem Engr Lab I	4
MSE 201 Struct & Prop Engr Mat		Free Elective	<u>3</u>
GEP Requirement*	3		<b>17</b>
CHE 395 Professional Dev Seminar	<u>1</u>		
	<b>17</b>		

<b>Fall Semester</b>	<b>Credit</b>	<b>Spring Semester</b>	<b>Credit</b>
CHE 331 Chem Engr Lab II	2	CHE 435 Proc System Analy & Control	3
CHE 446 Des & Analy Chem Reactors	3	CHE 451 CHE Design II	3
CHE 450 CHE Design I	3	500-Level CHE Technical Elective	3
500-Level CHE Technical Elective	3	GEP Requirement*	3
GEP Requirement*	<u>3</u>	GEP IP Requirement*	<u>2-3</u>
	<b>14</b>		<b>14-15</b>

<b>Fall Semester</b>	<b>Credit</b>	<b>Spring Semester</b>	<b>Credit</b>
CHE 711 ChE Process Modeling	3	CHE 596U Special Topics in CHE	3
CHE 713 Thermodynamics I	3	CHE 721 Separation Processes	3
CHE 717 Chem Reaction Engineering	<u>3</u>	CHE Graduate Elective	<u>3</u>
	<b>9</b>		<b>9</b>

Minimum Credit Hours Required for Graduation:<sup>3</sup> **144**

### **Major/Program requirements and footnotes:**

<sup>1</sup> Must be completed with grade of (C-) or higher for matriculation.

<sup>2</sup> Chemistry electives include: CH 437: Physical Chemistry, CH 401/402: Inorganic Chemistry; CH/TC 461: Introduction to Fiber Forming Polymers; CH 415/416: Analytical Chemistry II; BCH 451: Biochemistry; FS 402: Food Chemistry; CH 610: Special Topics in Chemistry; CH 615: Chemical Separations (note: an additional hour of CH 499 would also be required to total 4 hours).

<sup>3</sup> Students must have an overall GPA of 3.5 through the end of the junior year and must maintain this GPA through the senior year to be admitted into the program. Students who wish to complete the Accelerated BS/MS ChE degree program must apply for candidacy to the MS degree during the spring semester of the junior year (semester during which CHE 312/316 are completed). The admissions process includes submitting the following information to the Chemical and Biomolecular Engineering Graduate Administrator. Dr. Saad Khan:

- (1) Completed copy of the signed graduate application form
- (2) NC Residency Form if you wish to claim NC residency for tuition purposes
- (3) Non-Refundable application fee in form of a check or money order
- (4) Three letters of recommendation
- (5) Official transcript sent directly from every college and graduate school attended
- (8) Graduate Record Examination (**GRE**) scores

Students must receive a grade of B (3.0/4.0) or better in the double counted graduate level courses. Courses with a grade of B- or below can not be double counted between the two degrees. No more than twelve (12) hours of graduate work may be counted towards the requirements of both degrees. Students must complete the Master's degree within 12 months from the completion of the baccalaureate degree for a non-thesis Master's degree and within 18 months for Master's programs requiring a thesis. If the Master's program is not completed within these time limits, none of the courses can be double counted. Note that the B.S. Degree must be completed in order to get the dual BS/MS (students cannot double major in something else and then skip to the MS CHE). Recipients of the MS degree must earn a minimum semester GPA of 3.0 during the final two semesters, including no more than one C grade in 500 and 700 level CHE courses.

### **\*General Education Program (GEP) requirements:**

To complete the requirements for graduation and the General Education Program, the following credit hours and co-requisites must be satisfied. University approved GEP course lists for each category can be found at <http://www.ncsu.edu/uap/academic-standards/>.

**PHYSICAL EDUCATION** - 2 hours to be selected from the approved GEP Physical Education list.

**a.** One fitness and wellness course (any PE 100-level course).

**b.** One additional credit hour of PE activity courses.

**HUMANITIES** - 6 credits to be selected in two different disciplines (two different course prefixes) from the approved GEP Humanities list.

**SOCIAL SCIENCES** - 3 credits to be selected in a discipline other than economics from the approved GEP Social Sciences list. EC 205 (or EC 201 or ARE 201) taken as part of the Major requirements satisfies 3 credit hours of the 6 credit hours needed to fulfill the GEP Social Sciences requirement.

**ADDITIONAL BREADTH** - 3 credits to be selected from the approved GEP Humanities, Social Sciences or Visual and Performing Arts lists.

**INTERDISCIPLINARY PERSPECTIVES** - 5 credits to be selected from the approved GEP Interdisciplinary Perspectives list.

### **Co-requisites:**

U.S. Diversity and Global Knowledge co-requisites must be satisfied to complete the General Education requirements. Choose course(s) that are identified on the approved GEP course lists as meeting the U.S. Diversity and Global Knowledge co-requisites.

Foreign Language proficiency at the FL\_102 level will be required for graduation.

## **Cooperative BS/MS Degree Programs in Chemical Engineering and Pharmaceutical Sciences (Campbell)**

The Cooperative BS/MS degree programs in chemical engineering and pharmaceutical sciences are designed for the chemical engineering biomolecular concentration or biomanufacturing sciences concentration students who want to gain advanced knowledge in an area of specialization in the pharmaceutical sciences. The MS in Pharmaceutical Sciences (Industrial Pharmacy track) includes extensive hands-on training in advanced laboratory techniques. The program is completed after five years, including one summer term during or before the junior year, and graduates from the program should be competent to support and to lead a team for the development of new pharmaceutical products and delivery systems. The BS degree in chemical engineering is completed at NC State and the MS degree in pharmaceutical sciences is completed at Campbell University.

The Master of Science in Pharmaceutical Science (MSPS) at Campbell features specialized training in several areas of the pharmaceutical sciences. The MSPS core curriculum includes a background in molecular biology, analytical instrumentation, pharmacology, biochemistry, and other courses. The student then takes advanced courses in a specialized track. The tracks are bioprocessing, industrial pharmacy, pharmacology, and pharmaceutical analysis, and these include extensive hands-on training in advanced laboratory techniques. Students are required to utilize these skills by conducting a research project within their area of specialization.

At its heart, chemical engineering education “integrates design and analysis, science, and technology with communication skills developed through exposure to the humanities and the social and economic sciences. Chemical engineering organizes these diverse skills into a coherent discipline uniquely suited to the needs of the chemical, biochemical, petroleum, plastics, textile, and pulp and paper industries.” In addition, both the chemical engineering biomolecular concentration and the biomanufacturing sciences concentration provide undergraduates with an educational background that is a strong preparation to pursue graduate education in the pharmaceutical sciences.

The Cooperative BS/MS degree programs are designed to educate and train a highly skilled individual who is competent to support and to lead a team for the development of new pharmaceutical products and delivery systems. Furthermore, by combining the NC State BS degree program in chemical engineering – either biomolecular concentration or the biomanufacturing sciences concentration with the Master of Science in Pharmaceutical Science program at Campbell University, interested students will be benefited by their ability to earn the two degrees in a total of five years, which includes one summer term at NC State, instead of the usual six years. Academically, all current NC State course and curriculum requirements will continue to be fulfilled only with NC State coursework, and the chemical engineering degree will be earned after four years, including two summer terms.

Students will normally apply for admission, and be admitted to, the dual degree program during the junior year and will be expected to enroll for classes during the summer following the junior year. Requirements for admission are:

- GPA of 3.0 and above through fall (1<sup>st</sup>) semester in the junior year.
- GRE 1,000 (verbal & quantitative) + 4.0 in analytical writing
- TOEFL > 550 (paper), 213 (computer), or 79 (Internet) if needed.
- General prerequisites: Physics I & II, General Chemistry I & II, Organic Chemistry I & II, Biochemistry, Analytical Instrumentation (This is satisfied by taking the three designated courses indicated in the curriculum)
- Application deadline is March 1 of the junior year.
- One recommendation letter out of three in the application should be from the dual degree contact person (academic advisor) at NCSU.

PHSC courses offered through Campbell are subject to Campbell tuition. Courses in the 5<sup>th</sup> year are taken at Campbell.

## **Administration of the Cooperative BS/MS Degree Program in Chemical Engineering and Pharmaceutical Sciences**

At NC State, Dr. Henry Lamb and Dr. Robert Kelly will continue to serve as academic advisors for students enrolled in the BS degree program in chemical engineering – biomanufacturing science concentration and the biomolecular concentration, respectively, and as such they will also serve as the academic advisors and primary contacts for students who are admitted to the cooperative degree program.

Dr. Henry Lamb  
Professor  
Department of Chemical & Biomolecular  
Engineering  
Box 7905 - NCSU  
Raleigh, NC 27695-7905

Phone: (919) 515-6395  
e-mail: [lamb@eos.ncsu.edu](mailto:lamb@eos.ncsu.edu)

Dr. Robert Kelly  
Professor  
Department of Chemical & Biomolecular  
Engineering  
Box 7905 - NCSU  
Raleigh, NC 27695-7905

Phone: (919) 515-6396  
e-mail: [rmkelly@eos.ncsu.edu](mailto:rmkelly@eos.ncsu.edu)

At Campbell University, the contact for the program is:

Emanuel J. Diliberto, Jr., Ph.D.  
Professor and Chair  
Department of Pharmaceutical Sciences  
Campbell University  
P. O. Box 1090  
Buies Creek, NC 27506

Phone: (910) 893-1696  
Fax: (910) 893-1697  
e-mail: [diliberto@campbell.edu](mailto:diliberto@campbell.edu)

**Cooperative BS/MS Degree Programs**  
**in Chemical Engineering and Pharmaceutical Sciences (Campbell)**  
**(Biomolecular Concentration)**

Fall Semester	Credits	Spring Semester	Credits		
CH 101	Chemistry - Molecular Sci	3	CH 201	Chem – Quantitative Sci	3
CH 102	General Chemistry Lab	1	CH 202	Quantitative Chem Lab	1
E 101	Intro to Engr & Prob Solv	1	EC 205	Econ (or EC 201 or ARE 201)	3
E 115	Intro to Computing Envir	1	MA 241	Analyt Geom & Calculus II	4
MA 141	Analyt Geom & Calculus I	4	PY 205	Physics Engr & Scien I	4
ENG 101	Academic Writing and Resch <sup>1</sup>	4	Physical Education – Healthy Living	<u>1</u>	<b>16</b>
PE 10x	Health & Phys Fitness	<u>1</u>			
	<b>15</b>				
CHE 205	Chemical Process Prin	4	CHE 225	Chemical Proc Systems	3
CH 221	Organic Chemistry I	3	CH 223	Organic Chemistry II	3
CH 222	Organic Chemistry I lab	1	CH 224	Organic Chemistry II Lab	1
PY 208	Physics Engr & Scien II	4	MA 341	Applied Differential Eqns	3
MA 242	Analyt Geom & Calculus III	<u>4</u>	BIO 183	Intro Biology	4
	<b>16</b>		GEP Requirement	<u>3</u>	<b>17</b>
BCH 451	Intro Biochemistry	4	BIT 464	Protein Purification <sup>4</sup>	2
GEP Requirement	3	CHE 312	Transport Processes II	3	
CHE 311	Transport Processes I	3	CHE 316	Thermo Chem & Phase Eq	3
CHE 315	Chem Process Thermo	3	CHE 330	CHE Lab I	4
BIT 410	Manipulation of Re DNA <sup>4</sup>	<u>4</u>	CHE 395	Professional Dev. Seminar	1
	<b>17</b>		BIT 569	RNA Purification & Analysis <sup>4</sup>	<u>2</u>
					<b>15</b>
<b>Summer Session:</b>					
BIO 212	Anatomy and Physiology	4			
GEP Requirement	2-3				
GEP Requirement	<u>3</u>				
	<b>7</b>				
GEP Requirement	3	CHE 435	Proc Sys Analy & Control	3	
CHE 447	Des & Analy Chem Reac	3	CHE 451	CHE Design II	3
CHE 450	CHE Design I	3	CHE 551	Biochemical Engineering	3
CHE 497	Chem Eng Proj I	3	Bioethics course <sup>2</sup>	3	
PHSC 514	Industrial Pharmacy <sup>3</sup>	<u>3</u>	PHSC 574	Biopharmaceutics <sup>3</sup>	3
	<b>15</b>		PHSC 540	Advanced Physical Pharmacy <sup>3</sup>	<u>3</u>
					<b>18</b>
PHSC 510	Pharmacokinetics	2	PHSC 508	Process Validation	2
PHSC 512	Prin. of Pharma and Med Chem.	3	PHSC 536	MS Seminar II	1
PHSC 523	Expt Design & Biostatistics	4	PHSC 542	Adv. Topics in Ind Pharmacy	4
PHSC 534	MS Seminar I	1	PHSC 620	Research Project	<u>4</u>
PHSC xxx	Elective(s)	3			<b>11</b>
PHSC 515	Industrial Pharmacy Lab	1			
PHSC 610	Research Proposal	<u>2</u>			
	<b>16</b>				

Minimum Credit Hours Required for BS CHE Graduation 128\*

Minimum Credit Hours Required for MS Pharmaceutical Sciences: 164

Students completing this concentration will simultaneously fulfill the requirements for a Minor in Biotechnology.

**Cooperative BS/MS Degree Programs**  
**in Chemical Engineering and Pharmaceutical Sciences (Campbell)**  
**(Biomanufacturing Concentration)**

<b>Fall Semester</b>		<b>Credits</b>	<b>Spring Semester</b>		<b>Credits</b>
CH 101	Chemistry - Molecular Sci	3	CH 201	Chem - Quantitative Sci	3
CH 102	General Chemistry Lab	1	CH 202	Quantitative Chem Lab	1
E 101	Intro to Engr & Prob Solv	1	EC 205	Econ (or EC 201 or ARE 201)	3
E 115	Intro to Computing Envir	1	MA 241	Analyt Geom & Calculus II	4
MA 141	Analyt Geom & Calculus I	4	PY 205	Physics Engr & Scien I	4
ENG 101	Academic Writing and Resch <sup>1</sup>	4	Physical Education		<u>1</u>
PE 10x	Health & Phys Fitness	<u>1</u>			<b>16</b>
		<b>15</b>			
PY 208	Physics Engr & Scien II	4	GEP Requirement		3
BEC 220	Intro Biomanufacturing	1	CH 223	Organic Chemistry II	3
CH 221	Organic Chemistry I	3	CH 224	Organic Chemistry II Lab	1
CH 222	Organic Chemistry I Lab	1	MA 341	Applied Differential Eqns	3
CHE 205	Chemical Process Principles	4	CHE 225	Chem. Eng. Analysis	3
MA 242	Analyt Geom & Calculus III	<u>4</u>	BIO 183	Intro Biology	<u>4</u>
		<b>17</b>			<b>17</b>
BCH 451	Intro Biochemistry	4	BEC 330	Fund. Downstream Process	2
GEP Requirement		3	CHE 312	Transport Processes II	3
CHE 311	Transport Processes I	3	CHE 316	Thermo Chem & Phase Eq	3
CHE 315	Chem Process Thermo	3	GEP Requirement		3
BEC 320	Fund. Micro. Cell Culture	2	BBS 426	Ind. Micro. Bioproc. Lab	<u>2</u>
BEC 420	Micro. Cell Biotransforms	<u>2</u>			<b>13</b>
		<b>17</b>			
<b>Summer Session:</b>					
BIO 212	Anatomy and Physiology	4			
GEP Requirement		<u>2-3</u>			
		<b>6</b>			
BEC 436	Downstream Proc. Biomat.	2	CHE 435	Proc Sys Analy & Control	3
CHE 447	Bioreactor Engineering	3	CHE 451	CHE Design II	3
CHE 450	CHE Design I	3	Bioethics course <sup>2</sup>		3
Biomanufacturing Elective <sup>1</sup>		2	BEC 485	LS Recovery/Purification	2
GEP Requirement		3	PHSC 574	Biopharmaceutics <sup>3</sup>	3
CHE 395	Professional Dev. Seminar	1	PHSC 540	Advanced Physical Pharmacy <sup>3</sup>	<u>3</u>
PHSC 514	Industrial Pharmacy <sup>3</sup>	<u>3</u>			<b>17</b>
		<b>17</b>			
PHSC 510	Pharmacokinetics	2	PHSC 508	Process Validation	2
PHSC 512	Prin. of Pharma and Med Chem.	3	PHSC 536	MS Seminar II	1
PHSC 523	Expt Design & Biostatistics	4	PHSC 542	Adv. Topics in Ind Pharmacy	4
PHSC 534	MS Seminar I	1	PHSC 620	Research Project	<u>4</u>
PHSC xxx	Elective(s)	3			<b>11</b>
PHSC 515	Industrial Pharmacy Lab	1			
PHSC 610	Research Proposal	<u>2</u>			
		<b>16</b>			

Minimum Credit Hours Required for BS CHE Graduation 126\*

Minimum Credit Hours Required for MS Pharmaceutical Sciences 162

Students completing this concentration will simultaneously fulfill the requirements for a Minor in Biomanufacturing.

**\*General Education Program (GEP) requirements:**

To complete the requirements for graduation and the General Education Program, the following credit hours and co-requisites must be satisfied. University approved GEP course lists for each category can be found at <http://www.ncsu.edu/uap/academic-standards/> .

**PHYSICAL EDUCATION** - 2 hours to be selected from the approved GEP Physical Education list.

a. One fitness and wellness course (any PE 100-level course).

b. One additional credit hour of PE activity courses.

**HUMANITIES** - 6 credits to be selected in two different disciplines (two different course prefixes) from the approved GEP Humanities list.

**SOCIAL SCIENCES** - 3 credits to be selected in a discipline other than economics from the approved GEP Social Sciences list. EC 205 (or EC 201 or ARE 201) taken as part of the Major requirements satisfies 3 credit hours of the 6 credit hours needed to fulfill the GEP Social Sciences requirement.

**ADDITIONAL BREADTH** - 3 credits to be selected from the approved GEP Humanities, Social Sciences or Visual and Performing Arts lists.

**INTERDISCIPLINARY PERSPECTIVES** - 5 credits to be selected from the approved GEP Interdisciplinary Perspectives list.

**Co-requisites:**

U.S. Diversity and Global Knowledge co-requisites must be satisfied to complete the General Education

<sup>1</sup> The biomanufacturing elective course must be selected from the following list:

BEC 480 – Large-Scale Fermentation

BEC 497 – Biomanufacturing Research Projects

BIT 466 – Animal Cell Culture

BIT 470 – Advanced Animal Cell Culture – Bioreactor Culture

<sup>2</sup> The BIT minor bioethics course counts as an H&SS for the Interdisciplinary Perspectives category. The courses include:

IDS 201: Environmental Ethics

STS 302: Cont Science, Technology, and Human Values

IDS 303: Humans and the Environment

STS 304: Ethical Dimensions of Progress

STS 320: Ethics in Engineering

STS(PHI) 325: Bio-Medical Ethics

<sup>3</sup> Offered via videoconference from Campbell. The lab, PHSC 515, will be offered either at Campbell or at BTEC.

<sup>4</sup> These three courses are required to satisfy a prerequisite (analytical instrumentation) for MSPS program. Otherwise, CH 315 (Quantitative Chemical Analysis) has to be taken before the senior year.

**Bachelor of Science in Paper Science & Engineering -- Chemical Engineering Concentration**  
**(Degrees: B.S. in Pulp & Paper Technology, B. S. in Chemical Engineering)(15 PSE 097D)**

<b>Fall Semester</b>	<b>Credit</b>	<b>Spring Semester</b>	<b>Credit</b>
CH 101 Chemistry, A Molecular Science <sup>1</sup>	3	CH 201 Chemistry, A Quant Science <sup>2</sup>	3
CH 102 General Chemistry Lab <sup>1</sup>	1	CH 202 Quantitative Chemistry Lab <sup>2</sup>	1
E 101 Introduction to Engr & Prob Solv <sup>1</sup>	1	EC 205 Econ (or EC 201 or ARE 201)*	3
E 115 Intro to Computing Environ	1	MA 241 Calculus II <sup>1</sup>	4
ENG 101 Academic Writing and Research <sup>1</sup>	4	PY 205 Physics Engr & Scientists I <sup>1</sup>	4
MA 141 Calculus I <sup>1</sup>	4	PSE 201 Pulping & Paper Tech <sup>2</sup>	<u>3</u>
PE 10x Fitness & Wellness Course *	<u>1</u>		<b>18</b>
	<b>15</b>		
CH 221 Organic Chemistry I	3	CH 223 Organic Chemistry II	3
CH 222 Organic Chemistry I Lab	1	CH 224 Organic Chemistry II Lab	1
CHE 205 Chemical Proc Princ <sup>2</sup>	4	CHE 225 Chemical Proc Systems <sup>2</sup>	3
MA 242 Calculus III <sup>2</sup>	4	MA 341 Applied Differential Eq <sup>2</sup>	3
PSE 212 Paper Properties <sup>2</sup>	3	PY 208 Physics for Engr & Scientists II	4
PE Phys Ed/Healthy Living Elective*	<u>1</u>	PSE 371 Pulping Process Analysis <sup>2</sup>	<u>3</u>
	<b>16</b>		<b>17</b>
CH 315 Quantitative Analysis	4	CHE 312 Transport Processes II	3
CHE 311 Transport Processes I <sup>2</sup>	3	CHE 316 Thermo of Chem & Phase Eq	3
CHE 315 Chem Process Thermo <sup>2</sup>	3	PSE 332 Wood & Pulping Chemistry	3
PSE 211 Pulp & Paper Internship <sup>3</sup>	1	PSE 360 Pulp & Paper Unit Proc. II	3
PSE 322 Wet End/Polymer Chemistry	4	GEP Requirement*	<u>3</u>
GEP Requirement*	<u>3</u>		<b>15</b>
	<b>18</b>		
PSE 415 Senior Research Projects	3	PSE 416 Project Design and Analysis	3
PSE 417 Process Design & Analy. Lab	3	PSE 465 Paper Physics & Product Design	3
PSE 425 Bioenergy & Biomaterials Engr	3	PSE 472 Paper Process Analysis	3
PSE 475 Process Control	3	GEP Requirement*	3
GEP Requirement*	3	GEP IP Requirement*	<u>2-3</u>
GEP Requirement*	<u>3</u>		<b>14-15</b>
	<b>18</b>		
CHE 330 CHE Lab I	4		
CHE 446 or 447 Des & Analy Chem Reac	3		
CHE 450 CHE Design I	3		
ECE 331 Intro Elect Circuits <b>or</b>			
MSE 201 Intro Material Sci Engr.	<u>3</u>		
	<b>13</b>		

Minimum Credit Hours Required for Graduation\*<sup>I,J,K</sup>:

144

**Major/Program requirements and footnotes:**

1. Matriculation course. Minimum grade of C-.
2. Minimum grade of C-.
3. There is one required internship in industry. PSE 211 should be taken the first semester upon returning from that internship.

**\*General Education Program (GEP) requirements and GEP Footnotes:**

To complete the requirements for graduation and the General Education Program, the following category credit hours and co-requisites must be satisfied.

University approved GEP course lists for each of the following categories can be found at <http://www.ncsu.edu/uap/academic-standards/gep/courselists/index.html>.

- A. **Mathematical Sciences** (6 credit hours – one course with MA or ST prefix)  
*Fulfilled as part of the Major requirements.*
- B. **Natural Sciences** (7 credit hours – include one laboratory course or course with a lab)  
*Fulfilled as part of the Major requirements.*
- C. **Humanities** (6 credit hours selected from two different disciplines/course prefixes)  
*Choose from the University approved GEP Humanities course list.*
- D. **Social Sciences** (6 credit hours selected from two different disciplines/course prefixes)  
*Choose from the University approved GEP Social Sciences course list in a discipline other than Economics. Economics 205 (or EC 201 or ARE 201), taken as part of the Major requirements, satisfies 3 credit hours needed to fulfill the GEP Social Sciences Requirement.*
- E. **Physical Education/Healthy Living** (2 credit hours – at least one 100-level Fitness and Wellness Course)  
*Choose from the University approved GEP Physical Education/Healthy Living course list.*
- F. **Additional Breadth** - (3 credit hours to be selected from the following checked University approved GEP course lists)  
XX Humanities/Social Sciences/Visual and Performing Arts
- G. **Interdisciplinary Perspectives** (5-6 credit hours)  
*Choose from the University approved GEP Interdisciplinary Perspectives course list.*
- H. **Introduction to Writing** (4 credit hours satisfied by completing ENG 101 with a C- or better )

The following Co-Requisites must be satisfied to complete the General Education Program requirements:

- I. **U.S. Diversity** (USD)  
*Choose from the University approved GEP U.S. Diversity course list or choose a course identified on the approved GEP course lists as meeting the U.S. Diversity (USD) co-requisite.*
- J. **Global Knowledge** (GK)  
*Choose from the University approved GEP Global Knowledge course list or choose a course identified on the approved GEP course lists as meeting the Global Knowledge (GK) co-requisite.*
- K. **Foreign Language proficiency** - Proficiency at the FL\_102 level is required for graduation.

**CURRICULUM IN CHEMICAL ENGINEERING & CHEMISTRY (BA)**  
**(Degrees earned: B. S. in Chemical Engineering/ B. A. in Chemistry)**

Fall Semester			Credits	Spring Semester			Credits
CH	101	Chemistry - Molecular Sci	3	CH	201	Chem - Quantitative Sci	3
CH	102	General Chemistry Lab	1	CH	202	Quantitative Chem Lab	1
E	101	Intro to Engr. & Prob Solv	1	Humanities/Social Science Elective			3
E	115	Intro to Computing Envir	1	MA	241	Calculus II	4
ENG	101	Acad Writing and Resch <sup>1</sup>	4	PY	205	Physics Engr & Scien I	4
MA	141	Calculus I	4	Physical Education			<u>1</u>
PE	10x	Physical Education	<u>1</u>				16
			15				
CH	221	Organic Chemistry I	3	CH	223	Organic Chemistry II	3
CH	222	Organic Chemistry I lab	1	CH	224	Organic Chemistry II Lab	1
CHE	205	Chemical Process Prin	4	PY	208	Physics Engr & Scien II	4
MA	242	Analyt Geom & Calculus III	4	CHE	225	Chemical Proc Systems	3
Humanities/Social Science Elective <sup>2</sup>			<u>3</u>	MA	341	Applied Differential Eqns	3
			15	Humanities/Social Science Elective <sup>2</sup>			<u>3</u>
							17
CH	315	Quantitative Analysis	4	CH	437	Intro Physical Chem	4
CHE	311	Transport Processes I	3	CHE	312	Transport Processes II	3
CHE	315	Chem Process Thermo	3	CHE	316	Thermo Chem & Phase Eq	3
ENG	331	Comm for Engr & Tech*	3	CHE	330	CHE Lab I	4
Humanities/Social Science Elective			<u>3</u>	Humanities/Social Science Elective			3
			16	CHE	395	Professional Dev. Seminar	<u>1</u>
							18
CHE	331	CHE Lab II	2	CH	401	Sys Inorganic Chem	3
CHE	446	Des & Analy Chem Reac	3	CHE	425	Proc Sys Analy & Control	3
CHE	450	CHE Design I	3	CHE	451	CHE Design II	3
Humanities/Social Science Elective			3	Humanities/Social Science Elective			3
Humanities/Social Science Elective			<u>3</u>	Technical Elective			<u>3</u>
			15				15
BCH	451	Prin of Biochemistry	4				
ECE	331	Prin Electrical Engr or					
MSE	201	Struct & Prop Engr Matl	3				
Humanities/Social Science Elective <sup>1</sup>			3				
Humanities/Social Science Elective <sup>1</sup>			3				
Technical Elective			<u>3</u>				
			16				
Total Hours Required for Graduation				140 <sup>2</sup>			

<sup>1</sup> These H&SS can be from any approved H&SS GER category.

<sup>2</sup> To graduate, students must demonstrate competency in a foreign language at the FL 102 level and have a grade of C- or higher in ENG 101, MA 141, MA 241, MA 242, MA 341, PY 205, E101, CH 101, CHE 205, CHE 225, CHE 311, and CHE 315.

**CURRICULUM IN CHEMICAL ENGINEERING & CHEMISTRY (BS)**  
**(Degrees earned: B. S. in Chemical Engineering/ B. S. in Chemistry)**

Fall Semester	Credits	Spring Semester	Credits
CH 101 Chem - Molecular Sci	3	CH 201 Chem - Quantitative Sci	3
CH 102 General Chemistry Lab	1	CH 202 Quantitative Chem Lab	1
E 101 Intro to Engr. & Prob Solv	1	Humanities/Social Science Elective	3
E 115 Intro to Computing Envir <sup>1</sup>	1	MA 241 Calculus II	4
ENG 101 Academic Writing and Resch <sup>1</sup>	4	PY 205 Physics Engr & Scien I	4
MA 141 Calculus I	4	Physical Education	<u>1</u>
PE 10x Physical Education	<u>1</u>		16
	15		
CH 221 Organic Chemistry I	3	CH 223 Organic Chemistry II	3
CH 222 Organic Chemistry I lab	1	CH 224 Organic Chemistry II Lab	1
CHE 205 Chemical Process Prin	4	PY 208 Physics Engr & Scien II	4
MA 242 Analyt Geom & Calculus III	4	CHE 225 Chemical Proc Systems	3
Humanities/Social Science Elective <sup>2</sup>	<u>3</u>	MA 341 Applied Differential Eqns	3
	15	Humanities/Social Science Elective <sup>2</sup>	<u>3</u>
			17
CH 315 Quantitative Analysis	4	CH 401 Sys Inorganic Chem	3
CHE 311 Transport Processes I	3	CHE 312 Transport Processes II	3
CHE 315 Chem Process Thermo	3	CHE 316 Thermo Chem & Phase Eq	3
ENG 331 Comm for Engr & Tech	3	CHE 330 CHE Lab I	4
Humanities/Social Science Elective	<u>3</u>	Technical Elective	3
	16	CHE 395 Professional Dev Seminar	<u>1</u>
			17
CH 428 Qual Organic Analysis	3	CH 402 Inorganic Chem Lab	1
CHE 450 CHE Design I	3	CH 403 Sys Inorganic Chem II	3
CHE 331 CHE Lab II	2	CH 434 Physical Chemistry Lab	3
CHE 446 Des & Analy Chem Reac	3	CHE 451 CHE Design II	3
Humanities/Social Science Elective	3	CHE 435 Proc Sys Analy & Control	3
CH 437 Physical Chemistry	<u>4</u>	Humanities/Social Science Elective	<u>3</u>
	18		16
CH 415 Analytical Chemistry II	3		
CH 416 Analytical Chem II Lab	1		
CH 435 Intro Quantum Chem	3		
ECE 331 Prin Electrical Engr <b>or</b>			
MSE 201 Struct & Prop Engr Matl	3		
Humanities/Social Science Elective	3		
Technical Elective	<u>3</u>		
	16		
Total Hours Required for Graduation	146 <sup>2</sup>		

<sup>1</sup> Students completing both degrees can substitute E 115 for CH 106/108.

<sup>2</sup> To graduate, students must demonstrate competency in a foreign language at the FL 102 level and have a grade of C- or higher in ENG 101, MA 141, MA 241, MA 242, MA 341, PY 205, E101, CH 101, CHE 205, CHE 225, CHE 311, and CHE 315.

**CURRICULUM IN CHEMICAL ENGINEERING & TEXTILE ENGINEERING**  
**(Degrees Earned: B.S. Chemical Engineering and B.S. Textile Engineering) (14CHE097T)**

<b>Fall Semester</b>	<b>Credit</b>	<b>Spring Semester</b>	<b>Credit</b>
CH 101 Chemistry, A Molecular Science <sup>1</sup>	3	CH 201 Chemistry – Quantitative Sci.	3
CH 102 General Chemistry Lab <sup>1</sup>	1	CH 202 Quantitative Chem Lab	1
E 101 Introduction to Engr & Prob Solv <sup>1</sup>	1	MA 241 Calculus II <sup>1</sup>	4
E 115 Intro to Computing Environ	1	PY 205 Physics for Engr & Sc I <sup>1</sup>	4
ENG 101 Academic Writing and Research <sup>1</sup>	4	GEP Requirement*	3
MA 141 Calculus I <sup>1</sup>	4	PE Phys Ed/Healthy Living Elective*	<u>1</u>
PE 1** Fitness & Wellness Course*	<u>1</u>		<b>16</b>
	<b>15</b>		
CH 221 Organic Chemistry I <sup>3</sup>	3	TE 201 Textile Engr. Sci.	4
CH 222 Organic Chemistry I Lab	1	MAE 206 Engr Statics OR	
CHE 205 Chemical Proc Prin <sup>2</sup>	4	CE 214 Engr Statics	3
MA 242 Calculus III	4	MA 341 Applied Differential Eq	3
PY 208 Physics Engr & Scientists II	<u>4</u>	CH 223 Organic Chemistry II	3
	<b>16</b>	CH 224 Organic Chemistry II Lab	1
		CHE 225 Chemical Proc Systems <sup>2</sup>	<u>3</u>
			<b>17</b>
CH 315 Quantitative Analysis	4	TE 302 Textile Mfg Proc II	4
TE 301 Engr Textile Structures I	3	ST 370 Prob & Stat for Engineers	3
GC 120 Found of Graphics	3	CHE 312 Transport Processes II	3
CHE 311 Transport Processes I <sup>2</sup>	3	CHE 316 Thermo of Chem & Phase Eq	3
CHE 315 Chem Process Thermo <sup>2,4</sup>	3	TE 205 Analog & Digital Circuits <sup>5</sup>	<u>4</u>
CHE 395 Professional Dev Seminar	<u>1</u>		<b>17</b>
	<b>17</b>		
CHE 446 Des & Analy Chem Reactors	3	TE 402 Textile Engr Des II <sup>6</sup>	4
CHE 450 CHE Design I	3	TE 404 Six Sigma Quality	3
GEP IP Requirement*	3	TE 424 Tex Engr Qual Impr Lab	1
TE 401 Textile Engr Des I	4	GEP Requirement*	3
EC 205 Econ (or EC 201 or ARE 201)	<u>3</u>	GEP Requirement*	3
	<b>16</b>	GEP Requirement*	<u>3</u>
			<b>17</b>
CHE 330 Chem Engr Lab I	4		
CHE 435 Proc System Analy & Control	3		
PCC 301 Tech of Dyeing & Finish	4		
GEP IP Requirement*	<u>2-3</u>		
	13		

Minimum Credit Hours Required for Graduation\*:

144

**Major/Program requirements and footnotes:**

<sup>1</sup> Must be completed with grade of C-or higher for matriculation.

<sup>2</sup> Must be completed with grade of C-or higher for major requirements.

<sup>3</sup> CH 221 will replace TE 200 (in the Textile Engineering curriculum)

<sup>4</sup> CHE 315 will replace TE 303 (in the Textile Engineering curriculum)

<sup>5</sup> TE 402 will replace CHE 451 (in the Chemical Engineering curriculum)

<sup>6</sup> TE 110 is eliminated (TE program) due to similar content embedded in CHE 205 & 225.

\* **General Education Program (GEP) requirements:**

To complete the requirements for graduation and the General Education Program, the following credit hours and co-requisites must be satisfied. University approved GEP course lists for each category can be found at <http://www.ncsu.edu/uap/academic-standards/gep/courselists/index.html> .

**PHYSICAL EDUCATION** - 2 hours to be selected from the approved GEP Physical Education list.

a. One fitness and wellness course (any PE 100-level course).

b. One additional credit hour of PE activity courses.

**HUMANITIES** – 6 credits to be selected in two different disciplines (two different course prefixes) from the approved GEP Humanities list.

**SOCIAL SCIENCES**- 3 credits to be selected in a discipline other than economics from the approved GEP Social Sciences list. EC 205, 201 or ARE 201 taken as part of the Major requirements satisfies 3 credit hours of the 6 credit hours needed to fulfill the GEP Social Sciences requirement.

**ADDITIONAL BREADTH** - 3 credits to be selected from the approved GEP Humanities, Social Sciences or Visual and Performing Arts lists.

**INTERDISCIPLINARY PERSPECTIVES**- 5 credits to be selected from the approved GEP Interdisciplinary Perspectives list.

**Co-requisites:**

U.S. Diversity and Global Knowledge co-requisites must be satisfied to complete the General Education requirements. Choose course(s) that are identified on the approved GEP course lists as meeting the U.S. Diversity and Global Knowledge co-requisites.

Foreign Language proficiency at the FL\_102 level will be required for graduation.

The following versions of the curricula are valid for students who matriculated prior to May 2009

**Bachelor of Science in Chemical Engineering (14CHE036Z)**

<b>Fall Semester</b>		<b>Credits</b>	<b>Spring Semester</b>		<b>Credits</b>
CH 101	Chemistry - Molecular Sci	3	CH 201	Chem - Quantitative Sci	3
CH 102	General Chemistry Lab	1	CH 202	Quantitative Chem Lab	1
E 101	Intro to Engr. & Prob Solv	1	Humanities/Social Science Elective <sup>2</sup>		3
E 115	Intro to Computing Envir	1	MA 241	Analyt Geom & Calculus II	4
MA 141	Analyt Geom & Calculus I	4	PY 205	Physics Engr & Scien I	4
ENG 101	Academic Writing and Resch <sup>1</sup>	4	Physical Education		<u>1</u>
PE 10x	Health & Phys Fitness	<u>1</u>			16
		15			
CH 221	Organic Chemistry I	3	CH 223	Organic Chemistry II	3
CH 222	Organic Chemistry I lab	1	CH 224	Organic Chemistry II Lab	1
CHE 205	Chemical Process Prin	4	PY 208	Physics Engr & Scien II	4
MA 242	Analyt Geom & Calculus III	4	CHE 225	Chemical Proc Systems	3
Humanities/Social Science Elective <sup>2</sup>		<u>3</u>	MA 341	Applied Differential Eqns	3
		15	Humanities/Social Science Elective <sup>2</sup>		<u>3</u>
					17
Humanities/Social Science Elective <sup>2</sup>		3	CHE 312	Transport Processes II	3
CHE 311	Transport Processes I	3	CHE 316	Thermo Chem & Phase Eq	3
CHE 315	Chem Process Thermo	3	CHE 330	CHE Lab I	4
CH 315	Quantitative Analysis	4	Chemistry Elective <sup>3</sup>		4
MSE 201	Struct Prop Engr Matl <b>or</b>		ENG 331	Comm for Engr & Tech <sup>4</sup>	<u>3</u>
CHE 395	Professional Dev. Seminar	1			17
ECE 331	Prin Elec Engr	<u>3</u>			
		17			
Technical Elective <sup>5</sup>		3	CHE 435	Proc Sys Analy & Control	3
CHE 446	Des & Analy Chem Reac	3	CHE 451	CHE Design II	3
CHE 450	CHE Design I	3	Technical Elective <sup>5</sup>		3
CHE 331	CHE Lab II	2	Humanities/Social Science Elective <sup>2</sup>		3
Humanities/Social Science Elective <sup>2</sup>		<u>3</u>	Humanities/Social Science Elective <sup>2</sup>		<u>3</u>
		14			15

Minimum Credit Hours Required for Graduation 126<sup>6</sup>

<sup>1</sup> ENG 101 may be taken in either the fall or the spring

<sup>2</sup> Select from the College of Engineering's Humanities and Social Sciences (H&SS) list for the GER. At least one of the courses must focus on a non-English speaking culture.

<sup>3</sup> **Chemistry electives** (note – must be 4 hrs) include:

CH 437: Physical Chemistry  
BCH 451: Biochemistry  
PCC 461: Intro to Fiber Form Polymers (fall only)  
FS 402 Food Science (fall only)  
CH 401 (Inorganic Chemistry) plus CH 230 or CH 232 (Computational Chemistry)  
CH 415 (Analytical Chemistry) plus CH 230 or CH 232 (Computational Chemistry)  
CH 441 (Forensic Chemistry) plus CH 230 or CH 232 (Computational Chemistry)

<sup>4</sup> Students can also take ENG 332 or 333 in place of ENG 331.

<sup>5</sup> **Technical electives** include:

CE 373: Principles of Environmental Eng.	CE 476: Air Pollution Control
CE 484: Water and Waste Systems	CE 479: Air Quality
CE 477: Solid Waste Management	TC 401: Env Aspects of the Textile Industry
BAE 422: Intro to Food Process Engineering	ISE 311: Engineering Economic Analysis
IE 443: Quality Design Control	MSE 201: Struct & Prop of Eng Materials
TE 466: Polymeric Biomaterials Engineering	ECE 331: Principles of Electrical Engineering
MAE 206: Engineering Statics	MAE 208: Engineering Dynamics
MAE 314: Solid Mechanics	MAE 406: Energy Conservation in Industry
MAE 421: Design of Solar Thermal Systems	NE 404: Radiation Safety and Shielding
NE 419: Introduction to Nuclear Energy	CE 596S: Sustainable Development
CHE 460 (and above) electives	
PSE 425: Bioenergy and Biomaterials Engineering	

<sup>6</sup> To graduate, students must demonstrate competency in a foreign language at the FL 102 level and have a grade of C- or higher in ENG 101.

**Bachelor of Science in Chemical Engineering**  
**Biomolecular Engineering Concentration (14CHE036B)**

Fall Semester	Credits	Spring Semester	Credits
CH 101 Chemistry - Molecular Sci	3	CH 201 Chem - Quantitative Sci	3
CH 102 General Chemistry Lab	1	CH 202 Quantitative Chem Lab	1
E 101 Intro to Engr & Prob Solv	1	Humanities/Social Science Elective <sup>2</sup>	3
E 115 Intro to Computing Envir	1	MA 241 Analyt Geom & Calculus II	4
MA 141 Analyt Geom & Calculus I	4	PY 205 Physics Engr & Scien I	4
ENG 101 Academic Writing and Resch <sup>1</sup>	4	Physical Education	<u>1</u>
PE 10x Health & Phys Fitness	<u>1</u>		16
	15		
CHE 205 Chemical Process Prin	4	CHE 225 Chemical Proc Systems	3
CH 221 Organic Chemistry I	3	CH 223 Organic Chemistry II	3
CH 222 Organic Chemistry I lab	1	CH 224 Organic Chemistry II Lab	1
PY 208 Physics Engr & Scien II	4	MA 341 Applied Differential Eqns	3
MA 242 Analyt Geom & Calculus III	<u>4</u>	BIO 183 General Biology	4
	16	Humanities/Social Science Elective <sup>2</sup>	<u>3</u>
			17
BCH 451 Intro Biochemistry	4	BIT Lab Modules <sup>3</sup>	4
Humanities/Social Science Elective <sup>2</sup>	3	CHE 312 Transport Processes II	3
CHE 311 Transport Processes I	3	CHE 316 Thermo Chem & Phase Eq	3
CHE 315 Chem Process Thermo	3	CHE 330 CHE Lab I	4
BIT 410 Manipulation of Re DNA	<u>4</u>	ENG 331 Comm for Engr & Tech <sup>4</sup>	3
	17	CHE 395 Professional Dev. Seminar	<u>1</u>
			18
Humanities/Social Science Elective <sup>2</sup>	3	CHE 435 Proc Sys Analy & Control	3
CHE 446 Des & Analy Chem Reac	3	CHE 451 CHE Design II	3
CHE 450 CHE Design I	3	CHE 551 Biochemical Engineering	3
CHE 497 Chem Eng Proj I	3	Biotech minor Group E course <sup>5</sup>	3
Humanities/Social Science Elective <sup>2</sup>	<u>3</u>	Humanities/Social Science Elective <sup>2</sup>	<u>3</u>
	15		15

Minimum Credit Hours Required for Graduation 129<sup>6</sup>

Students completing this concentration will simultaneously fulfill the requirements for a Minor in Biotechnology.

<sup>1</sup> ENG 101 may be taken in either the fall or the spring

<sup>2</sup> Select from the College of Engineering's Humanities and Social Sciences (H&SS) list for the GER. At least one of the courses must focus on a non-English speaking culture.

<sup>3</sup> Students must take two 2-hour BIT lab modules from the following list: CHE/BEC 463, CHE/BIT 464; BIT 462, 466, 467, 468, 481, and 569; BEC 462 and 465. In addition, selected BIT 495 Special Topics courses may be approved by the student's advisor.

<sup>4</sup> Students can also take ENG 332 or 333 in place of ENG 331.

<sup>5</sup> The biotech minor group E course counts as an H&SS for the Science, Technology, and Society category. The courses include:

IDS 201: Environmental Ethics

STS 302: Cont Science, Technology, and Human Values

IDS 303: Humans and the Environment

STS 304 Ethical Dimensions of Progress

STS 320: Ethics in Engineering

STS(PHI) 325: Bio-Medical Ethics

<sup>6</sup> To graduate, students must demonstrate competency in a foreign language at the FL 102 level and have a grade of C- or higher in ENG 101.

**B. S. in Chemical Engineering**  
**Biomanufacturing Sciences Concentration (14CHE081F)**

Fall Semester	Credits	Spring Semester	Credits
CH 101 Chemistry - Molecular Sci	3	CH 201 Chem - Quantitative Sci	3
CH 102 General Chemistry Lab	1	CH 202 Quantitative Chem Lab	1
E 101 Intro to Engr & Prob Solv	1	Humanities/Social Science Elective <sup>2</sup>	3
E 115 Intro to Computing Envir	1	MA 241 Analyt Geom & Calculus II	4
MA 141 Analyt Geom & Calculus I	4	PY 205 Physics Engr & Scien I	4
ENG 101 Academic Writing and Resch <sup>1</sup>	4	Physical Education	<u>1</u>
PE 10x Health & Phys Fitness	<u>1</u>		16
	15		
PY 208 Physics Engr & Scien II	4	Humanities/Social Science Elective <sup>2</sup>	3
BEC 220 Intro Biomanufacturing	1	CH 223 Organic Chemistry II	37
CH 221 Organic Chemistry I	3	CH 224 Organic Chemistry II Lab	1
CH 222 Organic Chemistry I Lab	1	MA 341 Applied Differential Eqns	3
CHE 205 Chemical Process Principles	4	CHE 225 Chem. Eng. Analysis	3
MA 242 Analyt Geom & Calculus III	<u>4</u>	BIO 183 General Biology <sup>3</sup>	<u>4</u>
	17		17
BCH 451 Intro Biochemistry	4	BEC 330 Fund. Downstream Process	2
Humanities/Social Science Elective <sup>2</sup>	3	CHE 312 Transport Processes II	3
CHE 311 Transport Processes I	3	CHE 316 Thermo Chem & Phase Eq	3
CHE 315 Chem Process Thermo	3	Humanities/Social Science Elective <sup>2</sup>	3
BEC 320 Fund. Micro. Cell Culture	2	BBS 426 Ind. Micro. Bioproc. Lab	2
BEC 420 Micro. Cell Biotransforms	<u>2</u>	ENG 331 Comm for Engr & Tech <sup>4</sup>	<u>3</u>
	17		16
BEC 436 Downstream Proc. Biomat.	2	CHE 435 Proc Sys Analy & Control	3
CHE 447 Bioreactor Engineering	3	CHE 451 CHE Design II	3
CHE 450 CHE Design I	3	Humanities/Social Science Elective <sup>2</sup>	3
Biomanufacturing Elective <sup>5</sup>	2	BIT minor bioethics course <sup>6</sup>	3
Humanities/Social Science Elective <sup>2</sup>	3	BEC 480 Large-Scale Fermentation <b>or</b>	
CHE 395 Professional Dev. Seminar	<u>1</u>	BEC 485 LS Recovery/Purification	<u>2</u>
	14		14

Minimum Credit Hours Required for Graduation 126<sup>7</sup>

Students completing this concentration will simultaneously fulfill the requirements for a Minor in Biomanufacturing.

<sup>1</sup> ENG 101 may be taken in either the fall or the spring

<sup>2</sup> Select from the College of Engineering's Humanities and Social Sciences (H&SS) list for the GER. At least one of the courses must focus on a non-English speaking culture.

<sup>3</sup> Students may substitute ZO 160 for BIO 183

<sup>4</sup> Students can also take ENG 332 or 333 in place of ENG 331.

<sup>5</sup> The biomanufacturing elective course must be selected from the following list:

BEC 440 – Expression Systems in Biomanufacturing

BEC 442 – Insect Cell Protein Expression

BEC 462 – Bionanotechnology Laboratory

BEC 480 – Large-Scale Fermentation

BEC 485 – Large-Scale Recovery and Purification

BEC 497 – Biomanufacturing Research Projects

BIT 466 – Animal Cell Culture

BIT 470 – Advanced Animal Cell Culture – Bioreactor Culture

<sup>6</sup> The BIT minor bioethics course counts as an H&SS for the Science, Technology, and Society category. The courses include:

IDS 201: Environmental Ethics

STS 302: Cont Science, Technology, and Human Values

IDS 303: Humans and the Environment

STS 304 Ethical Dimensions of Progress

STS 320: Ethics in Engineering

STS(PHI) 325: Bio-Medical Ethics

<sup>7</sup> To graduate, students must demonstrate competency in a foreign language at the FL 102 level and have a grade of C- or higher in ENG 101.

**Bachelor of Science in Chemical Engineering**  
**Green Chemistry and Engineering Concentration (14CHE036R)**

Fall Semester	Credits	Spring Semester	Credits
CH 101 Chemistry - Molecular Sci	3	CH 201 Chem - Quantitative Sci	3
CH 102 General Chemistry Lab	1	CH 202 Quantitative Chem Lab	1
E 101 Intro to Engr.& Prob Solv	1	Humanities/Social Science Elective <sup>2</sup>	3
E 115 Intro to Computing Envir	1	MA 241 Analyt Geom & Calculus II	4
MA 141 Analyt Geom & Calculus I	4	PY 205 Physics Engr & Scien I	4
ENG 101 Academic Writing & Research <sup>1</sup>	4	Physical Education	<u>1</u>
PE 10x Health & Phys Fitness	<u>1</u>		16
	15		
CH 221 Organic Chemistry I	3	CH 223 Organic Chemistry II	3
CH 222 Organic Chemistry I lab	1	CH 224 Organic Chemistry II Lab	1
CHE 205 Chemical Process Prin	4	PY 208 Physics Engr & Scien II	4
MA 242 Analyt Geom & Calculus III	4	CHE 225 Chemical Proc Systems	3
Humanities/Social Science Elective <sup>2</sup>	<u>3</u>	MA 341 Applied Differential Eqns	3
	15	Humanities/Social Science Elective <sup>2</sup>	<u>3</u>
			17
ENG 331 Comm for Engr & Tech <sup>3</sup>	3	CHE 312 Transport Processes II	3
CHE 311 Transport Processes I	3	CHE 316 Thermo Chem & Phase Eq	3
CHE 315 Chem Process Thermo	3	CHE 330 CHE Lab I	4
CH 315 Quantitative Analysis	4	Chemistry Elective <sup>4</sup>	4
MSE 201 Struct & Propr Engr Matl <b>or</b>		Humanities/Social Science Elective <sup>2</sup>	<u>3</u>
ECE 331 Prin Elec Engr	<u>3</u>		17
	16		
Concentration Elective <sup>5</sup>	3	CHE 435 Proc Sys Analy & Control	3
CHE 446 Des & Analy Chem Reac	3	CHE 451 CHE Design II	3
CHE 450 CHE Design I	3	CHE 475 Adv Pollution Prevention	3
CHE 331 CHE Lab II	2	Humanities/Social Science Elective <sup>2</sup>	3
Humanities/Social Science Elective <sup>2</sup>	3	Humanities/Social Science Elective <sup>2</sup>	<u>3</u>
CHE 395 Professional Dev. Seminar	<u>1</u>		15
	15		

Minimum Credit Hours Required for Graduation 126<sup>6</sup>

<sup>1</sup> ENG 101 may be taken in either the fall or the spring

<sup>2</sup> Select from the College of Engineering's Humanities and Social Sciences (H&SS) list for the GER. At least one of the courses must focus on a non-English speaking culture.

<sup>3</sup> Students can also take ENG 332 or 333 in place of ENG 331.

<sup>4</sup> **Chemistry electives** include:

CH 437: Physical Chemistry

PCC 461: Intro to Fiber Form Polymers

BCH 451: Biochemistry

CH 401/402: Inorganic Chemistry

CH 415/416: Analytical Chemistry II

<sup>5</sup> **Concentration electives** include:

CE 373: Principles of Environmental Eng

CE 484: Water and Waste Systems

CE 479: Air Quality

CE 476: Air Pollution Control

CE 477: Solid Waste Management

PSE 425: Bioenergy and Biomaterials

<sup>6</sup> To graduate, students must demonstrate competency in a foreign language at the FL 102 level and have a grade of C- or higher in ENG 101.

**Bachelor of Science in Chemical Engineering**  
**Honors Program (14CHE036H)**

Fall Semester	Credits	Spring Semester	Credits		
CH 101	Chemistry - Molecular Sci	3	CH 201	Chem - Quantitative Sci	3
CH 102	General Chemistry Lab	1	CH 202	Quantitative Chem Lab	1
E 101	Intro to Engr.& Prob Solv	1	Humanities/Social Science Elective <sup>2</sup>		3
E 115	Intro to Computing Envir	1	MA 241	Analyt Geom & Calculus II	4
ENG 101	Academic Writing and Resch <sup>1</sup>	4	PY 205	Physics Engr & Scien I	4
MA 141	Analyt Geom & Calculus I	4	Physical Education		<u>1</u>
PE 10x	Physical Education	<u>1</u>			16
		15			
CH 221	Organic Chemistry I	3	CH 223	Organic Chemistry II	3
CH 222	Organic Chemistry I lab	1	CH 224	Organic Chemistry II Lab	1
CHE 205	Chemical Process Prin	4	PY 208	Physics Engr & Scien II	4
MA 242	Analyt Geom & Calculus III	4	CHE 225	Chemical Proc Systems	3
Humanities/Social Science Elective <sup>2</sup>		<u>3</u>	MA 341	Applied Differential Eqns	3
		15	Humanities/Social Science Elective <sup>2</sup>		<u>3</u>
					17
CH 315	Quantitative Analysis	4	Chemistry Elective <sup>3</sup>		4
CHE 311H	Transport Processes I	3	CHE 312H	Transport Processes II	3
CHE 315	Chem Process Thermo	3	CHE 316	Thermo Chem & Phase Eq	3
Mathematics Elective <sup>4</sup>		3	CHE 330	CHE Lab I	4
Humanities/Social Science Elective <sup>2</sup>		<u>3</u>	CHE 395	Prof Dev Seminar	1
		16	ENG 333	Comm for Sci & Research <sup>1</sup>	<u>3</u>
					18
CHE 497	Chem Engr Projects <sup>2</sup>	3	CHE 435	Proc Sys Analy & Control	3
CHE 446	Design & Analy Chem. React	3	CHE 451	CHE Design II	3
CHE 450	CHE Design I	3	Humanities/Social Science Elective <sup>2</sup>		3
CHE 7xx <sup>5</sup>		3	Humanities/Social Science Elective <sup>2</sup>		3
Humanities/Social Science Elective <sup>2</sup>		<u>3</u>	Honors Electives <sup>6</sup>		3
		15	CHE 495	Honors Thesis Prep <sup>7</sup>	<u>1</u>
					16
Total Hours Required for Graduation			<b>128</b> <sup>8</sup>		

<sup>1</sup> ENG 101 may be taken in either the fall or the spring

<sup>2</sup> Select from the College of Engineering's Humanities and Social Sciences (H&SS) list for the GER. At least one of the courses must focus on a non-English speaking culture.

<sup>3</sup> **Chemistry electives** include:

CH 437: Physical Chemistry

CH 415/416: Analytical Chemistry II

BCH 451: Biochemistry

CH 401/402: Inorganic Chemistry

PCC 461: Intro to Fiber Form Polymers

<sup>4</sup> **Math electives** include:

MA401: Applied Differential Equations II

MA405: Intro to Linear Algebra and Matrices

MA 501: Advanced Math for Eng and Sci

MA402: Computational Math

MA/CSC 427: Intro to Numerical Analysis

<sup>5</sup> **CHE 7xx** includes:

CHE 711: Chemical Eng Process Modeling

CHE 715: Transport Phenomena I

CHE 713: Thermodynamics I

CHE 717: Chemical Reaction Engineering.

<sup>6</sup> **Honors electives** include

CHE 460 and above

CHE 5xx

CHE 7xx.

<sup>7</sup> An honors thesis is required for completion of the Honors Program.

<sup>8</sup> To graduate, students must demonstrate competency in a foreign language at the FL 102 level and have a grade of C- or higher in ENG 101.

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Candidates for admission to the CHE Honors Program must have earned a minimum over-all grade point average of 3.50, and a minimum major grade point average of 3.5 based on taking CHE 205 and CHE 225. Students must graduate with a total GPA of at least 3.25 to get credit for completing the Honors Program.

**Bachelor of Science in Chemical Engineering**  
**Nanoscience concentration (14CHE036E)**

Fall Semester	Credits	Spring Semester	Credits		
CH 101	Chemistry - Molecular Sci	3	CH 201	Chem - Quantitative Sci	3
CH 102	General Chemistry Lab	1	CH 202	Quantitative Chem Lab	1
E 101	Intro to Engr. & Prob Solv	1	Humanities/Social Science Elective <sup>2</sup>		3
E 115	Intro to Computing Envir	1	MA 241	Analyt Geom & Calculus II	4
ENG 101	Academic Writing & Resrch <sup>1</sup>	4	PY 205	Physics Engr & Scien I	4
MA 141	Analyt Geom Calculus I	4	Physical Education		<u>1</u>
PE 10x		<u>1</u>			16
		17			
CH 221	Organic Chemistry I	3	CH 223	Organic Chemistry II	3
CH 222	Organic Chemistry I lab	1	CH 224	Organic Chemistry II Lab	1
CHE 205	Chemical Process Prin	4	MSE 201	Struct & Prop Engr Matl	3
MA 242	Analyt Geom & Calculus III	4	CHE 225	Chemical Proc Systems	3
PY 208	Physics Engr & Scien II	<u>4</u>	MA 341	Applied Differential Eqns	3
		16	Humanities/Social Science Elective <sup>2</sup>		<u>3</u>
					16
Chemistry Elective <sup>3</sup>		4	CH 437	Physical Chem for Engrs	4
CHE 311	Transport Processes I	3	CHE 312	Transport Processes II	3
CHE 315	Chem Process Thermo	3	CHE 316	Thermo Chem & Phase Eq	3
Humanities/Social Science Elective <sup>2</sup>		3	CHE 330	CHE Lab I	4
Humanities/Social Science Elective <sup>2</sup>		<u>3</u>	ENG 331	Comm for Engr & Tech <sup>4</sup>	3
		16	CHE 395	Prof. Dev. Seminar	<u>1</u>
					18
CHE 331	CHE Lab II	2	CHE 435	Proc Sys Analy & Control	3
CHE 446	Des & Analy Chem Reac	3	CHE 451	CHE Design II	3
CHE 450	CHE Design I	3	Nanoscience Elective <sup>5</sup>		3
Nanoscience Elective <sup>5</sup>		3	Humanities/Social Science Elective <sup>2</sup>		3
Humanities/Social Science Elective <sup>2</sup>		<u>3</u>	Humanities/Social Science Elective <sup>2</sup>		<u>3</u>
		14			15
Total Hours Required for Graduation			126 <sup>6</sup>		

<sup>1</sup> ENG 101 may be taken in either the fall or the spring

<sup>2</sup> Select from the College of Engineering's Humanities and Social Sciences (H&SS) list for the GER. At least one of the courses must focus on a non-English speaking culture.

<sup>3</sup> Chemistry electives include:

CH 401/402: Inorganic Chemistry	CH 415/416: Analytical Chemistry II
CH 315: Quantitative Analysis	PCC 461: Intro to Fiber Form Polymers
BCH 451: Biochemistry	

<sup>4</sup> Students can also take ENG 332 or 333 in place of ENG 331.

<sup>5</sup> Nanoscience electives include:

CHE/MSE 455	Polymer Technology and Engineering
CHE 460:	Chemical Properties of Electronic Materials
CHE 461:	Polymer Science and Technology
CHE 462:	Soft Matter
CHE 467:	Rheology
CHE 596C:	Thin Films and Surfaces
CHE 596D:	Colloidal and Macromolecular Physics
CHE 596J:	Polymers at Interfaces and in Confined Geometries
ECE 331:	Principles of Electrical Engineering
CH 795M:	Special Topics in Chemistry
MSE 425:	Polymer Science & Technology
MSE 331:	Elec Properties of Materials
MSE 460:	Microelectronic Materials
PY 407:	Intro to Modern Physics
BEC 462 (Bionanotechnology) + 1 credit CHE 498 (research)	

Additional nanoscience electives may be approved on a case-by-case basis as new courses are introduced.

<sup>6</sup> To graduate, students must demonstrate competency in a foreign language at the FL 102 level and have a grade of C- or higher in ENG 101.

**Accelerated Master's Degree in Chemical Engineering (BS and MS degrees)**

<b>Fall Semester</b>		<b>Credits</b>	<b>Spring Semester</b>		<b>Credits</b>
CH 101	Chemistry - Molecular Sci	3	CH 201	Chem - Quantitative Sci	3
CH 102	General Chemistry Lab	1	CH 202	Quantitative Chem Lab	1
E 101	Intro to Engr. & Prob Solv	1	Humanities/Social Science Elective <sup>2</sup>		3
E 115	Intro to Computing Envir	1	MA 241	Calculus II	4
MA 141	Calculus I	4	PY 205	Physics Engr & Scien I	4
ENG 101	Academic Writing and Resch <sup>1</sup>	4	Physical Education		<u>1</u>
PE 10x	Health & Phys Fitness	<u>1</u>			16
		15			
CH 221	Organic Chemistry I	3	CH 223	Organic Chemistry II	3
CH 222	Organic Chemistry I lab	1	CH 224	Organic Chemistry II Lab	1
CHE 205	Chemical Process Prin	4	PY 208	Physics Engr & Scien II	4
MA 242	Analyt Geom & Calculus III	4	CHE 225	Chemical Proc Systems	3
Humanities/Social Science Elective <sup>2</sup>		<u>3</u>	MA 341	Applied Differential Eqns	3
		15	Humanities/Social Science Elective <sup>2</sup>		<u>3</u>
					17
Humanities/Social Science Elective <sup>2</sup>		3	CHE 312	Transport Processes II	3
CHE 311	Transport Processes I	3	CHE 316	Thermo Chem & Phase Eq	3
CHE 315	Chem Process Thermo	3	CHE 330	CHE Lab I	4
CH 315	Quantitative Analysis	4	Chemistry Elective <sup>3</sup>		4
MSE 201	Struct & Propr Engr Matl or		CHE 395	Professional Dev. Seminar	1
ECE 331	Prin Elec Engr	<u>3</u>	ENG 331	Comm for Engr & Tech <sup>4</sup>	<u>3</u>
		16			18
500-level Technical Elective		3	CHE 535	Proc Sys Analy & Control	3
CHE 546	Des & Analy Chem Reac	3	CHE 451	CHE Design II	3
CHE 450	CHE Design I	3	500-level Technical Elective		3
CHE 331	CHE Lab II	2	Humanities/Social Science Elective <sup>2</sup>		3
Humanities/Social Science Elective <sup>2</sup>		<u>3</u>	Humanities/Social Science Elective <sup>2</sup>		<u>3</u>
		14			15
CHE 711	ChE Process Modeling	3	CHE 596U	Special Topics in CHE	3
CHE 713	Thermodynamics I	3	CHE 721	Separation Processes	3
CHE 717	Chem Reaction Engr	<u>3</u>	CHE Graduate Elective		<u>3</u>
		9			9
Total Hours Required for Graduation			144 <sup>5,6</sup>		

<sup>1</sup> ENG 101 may be taken in either the fall or the spring

<sup>2</sup> Select from the College of Engineering's Humanities and Social Sciences (H&SS) list for the GER. At least one of the courses must focus on a non-English speaking culture.

<sup>3</sup> **Chemistry electives** include:

CH 437: Physical Chemistry	CH 401/402: Inorganic Chemistry
CH 415/416: Analytical Chemistry II	BCH 451: Biochemistry
PCC 461: Intro to Fiber Form Polymers	

<sup>4</sup> Students can also take ENG 332 or 333 in place of ENG 331.

<sup>5</sup> To graduate, students must demonstrate competency in a foreign language at the FL 102 level and have a grade of C- or higher in ENG 101.

<sup>6</sup> Students must have an overall GPA of 3.5 through the end of the junior year and must maintain this GPA through the senior year to be admitted into the program. Students who wish to complete the Accelerated BS/MS ChE degree program must apply for candidacy to the MS degree during the spring semester of the junior year (semester during which CHE 312/316 are completed). The admissions process includes submitting the following information to the Chemical and Biomolecular Engineering Graduate Administrator, Dr. Saad Khan:

- (1) Completed copy of the signed graduate application form
- (2) NC Residency Form if you wish to claim NC residency for tuition purposes
- (3) Non-Refundable application fee in form of a check or money order
- (4) Three letters of recommendation
- (5) Official transcript sent directly from every college and graduate school attended
- (8) Graduate Record Examination (**GRE**) scores

Students must receive a grade of B (3.0/4.0) or better in the double counted graduate level courses. Courses with a grade of B- or below can not be double counted between the two degrees. No more than twelve (12) hours of graduate work may be counted towards the requirements of both degrees. Students must complete the Master's degree within 12 months from the completion of the baccalaureate degree for a non-thesis Master's degree and within 18 months for Master's programs requiring a thesis. If the Master's program is not completed within these time limits, none of the courses can be double counted. Note that the B.S. Degree must be completed in order to get the dual BS/MS (students cannot double major in something else and then skip to the MS CHE).

Recipients of the MS degree must earn a minimum semester GPA of 3.0 during the final two semesters, including no more than one C grade in 500 and 700 level CHE courses.

## Cooperative BS/MS Degree Programs in Chemical Engineering and Pharmaceutical Sciences (Campbell)

The Cooperative BS/MS Degree Programs in chemical engineering and pharmaceutical sciences are designed for the chemical engineering biomolecular concentration or biomanufacturing sciences concentration students who want to gain advanced knowledge in an area of specialization in the pharmaceutical sciences. The MS in Pharmaceutical Sciences (Industrial Pharmacy track) includes extensive hands-on training in advanced laboratory techniques. The program is completed after five years, including one summer term during or before the junior year, and graduates from the program should be competent to support and to lead a team for the development of new pharmaceutical products and delivery systems. The BS degree in chemical engineering is completed at NC State and the MS degree in pharmaceutical sciences is completed at Campbell University.

The Master of Science in Pharmaceutical Science (MSPS) at Campbell features specialized training in several areas of the pharmaceutical sciences. The MSPS core curriculum includes a background in molecular biology, analytical instrumentation, pharmacology, biochemistry, and other courses. The student then takes advanced courses in a specialized track. The tracks are bioprocessing, industrial pharmacy, pharmacology, and pharmaceutical analysis, and these include extensive hands-on training in advanced laboratory techniques. Students are required to utilize these skills by conducting a research project within their area of specialization.

At its heart, chemical engineering education “integrates design and analysis, science, and technology with communication skills developed through exposure to the humanities and the social and economic sciences. Chemical engineering organizes these diverse skills into a coherent discipline uniquely suited to the needs of the chemical, biochemical, petroleum, plastics, textile, and pulp and paper industries.” In addition, both the chemical engineering biomolecular concentration and the biomanufacturing sciences concentration provide undergraduates with an educational background that is a strong preparation to pursue graduate education in the pharmaceutical sciences.

The Cooperative Degree Programs are designed to educate and train a highly skilled individual who is competent to support and to lead a team for the development of new pharmaceutical products and delivery systems. Furthermore, by combining the NC State BS degree program in chemical engineering – either biomolecular concentration or the biomanufacturing sciences concentration with the Master of Science in Pharmaceutical Science program at Campbell University, interested students will be benefited by their ability to earn the two degrees in a total of five years, which includes one summer term at NC State, instead of the usual six years. Academically, all current NC State course and curriculum requirements will continue to be fulfilled only with NC State coursework, and the chemical engineering degree will be earned after four years, including two summer terms.

Students will normally apply for admission, and be admitted to, the dual degree program during the junior year and will be expected to enroll for classes during the summer following the junior year. Requirements for admission are:

- GPA of 3.0 and above through fall (1<sup>st</sup>) semester in the junior year.
- GRE 1,000 (verbal & quantitative) + 4.0 in analytical writing
- TOEFL > 550 (paper), 213 (computer), or 79 (Internet) if needed.
- General prerequisites: Physics I & II, General Chemistry I & II, Organic Chemistry I & II, Biochemistry, Analytical Instrumentation (This is satisfied by taking the three designated courses indicated in the curriculum)
- Application deadline is March 1 of the junior year.
- One recommendation letter out of three in the application should be from the dual degree contact person (academic advisor) at NCSU.

**Cooperative BS/MS Degree Programs**  
**in Chemical Engineering and Pharmaceutical Sciences**  
**(Biomolecular Version)**

Fall Semester	Credits	Spring Semester	Credits
CH 101 Chemistry - Molecular Sci	3	CH 201 Chem - Quantitative Sci	3
CH 102 General Chemistry Lab	1	CH 202 Quantitative Chem Lab	1
E 101 Intro to Engr & Prob Solv	1	Humanities/Social Science Elective <sup>2</sup>	3
E 115 Intro to Computing Envir	1	MA 241 Analyt Geom & Calculus II	4
MA 141 Analyt Geom & Calculus I	4	PY 205 Physics Engr & Scien I	4
ENG 101 Academic Writing and Resch <sup>1</sup>	4	Physical Education	<u>1</u>
PE 10x Health & Phys Fitness	<u>1</u>		16
	15		
CHE 205 Chemical Process Prin	4	CHE 225 Chemical Proc Systems	3
CH 221 Organic Chemistry I	3	CH 223 Organic Chemistry II	3
CH 222 Organic Chemistry I lab	1	CH 224 Organic Chemistry II Lab	1
PY 208 Physics Engr & Scien II	4	MA 341 Applied Differential Eqns	3
MA 242 Analyt Geom & Calculus III	<u>4</u>	BIO 183 General Biology	4
	16	Humanities/Social Science Elective <sup>2</sup>	<u>3</u>
			17
BCH 451 Intro Biochemistry	4	BIT 464 Protein Purification	2
Humanities/Social Science Elective <sup>2</sup>	3	CHE 312 Transport Processes II	3
CHE 311 Transport Processes I	3	CHE 316 Thermo Chem & Phase Eq	3
CHE 315 Chem Process Thermo	3	CHE 330 CHE Lab I	4
BIT 410 Manipulation of Re DNA	<u>4</u>	ENG 331 Comm for Engr & Tech <sup>4</sup>	3
	17	CHE 395 Professional Dev. Seminar	1
		BIT 569 RNA Purification & Analysis	<u>2</u>
			18
<b>Summer Session:</b>			
BIO 212 Anatomy and Physiology	4		
Humanities/Social Science Elective <sup>2</sup>	3		
Humanities/Social Science Elective <sup>2</sup>	<u>3</u>		
	10		
Humanities/Social Science Elective <sup>2</sup>	3	CHE 435 Proc Sys Analy & Control	3
CHE 446 Des & Analy Chem Reac	3	CHE 451 CHE Design II	3
CHE 450 CHE Design I	3	CHE 551 Biochemical Engineering	3
CHE 497 Chem Eng Proj I	3	Biotech minor Group E course <sup>5</sup>	3
PHSC 514 Industrial Pharmacy <sup>3</sup>	<u>3</u>	PHSC 574 Biopharmaceutics <sup>3</sup>	3
	15	PHSC 540 Advanced Physical Pharmacy <sup>3</sup>	<u>3</u>
			18
PHSC 510 Pharmacokinetics	2	PHSC 508 Process Validation	2
PHSC 512 Prin. of Pharma and Med Chem.	3	PHSC 536 MS Seminar II	1
PHSC 523 Expt Design & Biostatistics	4	PHSC 542 Adv. Topics in Ind Pharmacy	4
PHSC 534 MS Seminar I	1	PHSC 620 Research Project	<u>4</u>
PHSC xxx Elective(s)	3		11
PHSC 515 Industrial Pharmacy Lab	1		
PHSC 610 Research Proposal	<u>2</u>		
	16		

Minimum Credit Hours Required for BS CHE Graduation 128<sup>6</sup>

Minimum Credit Hours Required for MS Pharmaceutical Sciences 168

Students completing this concentration will simultaneously fulfill the requirements for a Minor in Biotechnology.

PHSC courses offered through Campbell are subject to Campbell tuition. Courses in the 5<sup>th</sup> year are taken at Campbell.

<sup>1</sup> ENG 101 may be taken in either the fall or the spring

<sup>2</sup> Select from the College of Engineering's Humanities and Social Sciences (H&SS) list for the GER. At least one of the courses must focus on a non-English speaking culture.

<sup>3</sup> Offered via videoconference from Campbell. The lab, PHSC 515, will be offered either at Campbell or at BTEC.

<sup>4</sup> Students can also take ENG 332 or 333 in place of ENG 331.

<sup>5</sup> The biotech minor group E course counts as an H&SS for the Science, Technology, and Society category. The courses include:

IDS 201: Environmental Ethics

STS 302: Cont Science, Technology, and Human Values

IDS 303: Humans and the Environment

STS 304: Ethical Dimensions of Progress

STS 320: Ethics in Engineering

STS(PHI) 325: Bio-Medical Ethics

<sup>6</sup> To graduate, students must demonstrate competency in a foreign language at the FL 102 level and have a grade of C- or higher in ENG 101.

**Cooperative BS/MS Degree Programs**  
**in Chemical Engineering and Pharmaceutical Sciences**  
**(Biomanufacturing Version)**

<b>Fall Semester</b>		<b>Credits</b>	<b>Spring Semester</b>		<b>Credits</b>
CH 101	Chemistry - Molecular Sci	3	CH 201	Chem - Quantitative Sci	3
CH 102	General Chemistry Lab	1	CH 202	Quantitative Chem Lab	1
E 101	Intro to Engr & Prob Solv	1	Humanities/Social Science Elective <sup>2</sup>		3
E 115	Intro to Computing Envir	1	MA 241	Analyt Geom & Calculus II	4
MA 141	Analyt Geom & Calculus I	4	PY 205	Physics Engr & Scien I	4
ENG 101	Academic Writing and Resch <sup>1</sup>	4	Physical Education		<u>1</u>
PE 10x	Health & Phys Fitness	<u>1</u>			16
		15			
PY 208	Physics Engr & Scien II	4	Humanities/Social Science Elective <sup>2</sup>		3
BEC 220	Intro Biomanufacturing	1	CH 223	Organic Chemistry II	3
CH 221	Organic Chemistry I	3	CH 224	Organic Chemistry II Lab	1
CH 222	Organic Chemistry I Lab	1	MA 341	Applied Differential Eqns	3
CHE 205	Chemical Process Principles	4	CHE 225	Chem. Eng. Analysis	3
MA 242	Analyt Geom & Calculus III	<u>4</u>	BIO 183	General Biology	<u>4</u>
		17			17
BCH 451	Intro Biochemistry	4	BEC 330	Fund. Downstream Process	2
Humanities/Social Science Elective <sup>2</sup>		3	CHE 312	Transport Processes II	3
CHE 311	Transport Processes I	3	CHE 316	Thermo Chem & Phase Eq	3
CHE 315	Chem Process Thermo	3	Humanities/Social Science Elective <sup>2</sup>		3
BEC 320	Fund. Micro. Cell Culture	2	BBS 426	Ind. Micro. Bioproc. Lab	2
BEC 420	Micro. Cell Biotransforms	<u>2</u>	ENG 331	Comm for Engr & Tech <sup>4</sup>	<u>3</u>
		17			16
<b>Summer Session:</b>					
BIO 212 Anatomy and Physiology		4			
Humanities/Social Science Elective <sup>2</sup>		<u>3</u>			
		7			
BEC 436	Downstream Proc. Biomat.	2	CHE 435	Proc Sys Analy & Control	3
CHE 447	Bioreactor Engineering	3	CHE 451	CHE Design II	3
CHE 450	CHE Design I	3	BIT minor bioethics course <sup>6</sup>		3
Biomanufacturing Elective <sup>5</sup>		2	BEC 485	LS Recovery/Purification	2
Humanities/Social Science Elective <sup>2</sup>		3	PHSC 574	Biopharmaceutics <sup>3</sup>	3
CHE 395	Professional Dev. Seminar	1	PHSC 540	Advanced Physical Pharmacy <sup>3</sup>	<u>3</u>
PHSC 514	Industrial Pharmacy <sup>3</sup>	<u>3</u>			17
		17			
PHSC 510	Pharmacokinetics	2	PHSC 508	Process Validation	2
PHSC 512	Prin. of Pharma and Med Chem.	3	PHSC 536	MS Seminar II	1
PHSC 523	Expt Design & Biostatistics	4	PHSC 542	Adv. Topics in Ind Pharmacy	4
PHSC 534	MS Seminar I	1	PHSC 620	Research Project	<u>4</u>
PHSC xxx	Elective(s)	3			11
PHSC 515	Industrial Pharmacy Lab	1			
PHSC 610	Research Proposal	<u>2</u>			
		16			

Minimum Credit Hours Required for BS CHE Graduation 126<sup>6</sup>

Minimum Credit Hours Required for MS Pharmaceutical Sciences 166

Students completing this concentration will simultaneously fulfill the requirements for a Minor in Biomanufacturing.

PHSC courses offered through Campbell are subject to Campbell tuition. Courses in the 5<sup>th</sup> year are taken at Campbell.

<sup>1</sup> ENG 101 may be taken in either the fall or the spring

<sup>2</sup> Select from the College of Engineering's Humanities and Social Sciences (H&SS) list for the GER. At least one of the courses must focus on a non-English speaking culture.

<sup>3</sup> Offered via videoconference from Campbell. The lab, PHSC 515, will be offered either at Campbell or at BTEC.

<sup>4</sup> Students can also take ENG 332 or 333 in place of ENG 331.

<sup>5</sup> The biomanufacturing elective course must be selected from the following list:

BEC 480 – Large-Scale Fermentation

BEC 497 – Biomanufacturing Research Projects

BIT 466 – Animal Cell Culture

BIT 470 – Advanced Animal Cell Culture – Bioreactor Culture

<sup>6</sup> The BIT minor bioethics course counts as an H&SS for the Science, Technology, and Society category. The courses include:

IDS 201: Environmental Ethics

STS 302: Cont Science, Technology, and Human Values

IDS 303: Humans and the Environment

STS 304: Ethical Dimensions of Progress

STS 320: Ethics in Engineering

STS(PHI) 325: Bio-Medical Ethics

<sup>7</sup> To graduate, students must demonstrate competency in a foreign language at the FL 102 level and have a grade of C- or higher in ENG 101.

**Bachelor of Science in Paper Science & Engineering -- Chemical Engineering Concentration**  
**(Degrees earned: B.S. in Pulp & Paper Technology, B. S. in Chemical Engineering)**

<b>Fall Semester</b>				<b>Credits</b>	<b>Spring Semester</b>				<b>Credits</b>
CH	101	Chemistry - Molecular Sci	3	CH	201	Chem - Quantitative Sci	3		
CH	102	General Chemistry Lab	1	CH	202	Quantitative Chem Lab	1		
E	101	Introduction Engineering <b>or</b>	1	WPS	201	Pulp & Paper Technology <sup>1</sup>	3		
WPS	100	Intro. to Pulp & Paper Sci.	1	EC	205	Fundamentals of Economics	3		
E	115	Intro to Computing Envir	1	MA	241	Analyt Geom & Calculus II	4		
ENG	101	Academic Writing Research <sup>1</sup>	4	PY	205	Physics Engr & Scien I	<u>4</u>		
MA	141	Analyt Geom & Calculus I	4						18
PE	10x	Physical Education	<u>1</u>						
			15						
CH	221	Organic Chemistry I	3	CH	223	Organic Chemistry II	3		
CH	222	Organic Chemistry I lab	1	CH	224	Organic Chemistry II Lab	1		
CHE	205	Chemical Process Prin	4	PY	208	Physics Engr & Scien II	4		
MA	242	Analyt Geom & Calculus III	4	CHE	225	Chemical Proc Systems	3		
WPS	212	Paper Properties <sup>1</sup>	3	MA	341	Applied Differential Eqns	3		
PE		Physical Ed. Elective	<u>1</u>	WPS	371	Pulping Paper Analysis	<u>3</u>		
			16						17
		<b>Summer Session</b>		<b>Credits</b>					
	WPS 211	Pulp and Paper Internship					1		
CH	315	Quantitative Analysis	4	CHE	312	Transport Processes II	3		
CHE	311	Transport Processes I	3	CHE	316	Thermo Chem & Phase Eq	3		
CHE	315	Chem Process Thermo	3	WPS	360	Pulp & Paper Unit Proc. II	3		
WPS	322	Wet End/Polymer Chemistry	4	WPS	332	Wood & Pulping Chemistry	3		
Humanities/Social Science Elective <sup>2</sup>			<u>3</u>	ENG	331	Comm for Engr & Tech	<u>3</u>		
			17						15
WPS	475	Process Control	3	WPS	416	Proc. Des. & Analy.	3		
WPS	415	Senior Research Project	3	WPS	465	Paper Physics & Prof. Des	3		
WPS	417	Proc. Des. & Analy. Lab	2	WPS	472	Paper Process Analysis	3		
Humanities/Social Science Elective <sup>2</sup>			3	Humanities/Social Science Elective <sup>2</sup>			3		
Humanities/Social Science Elective <sup>2</sup>			<u>3</u>	Humanities/Social Science Elective <sup>2</sup>			3		
			14	Humanities/Social Science Elective <sup>2</sup>			<u>3</u>		
									18
CHE	330	CHE Lab I	4						
CHE	450	CHE Design I	3						
ECE	331	Prin Electrical Engr <b>or</b>							
MAT	201	Struct & Prop Engr Matl	3						
CHE	446	Des & Analy Chem Reac	<u>3</u>						
			13						
Total Hours Required for Graduation			144*						

<sup>1</sup> Minimum of C- required for graduation in PSE

<sup>2</sup> 21 credit hours of Humanities/Social Sciences electives must be selected from the university approved lists in the departmental handbook or at <http://www.engr.ncsu.edu/students/hss/> . At least one course must be taken which focuses on a non-English speaking culture.

\* Foreign Language proficiency at the FL 102 level required for graduation for all students admitted as freshmen or transfer students beginning summer and fall 1994

**CURRICULUM IN CHEMICAL ENGINEERING & CHEMISTRY (BA)**  
**(Degrees earned: B. S. in Chemical Engineering/ B. A. in Chemistry)**

Fall Semester			Credits	Spring Semester			Credits
CH	101	Chemistry - Molecular Sci	3	CH	201	Chem - Quantitative Sci	3
CH	102	General Chemistry Lab	1	CH	202	Quantitative Chem Lab	1
E	101	Intro to Engr. & Prob Solv	1	Humanities/Social Science Elective			3
E	115	Intro to Computing Envir	1	MA	241	Calculus II	4
ENG	101	Acad Writing and Resch <sup>1</sup>	4	PY	205	Physics Engr & Scien I	4
MA	141	Calculus I	4	Physical Education			<u>1</u>
PE	10x	Physical Education	<u>1</u>				16
			15				
CH	221	Organic Chemistry I	3	CH	223	Organic Chemistry II	3
CH	222	Organic Chemistry I lab	1	CH	224	Organic Chemistry II Lab	1
CHE	205	Chemical Process Prin	4	PY	208	Physics Engr & Scien II	4
MA	242	Analyt Geom & Calculus III	4	CHE	225	Chemical Proc Systems	3
Humanities/Social Science Elective <sup>2</sup>			<u>3</u>	MA	341	Applied Differential Eqns	3
			15	Humanities/Social Science Elective <sup>2</sup>			<u>3</u>
							17
CH	315	Quantitative Analysis	4	CH	437	Intro Physical Chem	4
CHE	311	Transport Processes I	3	CHE	312	Transport Processes II	3
CHE	315	Chem Process Thermo	3	CHE	316	Thermo Chem & Phase Eq	3
ENG	331	Comm for Engr & Tech*	3	CHE	330	CHE Lab I	4
Humanities/Social Science Elective			<u>3</u>	Humanities/Social Science Elective			3
			16	CHE	395	Professional Dev. Seminar	<u>1</u>
							18
CHE	331	CHE Lab II	2	CH	401	Sys Inorganic Chem	3
CHE	446	Des & Analy Chem Reac	3	CHE	425	Proc Sys Analy & Control	3
CHE	450	CHE Design I	3	CHE	451	CHE Design II	3
Humanities/Social Science Elective			3	Humanities/Social Science Elective			3
Humanities/Social Science Elective			<u>3</u>	Technical Elective			<u>3</u>
			15				15
BCH	451	Prin of Biochemistry	4				
ECE	331	Prin Electrical Engr <b>or</b>					
MSE	201	Struct & Prop Engr Matl	3				
Humanities/Social Science Elective <sup>1</sup>			3				
Humanities/Social Science Elective <sup>1</sup>			3				
Technical Elective			<u>3</u>				
			16				
Total Hours Required for Graduation				140 <sup>2</sup>			

<sup>1</sup> These H&SS can be from any approved H&SS GER category.

<sup>2</sup> To graduate, students must demonstrate competency in a foreign language at the FL 102 level and have a grade of C- or higher in ENG 101.

**CURRICULUM IN CHEMICAL ENGINEERING & CHEMISTRY (BS)**  
**(Degrees earned: B. S. in Chemical Engineering/ B. S. in Chemistry)**

Fall Semester	Credits	Spring Semester	Credits
CH 101 Chem - Molecular Sci	3	CH 201 Chem - Quantitative Sci	3
CH 102 General Chemistry Lab	1	CH 202 Quantitative Chem Lab	1
E 101 Intro to Engr. & Prob Solv	1	Humanities/Social Science Elective	3
E 115 Intro to Computing Envir <sup>1</sup>	1	MA 241 Calculus II	4
ENG 101 Academic Writing and Resch <sup>1</sup>	4	PY 205 Physics Engr & Scien I	4
MA 141 Calculus I	4	Physical Education	<u>1</u>
PE 10x Physical Education	<u>1</u>		16
	15		
CH 221 Organic Chemistry I	3	CH 223 Organic Chemistry II	3
CH 222 Organic Chemistry I lab	1	CH 224 Organic Chemistry II Lab	1
CHE 205 Chemical Process Prin	4	PY 208 Physics Engr & Scien II	4
MA 242 Analyt Geom & Calculus III	4	CHE 225 Chemical Proc Systems	3
Humanities/Social Science Elective <sup>2</sup>	<u>3</u>	MA 341 Applied Differential Eqns	3
	15	Humanities/Social Science Elective <sup>2</sup>	<u>3</u>
			17
CH 315 Quantitative Analysis	4	CH 401 Sys Inorganic Chem	3
CHE 311 Transport Processes I	3	CHE 312 Transport Processes II	3
CHE 315 Chem Process Thermo	3	CHE 316 Thermo Chem & Phase Eq	3
ENG 331 Comm for Engr & Tech	3	CHE 330 CHE Lab I	4
Humanities/Social Science Elective	<u>3</u>	Technical Elective	3
	16	CHE 395 Professional Dev Seminar	<u>1</u>
			17
CH 428 Qual Organic Analysis	3	CH 402 Inorganic Chem Lab	1
CHE 450 CHE Design I	3	CH 403 Sys Inorganic Chem II	3
CHE 331 CHE Lab II	2	CH 434 Physical Chemistry Lab	3
CHE 446 Des & Analy Chem Reac	3	CHE 451 CHE Design II	3
Humanities/Social Science Elective	3	CHE 435 Proc Sys Analy & Control	3
CH 437 Physical Chemistry	<u>4</u>	Humanities/Social Science Elective	<u>3</u>
	18		16
CH 415 Analytical Chemistry II	3		
CH 416 Analytical Chem II Lab	1		
CH 435 Intro Quantum Chem	3		
ECE 331 Prin Electrical Engr <b>or</b>			
MSE 201 Struct & Prop Engr Matl	3		
Humanities/Social Science Elective	3		
Technical Elective	<u>3</u>		
	16		
Total Hours Required for Graduation	146 <sup>2</sup>		

<sup>1</sup> Students completing both degrees can substitute E 115 for CH 106/108.

<sup>2</sup> To graduate, students must demonstrate competency in a foreign language at the FL 102 level and have a grade of C- or higher in ENG 101.

**CURRICULUM IN CHEMICAL ENGINEERING & TEXTILE ENGINEERING**  
**(Degrees Earned: B.S. Chemical Engineering and B.S. Textile Engineering) (14CHE036T)**

**Fall Semester**

**Spring Semester**

CH 101	Gen. Chem I	3
CH 102	Gen. Chem I Lab	1
ENG 101	Acad Writing Rsrch	4
MA 141	Analy. Geom. & Calc. I	4
E 115	Intro Computing Envt.	1
E 101	Intro engineering & Prob Sol	1
Physical Fitness Elective		<u>1</u>
		15

CH 201	Chem – A Quanti Sci	3
CH 202	Quant Chem Lab	1
MA 241	Analy. Geom. & Calc. II	4
PY 205	Physics for Engr. & Scien I	4
Humanities/Social Science Elective		3
Physical Fitness Elective		<u>1</u>
		16

MA 242	Analy. Geom. & Calculus III	4
CHE 205	Chemical Proc. Prin.	4
CH 221	Organic Chemistry I <sup>1</sup>	3
CH 222	Organic Chemistry I Lab	1
PY 208	Physics Engr. and Scien. II	<u>4</u>
		16

TE 200	Textile Engineering Science	4
MAE 206	Engineering Statics	
<b>OR</b> CE 214	Engineering Statics	3
CH 223	Organic Chemistry II	3
CH 224	Organic Chemistry II Lab	1
MA 341	Applied Diff. Equations	3
CHE 225	Chemical Proc. Systems	<u>3</u>
		17

CH 315	Quant Analysis <sup>3</sup>	4
TE 301	Engr Tex Struc I	3
GC 120	Found of Graphics (HSS)	3
CHE 311	Transport Processes I	3
CHE 315	Chem Process Thermo I <sup>2</sup>	3
CHE 395	Prof. Dev. Seminar	<u>1</u>
		17

TE 302	Textile Mfg. Processes II	4
ST 370	Prob. & Statistics For Engr.'s	3
CHE 312	Transport Processes II	3
CHE 316	Thermo Chem & Phase Eq	3
TE 205	Analog Digital Circuits <sup>3</sup>	<u>4</u>
		17

CHE 446	Des & Analy Chem Reac	3
TE 401	Tex. Engineering Design I	4
ENG 331	Comm for Engr & Tech	3
EC 205	Fund of Econ (HSS)	3
CHE 450	Chem Engr Design I	<u>3</u>
		16

TE 402	Tex. Engineering Design II <sup>5</sup>	4
TE 404	Six Sigma Quality	3
TE 424	Tex. Engr. Qual. Impr. Lab	1
Humanities/Social Science Elective		3
Humanities/Social Science Elective		<u>3</u>
		14

CHE 330	CHE Lab I	4
TE/CHE 435	Proc Sys Analy Cnt	3
Humanities/Social Science Elective		3
PCC 301	Tech. Of Dyeing and Finishing	4
Humanities/Social Science Elective		<u>3</u>
		17

Total hours required for graduation: 145

All students graduating from this curriculum must demonstrate 102 level competency in a foreign language. A grade of “C-“ or higher is required for: E 101, CH 101, CH 102, ENG 101, MA 141, MA 241, PY 205

1. CH 221 will replace TC203 (in the TE curriculum)
2. CHE315 will replace TE303 (in the TE curriculum)
3. TE205 will replace ECE 331 (in the ChE curriculum)
4. TE 402 will replace CHE 451 (in the ChE curriculum)

# HUMANITIES & SOCIAL SCIENCES REQUIREMENTS

A total of **seven courses (21 credit hours)** from the **Approved COE Humanities & Social Sciences** list is required. These courses may be taken in any order. All of the courses must be completed for a letter grade; none of the seven courses may be taken as pass / fail or credit only grading.

<b>LITERATURE</b> Select one course from the approved list of "Literature."	_____ (3cr.)
<b>HISTORY, PHILOSOPHY, OR RELIGION</b> Select one course from the approved lists: "History," "Philosophy," or "Religion."	_____ (3cr.)
<b>VISUAL &amp; PERFORMING ARTS OR HISTORY</b> Select one course from the approved lists: "Visual & Performing Arts" or "History" <small>NOTE: CEM, ENE &amp; TE majors must choose GC 120.</small>	_____ (3cr.)
<b>SOCIAL SCIENCES</b> Select one course from the approved list of "Social Sciences" (anthropology, politics & government, sociology, cultural geography, psychology, or linguistics). <small>NOTE: ENE majors must choose PS 336 or PS 320.</small>	_____ (3cr.)
<b>INTRODUCTORY ECONOMICS</b> Select an introductory economics course: EC 205 ( <b>recommended</b> ), EC 201, or ARE 201. <i>Transfer or AP credit for EC 202 can count here.</i>	_____ (3cr.)
<b>SCIENCE, TECHNOLOGY, &amp; SOCIETY</b> Select one course from the approved list of "Science, Technology, and Society." <small>NOTE: BE majors must choose from IDS 201 or STS 302, 304, 320; PHI 422 IE &amp; IEF majors must choose from IDS 201, 303 or STS 214, 302, 304, 320, 322, 325</small>	_____ (3cr.)
<b>OTHER HUMANITIES &amp; SOCIAL SCIENCES</b> Select an additional course from <b>any</b> of the <i>Approved COE Humanities &amp; Social Sciences</i> to complete the <i>total of seven courses</i> . <small>NOTE: CEM majors choose from EC 301, 304, 336, 348, 372 AE &amp; ME majors choose from STS 302, 304, 320 (or may be used to fulfill Sci./Tech &amp; Society above); PHI 214, 375 (or may be used to fulfill Hist./Phil/Rel above) MSE majors choose from IDS 201, STS 302, 304, 320, 325 (or may be used to fulfill Sci./Tech &amp; Society above); PHI 214, 221, or 375 (or may be used to fulfill Hist./Phil/Rel above) ENE majors choose from ARE 309, 336 (may only be used to fulfill this Other Human. &amp; Soc. Sci.); ET 410, IDS 201, 303, or PHI 422 (or may be used to fulfill Sci./Tech &amp; Society above)</small>	_____ (3cr.)
<b>The following requirement must also be satisfied:</b>	<b>Total = 21 credit hours</b>
<b>NON-ENGLISH SPEAKING CULTURE</b> At least one of the seven courses selected above <b>must</b> focus on a <i>non-English speaking culture</i> (denoted by an asterisk *; complete list on last page) -- OR -- Select an additional course to satisfy this requirement.	_____ course from above (3cr.) -- OR -- _____ (3cr.)

NOTE: Foreign Language Proficiency is also required for graduation from all departmental degree programs.

**APPROVED HUMANITIES AND SOCIAL SCIENCES COURSES**  
 See [www.engr.ncsu.edu/students/hss](http://www.engr.ncsu.edu/students/hss) for statement of the requirements.

**LITERATURE**

ENG 205 Great Works of Western Lit	ENG 349 African Literature in English*	ENG 448 African-American Literature	FLN 301 Adv Hindi: Readings in Lit I*
ENG 206 Studies in Drama	ENG 362 British Novel 18 <sup>th</sup> Century	ENG 449 16 <sup>th</sup> Century English Lit.	FLN 302 Adv Hindi: Readings in Lit II*
ENG 207 Studies in Poetry	ENG 363 British Novel 19 <sup>th</sup> Century	ENG 451 Chaucer	FLR 303 Russian Lit in Translation I*
ENG 208 Studies in Fiction	ENG 369 19 <sup>th</sup> Cent American Novel	ENG 453 The Romantic Period	FLR 304 Russian Lit in Translation II*
ENG 209 Introduction to Shakespeare	ENG 370 Early 20 <sup>th</sup> Century Fiction	ENG 460 Major British Author	FLS 300 Intro to Hispanic Literature*
ENG(FL) 219 Great Works: Non-West Lit*	ENG 371 Late 20 <sup>th</sup> Century Fiction	ENG 463 The Victorian Period	FLS 301 Spanish Lit - Golden Age*
ENG(FL) 220 Great Works: Western Lit*	ENG 372 Early 20 <sup>th</sup> Century Poetry	ENG 464 British Literature, 1900-1945	FLS 302 Spanish Lit, 1700-Present*
ENG(FL) 221 Lit of Western World I*	ENG 373 Late 20 <sup>th</sup> Century Poetry	ENG 465 British Literature, since 1945	FLS 303 Latin Amer Lit to 1898*
ENG(FL) 222 Lit of Western World II*	ENG 376 Science Fiction	ENG 467 American Colonial Literature	FLS 304 Modern Latin Amer Literature*
ENG(FL) 223 Contemp. World Lit I*	ENG 377 Fantasy	ENG 468 American Romanticism	FLS 323 Contemporary Hispanic Lit*
ENG(FL) 224 Contemp. World Lit II*	ENG 380 Modern Drama	ENG 469 Amer Realism & Naturalism	FLS 341 Lit & Culture of Spain I*
ENG 232 Literature & Medicine	ENG 383 Folklore and Literature	ENG 470 American Literature, 1914-45	FLS 342 Lit & Culture of Spain II*
ENG 233 Literature & Agriculture	ENG 385 Biblical English Literature	ENG 471 American Lit since 1945	FLS 343 Lit & Culture of Spain III*
ENG 248 Survey African-American Lit	ENG 390 Classical English Literature	ENG 476 Southern Literature	FLS 351 Lit & Culture of Lat Amer I*
ENG 249 Native American Lit	ENG(FL) 393 Studies-Literary Genre*	ENG 486 Shakespeare, Earlier Plays	FLS 352 Lit & Culture of Lat Amer II*
ENG 251 Major British Writers	ENG(FL) 394 Studies in World Lit*	ENG 487 Shakespeare, Later Plays	FLS 353 Lit & Culture of Lat Amer III*
ENG 252 Major American Writers	ENG 398 Contemp Lit I 1900-1940	FLF 301 French Lit: Mid Ages-Enlight*	FLS 403 Hispanic Prose Fiction*
ENG 261 English Literature I	ENG 399 Contemp Lit II since 1940	FLF 302 French Lit: Romant-Contemp Per*	FLS 404 Hispanic Drama*
ENG 262 English Literature II	ENG(FL) 406 Modernism	FLF 323 French Novel of 20 <sup>th</sup> Century*	GRK 320 Greek Tragedy in Translation*
ENG 265 American Literature I	ENG(FL) 407 Postmodernism	FLF 414 Studies in French Prose*	
ENG 266 American Literature II	ENG 420 Major American Author	FLG 300 Intro to German Lit*	<i>HON 202 Inquiry, Discovery &amp; Literature</i>
ENG 283 Intro American Folklore	ENG 439 17 <sup>th</sup> Century English Lit	FLG 316 German Lyric Poetry*	<i>HON 293 Honors Literature Seminar</i>
ENG 305 Women and Literature	ENG 462 18 <sup>th</sup> Century English Lit	FLG 323 20 <sup>th</sup> Century German Lit*	

**HISTORY**

HI 205 Western Civilization since 1400*	HI 351 US Naval History	HI 422 Eur Intellectual Hist: 19 <sup>th</sup> Cent*	HI 458 Modern American Biography
HI 207 Ancient World to 1800 AD*	HI 364 History of North Carolina	HI 423 Women in European Enlightenment	HI 459 Early American Republic
HI 208 The Middle Ages*	HI 365 The American West	HI 425 Tudor & Stuart England	HI (REL) 460 Am Religion after Darwin
HI 209 Europe 1300-1815*	HI 366 Native American History	HI 429 20 <sup>th</sup> Century Britain	HI 461 Civilization of the Old South
HI 210 Mod Europe 1815-Present*	HI 372 African-American Hist to 1865	HI 430 Modern France*	HI 462 Social History of New South
HI 215 Latin America to 1826*	HI 373 African-American since 1865	HI 431 Germany: 1500-1871*	HI 465 Oil & Crisis in the Gulf
HI 216 Latin America since 1826*	HI 380 Nonprof, Philant, Soc Change	HI 432 Hist of Germany since 1871*	HI 466 Hist Palest. Israeli Conflict
HI 221 British History to 1688	HI 400 Civilization Ancient Near East*	HI 438 Russian Empire to 1917*	HI 467 Modern Mexico*
HI 222 History British Culture & Society	HI 403 Ancient Greek Civilization*	HI 439 Hist of Soviet Union and After*	HI 469 Latin-Am Revolution 20 <sup>th</sup> Cent*
HI 233 World in 20 <sup>th</sup> Century*	HI 404 Rome to 337 AD*	HI 440 American Environmental History	HI 471 Revolutionary China*
HI 251 Early American History	HI 405 Hist & Archaeology Roman Empire*	HI 441 Colonial & Revolution US	HI 472 Modern Japan, 1850-Present*
HI 252 Modern American History	HI 406 Roman Empire to Middle Ages*	HI 443 US Constitutional History to 1883	HI 473 Japan's Empire: 1868-1945*
HI 263 Asian Civilization to 1800*	HI (REL) 407 Islamic History to 1798*	HI 444 US Constitutional History since 1870	HI 474 Modern India*
HI 264 Modern Asia: 1800-Present*	HI (REL) 408 Islam in Modern World*	HI 445 Early American Frontiers	HI 475 Hist of Republic South Africa*
HI 270 Modern Middle East*	HI 409 High Middle Ages*	HI 446 Civil War & Reconstruction	HI 476 Leadership in Modern Africa*
HI 275 History South & East Africa*	HI 410 Italian Renaissance*	HI 447 American Women to 1900	HI 478 Islam & Christ. In Sub-Saharan Africa*
HI 276 History of West Africa*	HI 411 Prot. & Cath. Reformation 16 <sup>th</sup> Cent*	HI 448 American Women in 20 <sup>th</sup> Cent.	HI 479 Africa in the 20 <sup>th</sup> Century
HI (REL) 320 Religion in Amer History	HI 412 Sexes & Soc in Early Mod Europe	HI 451 Vietnam War	HI 480 Scientific Revolution: 1300-1700
HI 321 Ancient Medieval Science	HI 414 France in Old Regime*	HI 452 Recent America	HI 481 History of the Life Sciences
HI 322 Rise of Modern Science	HI 415 The French Revolution*	HI 453 US-Latin Relations since 1823	HI 482 Darwinism in Science & Society
HI 335 World at War	HI 418 Fascist Italy & Nazi Germany*	HI 454 US Foreign Relations, 1900-pres	HI 483 Sci. & Religion in European Hist.
HI 340 Perspectives in Ag. Hist.	HI 419 Modern Europe Imperialism*	HI 455 Hist of Civil Rights Movement	HI 484 Science in European Culture
HI 341 Technology in History	HI 420 European Diplomatic History*	HI 456 Early American Thought	HI 485 History of American Technology
HI 350 American Military History	HI 421 Eur Intellectual Hist: 18 <sup>th</sup> Cent*	HI 457 20 <sup>th</sup> Cent US Intellectual History	<i>HON 290 Honors History Seminar</i>

**PHILOSOPHY**

PHI 205 Problems & Types Philosophy	PHI 330 Metaphysics
PHI 214 Issues in Business Ethics	PHI 331 Philosophy of Language
PHI 221 Contemporary Moral Issues	PHI 332 Philosophy of Psychology
PHI 250 Practical Reasoning	PHI 333 Theory of Knowledge
PHI 300 Ancient Philosophy	PHI 340 Philosophy of Science
PHI 301 Early Modern Philosophy	PHI 375 Ethics
PHI 302 19 <sup>th</sup> Century Philosophy	PHI 376 History of Ethics
PHI 303 Medieval Philosophy	PHI 415 Life Science Ethics
PHI 305 Philosophy of Religion	PHI 422 Philos Issues Environ Ethics
PHI 306 Philosophy of Art	PHI(PHY) 425 Intro to Cognitive Science
PHI 309 Contemporary Political Philos	PHI 440 Scientific Method
PHI 310 Existentialism	<i>HON 294 Honors Phil/Rel Seminar</i>
PHI 312 Philosophy of Law	<i>HON 341 Time Travel</i>
PHI 313 Ethical Problems in the Law	<i>HON 343 Philosophical Ethics</i>
PHI(STS) 325 Bio-Medical Ethics	<i>HON 34x Honors Phil/Rel Seminar</i>

**RELIGION**

AFS 343 African Religions*	REL 334 Japanese Religions*
REL 200 Intro to Study of Religion*	REL 350 Introduction to Judaism*
REL 230 South Asian Rel Trad*	REL 383 Rel, Globalism & Justice
REL 300 Religion of the World*	REL(HI) 407 Islamic History to 1798*
REL(SOC) 309 Religion & Society*	REL(HI) 408 Islam in the Modern World*
REL 311 Intro to Old Testament*	REL 412 Adv Readings in Christian Gospels*
REL 312 Intro to New Testament*	REL 413 Life & Letters Apostle Paul*
REL 314 Intertestamental Literature*	REL 423 Rel & Pol in 20th Cent. America
REL 317 Christianity	REL(HI) 460 Am Religion After Darwin
REL(HI) 320 Relig in American History	REL(STS) 471 Darwinism & Christianity
REL 323 Rel Cults, Sects & Min Faiths in Am	REL(WGS) 472 Women & Religion*
REL 326 Catholic Tradition*	REL 481 Myth, Metaphor, & Rel Imagination*
REL 327 Issues in Contemp Religion*	REL 482 Religion & Conflict*
REL 331 The Hindu Tradition*	REL 484 Myth & Hist in Rel Biography*
REL 332 The Buddhist Traditions*	REL 489 Interpretations of Religion
REL 333 Chinese Religions*	<i>HON 342 Iss in Contemporary Religion</i>

**VISUAL & PERFORMING ARTS**

ADN 111 Two Dimensional Design	COM 103 Introduction to the Theatre	HA 201 Hist of Art from Ancient Greece	MUS 230 Intro to African-Amer Music
ADN 112 Three Dimensional Design	COM 203 Theory & Practice of Acting	-Renaissance*	MUS 260 History of Jazz
ADN 272 Intro to Print & Surface Design	COM 213 Oral Interpretation of Lit	HA 202 Hist of Art from Renaissance	MUS 301 Basic Music Theory I
ADN 311 Basic Visual Laboratories	COM 243 African-American Theatre	-20th Century*	MUS 302 Basic Music Theory II
	COM 364 History of Film to 1940	HA 203 History of American Art	MUS 305 Music Composition
ARC 140 Experiencing Architecture	COM 374 History of Film from 1940	HA 310 History of Art & Photography	MUS(ARS) 306 Music Composition w/ Comp
ARC 141 History of Design I	COM 493 Audition & Interpretation Techniques	HA 320 American Decorative Arts	MUS 310 Music of 17 <sup>th</sup> & 18 <sup>th</sup> Centuries
ARC 142 History of Design II	D 231 Design History for Engr & Sci	HA 401 19 <sup>th</sup> Century European Art*	MUS 315 Music of 19 <sup>th</sup> Century Europe*
ARC 241 Intro to World Architecture	DS 101 History of Design I	HA 404 Italian Renaissance Masters*	MUS 320 Music of 20 <sup>th</sup> Century
ARC 261 Discipline of Architecture	DS 102 History of Design II	LAR 221 Intro Environment &	MUS 330 Music Drama
ARC 445 Aesthetics and Design	DS 244 Material Culture & Ind Design	Behavior for Designers	MUS 335 Choral Literature
	DAN 272 Dance Composition	LAR 222 Perception & Behavior	MUS 340 The Symphony Orchestra
ARS 251 Arts of World Capital: London	ENG 282 Intro to Film	for Designers	MUS 345 Keyboard History & Literature
ARS 252 Vienna in 1900*	ENG 382 Film & Literature	LAR 443 Landscape History	MUS 350 World Music I: Music of Asia*
ARS 253 Arts of NC State	ENG 384 Film Theory	LAR 444 Hist of Landscape Architecture	MUS 351 World Music II: Africa & Am*
ARS 259 The Arts and Politics	FL 216 Art & Society in France*	MUS 180 Intro to Musical Experiences	MUS 360 Women in Music
ARS(MUS) 306 Music Composition	FLF 318 Heritage of French Cinema*	MUS 200 Understanding Music	TAM 400 Major Fashion Designers
with Computers	FLG 318 New German Cinema*	MUS 201 Intro to Music Literature I	TED 351 Art & Craft of Clay
ARS 327 Modern Art & Lit: 1880-1980	FLS 318 Hispanic Cinema*	MUS 202 Intro to Music Literature II	<i>HON 201 Inquiry, Discovery, and the Arts</i>
ARS 351 Arts, Ideas, & Values	GC 120 Foundations of Graphics	MUS 205 Intro to Music in West Soc	<i>HON 299 Honors Arts Seminar</i>
ARS 353 Arts & Cross Cultural Contacts*	GD 200 Intro to Graphic Design	MUS 206 America's Music	<i>HON 391 Music &amp; Social Life</i>
	GD 342 History of Graphic Design		

## SOCIAL SCIENCES

Anthropology	Politics & Government	Sociology
ANT 251 Physical Anthropology ANT 252 Cultural Anthropology* ANT 253 Introduction to Prehistory ANT 254 Language & Culture* ANT(SOC) 261 Tech. in Soc. & Culture* ANT 310 People & Culture: N America* ANT 325 Andean South America* ANT 330 People & Culture: Africa* ANT 346 People & Culture: SE Asia* ANT 348 People & Culture: Italy* ANT 370 Intro. to Forensic Anthropology ANT 371 Human Variation ANT 373 Human Fossil Record ANT 385 Island Archaeology ANT 389 Fund. of Archaeological Research	AFS(PS) 409 Black Political Participation BUS 305 Legal & Reg. Environment FOR 460 Renewable Res. Policy & Mgmt HON 351 American Ideals in Global Perspect. PS 201 American Politics & Government PS 202 State & Local Government PS 203 Intro to Nonprofits PS 204 Probs. of American Democracy PS 205 Law and Justice PS 231 International Relations PS 236 Issues in Global Politics PS 241 Intro. to Comparative Politics PS 301 The Presidency & Congress PS 302 Campaigns & Elections in U.S. PS 303 Race in U.S. Politics PS 305 Justice System in Am. Pol. Process	PS 309 Equality & Justice in U.S. Law PS 310 Public Policy PS 312 Intro to Public Administration PS 314 Science, Tech., & Public Policy PS 315 Public Leadership PS 320 U.S. Environment Law & Politics PS 331 U.S. Foreign Policy PS 335 International Law PS 336 Global Environmental Politics PS 339 Politics of the World Economy PS 341 European Politics PS 342 Politics of China & Japan* PS 345 Gov't & Politics: Middle East* PS 361 Intro to Political Theory PS 362 American Political Thought PS(AFS) 409 Black Political Participation PS 431 United Nations & Global Order PS 433 Global Problems & Policy
SOC 202 Principles of Sociology SOC 203 Current Social Problems SOC 204 Sociology of Family SOC 205 Jobs & Work SOC 206 Social Deviance SOC(GEO) 220 Cultural Geography* SOC 241 Soc. of Agric & Rural Society SOC(ANT) 261 Tech Society & Culture* SOC 300 Social Research Methods SOC 301 Human Behavior SOC 304 Women & Men in Society SOC 305 Racial & Ethnic Relations SOC 306 Criminology SOC(REL) 309 Religion & Society* SOC 310 Managers, Work & Orgs SOC 311 Community Relationships SOC 342 International Development* SOC 351 Population & Planning* SOC 381 Sociology of Medicine SOC 450 Environmental Sociology		

Cultural Geography	Psychology	
GEO(ECI) 200 Principles of Geography GEO(SOC) 220 Cultural Geography* GEO 300 World Regional Geography	AFS (PSY) 345 Psy.& African-Amer Exp EDP 304 Educational Psychology EDP 307 Applied Child Development PSY 200 Introduction to Psychology PSY 201 Controversial Issues in Psych. PSY 307 Industrial & Organizational	PSY 311 Social Psychology PSY 312 Applied Psychology PSY 340 Ergonomics PSY (AFS) 345 Psy.& African-Amer Exp PSY 376 Developmental Psychology PSY 400 Perception PSY 406 Psychology of Gender PSY(PHI) 425 Intro to Cognitive Sci.
<b>Linguistics</b> ENG 210 Intro. to Language & Linguistics		HON 295 Honors Social Sciences Seminar HON 35x Honors Social Sciences Seminar

## INTRODUCTORY ECONOMICS

EC 205 Fundamentals of Economics	EC 201 Principles of Microeconomics	ARE 201 Intro to Agricultural & Resource Economics
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## SCIENCE, TECHNOLOGY, & SOCIETY

ANT(SOC) 261 Tech. in Soc. & Culture*  ARE(EC) 336 Intro Resource & Env. Ec. ARE(EC) 436 Environmental Economics  D 231 Design Hist.: Engineers & Sci. DS 244 Material Culture & Ind Design ENG 232 Literature & Medicine ENG 233 Literature of Agriculture ENG 376 Science Fiction ENG 425 Analysis of Sci. & Tech. Writing ET 410 Toxic Substances & Society FLF 212 French: Language, Tech., & Culture FLG 212 German: Language, Tech., & Culture FLS 212 Spanish: Language, Tech., & Culture HI 321 Ancient & Medieval Science HI 322 Rise of Modern Science HI 341 Technology in History HI 440 American Environmental History HI 480 Scientific Revolution: 1300-1700 HI 481 History of the Life Sciences HI 482 Darwinism in Science & Society HI 483 Sci. & Religion in Europe History	HI 484 Science in European Culture HI 485 Hist of Amer Technology  IDS 201 Environmental Ethics IDS 220 Coastal & Ocean Frontiers IDS 260 Changing Paradigms Leadership, Learning & Service IDS 303 Humans & the Environment IDS(TAM) 414 Textiles & Society LAR 445 American Parks, Parkways, & Estates PHI 340 Philosophy of Science PHI 415 Life Science Ethics PHI 422 Philos Issues in Environ Ethics PHI 440 Scientific Method PHI 450 Software & Ethics of Ownership  PS 314 Science, Tech & Public Policy PS 336 Global Environmental Politics  PSY 312 Applied Psychology  REL(STS) 471 Darwinism & Christianity	SOC(ANT) 261 Tech. in Soc. & Culture* SOC 381 Sociology of Medicine SOC 450 Environmental Sociology  STS(WGS) 210 Women & Gender In Science & Technology STS 214 Intro. to STS STS 301 Science & Civilization STS 302 Contemporary Science, Technology, & Human Values STS 304 Ethical Dimen. of Progress STS 320 Ethics in Engineering STS 322 Technological Catastrophes STS 323 World Pop & Food Prospects STS 324 Alternative Futures STS(PHI) 325 Bio-Medical Ethics: An Interdisciplinary Inquiry STS 326 Technology Assessment STS 402 Peace & War in Nuclear Age STS 405 Tech. & Am. Culture STS 406 Conservation of Bio. Diversity STS 412 Ent 21st C.: Agric, Tech, Env. Pers.	STS 451 Practice of Science and Arts STS(REL) 471 Darwinism & Christianity STS 484 Cross Cultural Tech. Transfer STS 490 Iss Science, Tech, & Society  TAM(IDS) 414 Textiles & Society  WGS(STS) 210 Women & Gender in Science & Technology   HON 296 Honors STS Seminar - HSS Perspective
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## OTHER HUMANITIES & SOCIAL SCIENCES

Select a course from any previous list OR from the following:

Economics	Miscellaneous
ARE 210 Consumer Economics ARE(EC) 301 Intermed Microeconomics ARE 309 Environment Law & Ec Policy ARE 311 Agricultural Markets ARE(EC) 336 Intro Resource & Env Ec ARE 433 U.S. Agricultural Policy ARE(EC) 436 Environmental Economics  EC 202 Principles of Macroeconomics <i>(credit not given for both EC 205 &amp; 202)</i>  EC(ARE) 301 Intermed Microeconomics EC 302 Intermediate Macroeconomics EC 303 Markets & Governments EC 304 Intro Financial Markets & Instit EC(ARE) 336 Intro Resource & Env Ec EC 348 Intro to International Economics	EC 372 Evolution of American Business EC 375 Comparative Economic System EC(BUS) 404 Money, Financial Markets, & the Economy EC 410 Public Finance EC 413 Competition, Monopoly, & Public Policy EC 431 Labor Economics EC 435 Urban Economics EC(ARE) 436 Environmental Economics EC 437 Health Economics EC 442 Evolution of Economic Ideas EC 448 International Trade EC(BUS) 449 International Finance EC 470 The Japanese Economy* EC 471 Evolution of American Economy EC 472 The Rise of Industrialism  AFS 240 African Civilization AFS 241 Intro African Amer Studies II AFS 342 Intro to African Diaspora* AFS 344 Leadership in African-Amer Communities AFS (ARS) 346 Black Popular Culture AFS 442 Issues in African Diaspora*  ENG 324 Modern English ENG 326 History of English Language  FL 350 Modern European Lit Criticism FLF 315 French Civilization & Culture* FLF 425 Literature, Cinema & Culture of the Francophone World* FLG 315 German Civilization & Culture* FLS 315 Culture & Civilization of Iberian Peninsula*
	HSS 294 Soc Sci in Overseas Context HSS 392 International & Crosscultural Communication*  IDS 305 Peace in the Global Village IDS 401 The Contemporary City: Problems & Prospects  PRT 152 Intro to Parks, Recreation, & Tourism PRT 200 Leisure Behavior, Health & Wellness  WGS 200 Intro to Women's & Gender Studies



## ACADEMIC POLICIES AND PROCEDURES

**ACADEMIC MISCONDUCT** - Any student charged with and found guilty of committing any act of academic misconduct is subject to disciplinary action. Academic misconduct includes all forms of academic dishonesty wherever committed, including, but not limited to cheating, plagiarism, fabrication, giving or receiving aid on an examination or quiz, copying another student's exam, term paper, report, problem or laboratory report, etc., theft or attempted theft of examinations and/or exam answers, etc., receipt of stolen examinations and/or exam answers, etc., facilitating academic dishonesty. The Department of Chemical and Biomolecular Engineering pursues enforcement of sanctions against academic misconduct to the maximum extent specified under the NCSU Code of Student Conduct.

**ADVISOR ASSIGNMENT** – When you matriculate into Chemical and Biomolecular Engineering, you receive an advisor who will serve in that capacity until you graduate. Advisors are assigned using the following process:

Bullard	CHU, CHE Double Majors (PSE, TE, etc), Franklin Scholars, MSCHE, CHE Minor
Parsons	Nanoscience Concentration
Peretti	Green Chemistry and Engineering Concentration
Rao, Haugh, Kelly	Biomolecular Engineering Concentration
Lamb	Biomanufacturing Science Concentration
Genzer, Velez, Grant, Dickey, Spontak, Hall, Henderson, Ollis, Lim, Gubbins, Westmoreland	Straight CHE Curriculum (assigned to an advisor such that the faculty advising load is well balanced)

If there is a problem with your assigned advisor, or if your advisor is unavailable, you may see Dr. Bullard for assistance.

The following information has been extracted from the Advisers' Handbook.

### Responsibilities of the Student

Students have the primary responsibility for planning their individual programs and meeting graduation requirements. This involves: (1) keeping up-to-date with University, College, and departmental curricular requirements through materials available from the faculty advisers or departmental coordinator of advising; (2) keeping informed of academic deadlines and changes in academic policies; and (3) consulting with the faculty adviser or departmental coordinator of advising during each registration period, following notification of academic status or probationary status, and at other times as needed and required by academic policy.

### Responsibilities of the Adviser

Although students have the primary responsibility for planning their programs, faculty advisers are expected to: (1) be available for conferences at appropriate times and places about which their advisees have been informed; (2) provide accurate information about academic regulations and procedures, course prerequisites, and graduation requirements; (3) assist students in planning academic programs suited to their interests and abilities and their career objective; (4) discuss with their advisees appropriate course choices in fulfilling curriculum requirements as well as possible consequences of various alternative course choices; (5) inform their advisees when their proposed

course selections conflict with University academic or curricular regulations; (6) assist advisees with following proper procedures for such things as exceptions to the course drop deadlines, auditing a course before or after taking it for credit, taking a course under the credit by examination policy, registering for 19 or more credit hours, registering for CRC inter-institutional courses, or repeating a course previously passed; (7) refer their advisees for special testing or counseling as needed; (8) assist their advisees in considering the appropriateness of academic adjustments where these become necessary in cases of serious injury or illness.

### **Responsibilities of the Coordinator of Advising**

Each college or department has a coordinator of advising who is responsible for: (1) assigning, training, and supervising faculty advisers; (2) providing up-to-date, printed course and curriculum information for advisers and students; (3) reassigning to another adviser any student who so requests; and (4) assisting any student who wants to major in the coordinator's area of study but is ineligible at the time to transfer into it. Students in this category keep their adviser in the department in which they are enrolled but consult additionally with the coordinator of advising for the department offering the curriculum in which they wish to enroll. Whenever appropriate, the coordinator will advise students that they should consider alternative curricula.

**ADDING AND DROPPING COURSES** - Courses may be added without prior approval during the first week of a semester; during the second week of a semester, classes may be added only with the permission of the instructor. In a summer session, courses may be added without prior approval during the first two days, during the third and fourth days only with the permission of the instructor.

Courses may be dropped without regard to course load during the first two weeks of a semester and during the first two days of a summer session (This is also the deadline for a refund if any is due). Through the eighth week of a semester, courses may be dropped provided the student's course load after the change remains twelve hours or more. Students may drop courses during the first eleven days of a summer session.

After the University deadlines have passed, the College of Engineering will consider exceptions to the University drop policy (drop, change to audit, or change to credit-only grading) **only for documented medical reasons or other verified, unforeseen grounds of personal or family hardship**. *Changing majors, job demands or planning to change majors are not sufficient justification.*

Students who feel that they have justification for a drop after the deadline should first contact the Coordinator of Advising and be prepared to provide documentation to verify the circumstances associated with their drop request. All requests for exceptions to the add/drop policies require a letter from the student, a recommendation from the Coordinator of Advising, input from the instructor, and approval by the Assistant Dean for Academic Affairs in the College of Engineering.

**Any schedule revision, including a late drop, is not complete until the schedule revision form with all approvals has been submitted to Registration and Records in Harris Hall.** Retain a copy of your revised schedule until the change has been posted to your permanent record.

Note that no schedule changes (including changing to audit or credit only) are accepted during the last two weeks of the semester – no exceptions.

**The MyPack portal system closes at 5:00 p.m. on the last day to add a class.** Students who wish to make modifications to their schedules after that time (within the published deadlines) may do so by presenting their student identification card at Room 1000 Harris Hall.

**COURSE LOAD**-Students who are employed on a regular basis or who have time-consuming extracurricular activities are advised to reduce their course loads to a manageable level. **Note that 12 credit hours is the minimum course load for full-time status.** Check for tax, insurance, dormitory, financial aid, and other benefits and privileges which may depend upon full-time status.

<u>Student's GPA</u>	<u>Recommended Credit Hours</u>	Adjustments for part-time job or other regular obligation or commitment:	
		<u>Job (or other) Hours/Week</u>	<u>Recommend Reduce Course Load by</u>
1.8	12		
2.0	14		
2.2	15		
2.5	16	5	2 credit hours
3.0	17	10	3 " "
3.5	18	15	4-5 " "
		20	6 " "
For 19, 20, or 21 credit hours, approval of your faculty advisor is required		25	6-8 " "
		30	7-9 " "
		35	8-10 " "

**COURSE PREREQUISITE ENFORCEMENT** - All prerequisites in chemical engineering courses are strictly enforced. **Failure to complete prerequisites prior to enrolling in a CHE course may result in the student's administrative disenrollment after the deadline to enroll in other courses has passed.**

**PLUS/MINUS GRADING SYSTEM**-A plus/minus grading became effective in the fall of 1994 for students who entered in summer 1994 or later. Students who were taking courses through the Lifelong Education Program at NCSU prior to being admitted to the University for summer 1994 (or later) are considered NEW. Under the plus/minus system the quality points earned for each credit hour of a given course are:

A+ = 4.33	B+ = 3.33	C+ = 2.33	D+ = 1.33	F = 0
A = 4.0	B = 3.0	C = 2.0	D = 1.0	
A- = 3.67	B- = 2.67	C- = 1.67	D- = 0.67	

**CREDIT-ONLY GRADING** - Students may select credit-only grading for physical education and foreign language (proficiency) courses. Excluding PE and other courses authorized to be graded on an S/U basis (e.g. E 490 and E 115), courses taken as credit-only will **not** satisfy graduation requirements. Students may not select credit-only grading for Military Science and Aerospace Studies courses. The deadline for changing course grading to credit only is six weeks from the beginning of a regular semester and eleven class days from the beginning of a summer session.

The grades in credit-only courses are "S" and "U." These grades have no effect on the grade point average; however, the course and its grade are counted in the cumulative hours attempted. Students are encouraged to select credit-only grading for PE courses.

**DOUBLE MAJORS** - Students who intend to earn degrees in chemical engineering and a second major must fulfill all graduation requirements for both degrees. Where overlap between degree requirements occurs, the same courses can normally be used to satisfy graduation requirements in both curricula. In order to minimize the number of courses that must be completed, double major students should prepare a plan of work and review the plan with an academic advisor in each department as early as possible. In subsequent semesters, the student should consult with both advisors during the registration advising period.

Double major students whose second degree is chemical engineering and who wish to receive transfer credits for courses completed at other institutions must receive permission to do so from the Chemical and Biomolecular Engineering Coordinator of Advising (Dr. Bullard) prior to enrolling at the outside institution. **Receipt of transfer credit through another college at NCSU does not guarantee approval of those credits by the College of Engineering.**

**FIRST YEAR COURSE REPEAT POLICY** - The eligible student, after requesting that the first-year course repeat policy apply and completing the course for the second time, will have the grade points and the credit hours attempted and earned on the first completion of the course removed from the calculation of the cumulative grade point average and from the calculation of the total hours attempted, regardless of the grade earned on the second attempt. The course title and grade on the first completion will continue to be shown on the official record accompanied by an "R" to designate that the first-year course repeat policy was applied.

Repeating a course and using the first-year course repeat policy does not retroactively change a student's status regarding semester GPA, semester academic honors, academic warning, probation, or suspension in prior semesters.

A student may apply the first-year course repeat policy to a **maximum of two courses (not more than 8 credit hours)** at the **100- and/or 200-level** provided all of the following criteria have been satisfied:

- The student must have received below C- in the course that is repeated and both attempts must be for a letter grade.
- Both the initial attempt and repeat of the course must be at NCSU.
- The student's first attempt at the course must have occurred **within 12 months of the student's initial enrollment at NCSU**. This period is not lengthened by voluntary or involuntary failure to enroll in subsequent semesters or summer sessions, nor by enrolling at less than a minimum full-time load, following the initial date of enrollment.
- The second attempt must occur in a regular semester or summer session **which ends within twelve months of the completion of the first attempt**. If the course is not available during that period or if the student is not enrolled when it is available, the second attempt must occur in the next regular semester during which the student is enrolled at NCSU and the course is available.
- Only the first attempt to repeat a course (or its equivalent) qualifies, i.e., the first-year course repeat policy cannot be applied to remove the grade of a second attempt of a course even if the second attempt resulted in a lower grade than the first attempt.

- The student must repeat the course before receiving credit for an advanced course dealing with the same subject matter as the course being repeated.
- The second attempt must be for the same course or appear on the list of approved substitute courses (see your adviser.)
- Students must submit a request form for the first-year course repeat to Registration and Records on or before the last day to drop a course without a grade at the 400-level or below of the semester/summer session in which the course is repeated.
- Requests either to apply the course repeat policy to a course repeated in a prior semester, or to reverse a prior application of the repeat policy are inconsistent with the policy.

**GPA CALCULATIONS** - The semester and overall grade point averages are based on a weighted-average calculation. In computing the average, the credit hours associated with each course are multiplied by a weighting factor which depends on the course grade (See chart below). The results of this multiplication are **quality points**, which are summed and then divided by the hours attempted in order to calculate the GPA. **The credit hours associated with courses in which the grade earned is CR, TR, S, U, IN or LA, are not included in the GPA calculation.**

For instance, the grade point average earned during the semester which appears below is 2.12:

<u>COURSE</u>	CREDIT HRS	GRADE	MULTIPLIER	QUALITY POINTS
CH 101	3	B+	3.33	9.99
CH 102	1	A-	3.67	3.67
MA 141	4	C	2.0	8
E 115	1	S	0	0
PE 107	1	S	0	0
ENG 251	3	F	0	0
EC 205	<u>3</u>	B-	2.67	<u>8.01</u>
TOTAL	16			29.67

$$\text{Semester GPA} = 29.67/14 = 2.12 \text{ (2.119)}$$

Note that, since the grades in PE 107 and E 115 were S, the total credit hours **for purposes of the GPA calculation** equals 14 instead of 16.

Continuing the example, for the next semester the student plans to enroll in the following courses and is wondering what GPA must be earned in order to have an overall grade point average of 2.5 following the second semester:

CH 201	3	PE 241	1
CH 202	1	MA 241	4
ENG 251	3	PY 205	4
Total Hours = 16			

The student will take the PE course on a credit-only basis, and will use one of the allowed course repeats on the ENG 111 grade from the first semester. By using the course repeat, the **first** semester total hours for the GPA calculation will be reduced to 11. Furthermore, the **second** semester hours for the GPA calculation equal 15, and the total GPA hours after two semesters will equal 26. Therefore, obtaining the 2.5 GPA after two semesters requires a total of 65 quality points (26 X 2.5), and 35.33 of those must be earned during the spring semester. This means the second semester GPA must be  $35.33/15 = 2.35$ .

**SEMESTER DEAN’S LIST** - A full-time undergraduate student, who earns a semester average of (a) 3.5 or better on 12 to 14 credit hours of course work for which grade points are earned; or (b) 3.25 or better on 15 or more credit hours of course work for which grade points are earned, is on the Dean’s List for that semester. Students are not eligible for the Dean’s List in any semester in which they receive an F or IN grade. When IN grades are resolved, however, students who are otherwise eligible will be added retroactively to the Dean’s List for that semester. Dean’s List recognition is noted on the student’s semester grade report and permanent academic record.

**ELIGIBILITY TO CONTINUE ENROLLMENT** - The minimum eligibility standard for continued enrollment for any undergraduate student is defined as achieving the required cumulative grade point average for the total number of credit hours attempted at NC State plus transferred credit hours according to the Schedule of Performance Requirements for Continuing Undergraduate Enrollment, referred to hereafter as the Continuation Schedule.”

<b>Schedule of Performance Requirements for Continuing Undergraduate Enrollment (Effective Fall 2004)</b>	
<b>Credit Hours Attempted at NCSU Plus Credit Hours Transferred</b>	<b>Minimum Required Cumulative Grade Point Average on all Courses Taken at NCSU</b>
1-59	1.8
60 or more	2.0

B. Undergraduate students who, at the end of any spring semester, do not meet the minimum standards shown in the Continuation Schedule will not be allowed to continue their enrollment at the University during subsequent fall and spring semesters, with the following exceptions:

1. no student will be suspended until the end of the student's second regular semester at NCSU;
2. any student who begins a given semester with a cumulative GPA of 2.00 or better will be eligible to continue in the next regular semester in which they seek enrollment regardless of academic performance in that given semester;
3. students who are eligible to continue at the end of a spring semester will be eligible to continue into the following fall, regardless of summer session performance;
4. students will be eligible to continue their enrollment until they have attempted at least twelve hours at NC State; and,
5. suspended students re-admitted on appeal will be eligible to enroll on Academic Probation.

C. A student with a cumulative GPA below 2.00 will be in one of three academic statuses: Academic Warning, Academic Suspension, or Academic Probation.

**1. Academic Warning Status**

Every student who meets the criteria set forth in section II.B.1-5 above but whose cumulative grade point average is less than 2.00, the minimum for graduation, will be on Academic Warning Status. The [Timely Advising Requirement](#) applies to students on Academic Warning Status.

## 2. Academic Suspension Status

Academic Suspension Status is assigned at the end of the spring semester to students who do not meet the minimum eligibility standards and who were enrolled in either the fall or spring semester. Academically suspended students are subject to the provisions of the regulation on [Readmission of Former and Academically Suspended Undergraduate Degree Students](#).

## 3. Academic Probation Status

Academically suspended students may appeal to the University Admissions Committee for re-admission on Academic Probation Status in order to enroll in a regular semester (fall or spring). Students will not be considered in good academic standing while on Academic Probation Status. The [Timely Advising Requirement](#) applies to students on Academic Probation Status. The University Admissions Committee may prescribe additional requirements as a condition of re-admission. Students who obtain a cumulative GPA above the suspension level, after being placed on probation status, will have the probation status discontinued. Students who do not obtain a cumulative GPA above the suspension level, by the end of the spring semester after being placed on probation, will return to Academic Suspension Status.

### Timely Advising Requirement

All students on Academic Warning Status or Academic Probation Status are required to meet with their academic advisers during the first four weeks of classes in regular semesters to review their academic situations and to formulate or review and revise as needed their plans of study. Any student in either of these statuses who does not comply with this requirement will not be allowed to register and continue enrollment at the University during subsequent fall and spring semesters unless the cumulative GPA of the student is 2.00 or greater at the end of the semester in which the requirement was not met.

**FOREIGN LANGUAGE REQUIREMENT** – Requirements are listed at <http://sasw.chass.ncsu.edu/fl/place.htm>

Freshmen may satisfy this requirement **before** entering NC State in one of the following ways:

- Score of 510 or above on the College Board Foreign Language Achievement Test (SAT II)
- Advanced placement score of 3 or above (College Entrance Examination Board AP Test)
- Obtaining an average grade of C for two years of high school study of the same language

Proficiency at the FL 102 level **after** entering NC State may be demonstrated as follows:

- Completion of FL 102 course with a passing grade of S, D or better (note: in addition to PE, foreign language is the only class that can be taken for credit only)
- Transfer credit equivalent to FL 102 from an accredited institution or university-approved study abroad program
- Placement into FL 201 or higher on the placement tests in the languages offered by the Department of Foreign Languages and Literatures

If you have not met the requirement, please take the placement tests as soon as possible after enrolling. Taking the placement exam two or three years after entering will probably not produce the best results. If you don't pass, then you will have plenty of time to take the required course here or elsewhere.

The "Placement Tests" are offered in the Laundry Building M-F from 8-5. This is a computerized test. The student can take the test **\*only once\***. If you place into FL 201, then you have satisfied the

foreign language proficiency requirement. If you fail to place into the 201 level, then you need to take FL 102 here at NCSU or the equivalent elsewhere.

You can tell whether you have satisfied the requirement by looking at your degree audit. A student who has not yet fulfilled the requirement looks like this:

GRP 211 FOREIGN LANG PROFICI COREQ 090700

A student who has fulfilled the requirement looks like this:

FLF 100 HIGH SCHOOL FRENCH COREQ 8/03 MET 050800

**GRADUATION REQUIREMENTS** - Students are eligible for graduation when they have satisfactorily completed all academic requirements of their degree program. The course requirements for graduation appear on the Automated Degree Audit (ADA) form for all engineering students who have matriculated. Furthermore, competency in a foreign language at the 102 level is a graduation requirement for all students at NCSU. Students are not eligible to graduate if they have any late (LA) or incomplete (IN) grades.

NCSU requires that, in addition to other University, College and departmental requirements, all students must earn a grade point average of at least 2.0, based on all courses attempted at NCSU, in order to be eligible to receive a baccalaureate degree. Furthermore, all baccalaureate degree programs in engineering have the graduation requirement of at least a 2.0 GPA for all courses attempted in the student's major, or the alternative graduation requirement of a C- or better in all required courses in the student's major. For this purpose, the required major courses are defined as including only those courses offered by the major department, or courses which are substituted for the required major courses.

June or August graduates may participate in May graduation with a memo from the department to the bookstore to allow them to pick up a cap and gown. Students who are double majors should notify Registration and Records where they want both diplomas sent. If the student does not, each respective college receives the appropriate diploma and the student must arrange to get the one they did not pick up. University information regarding graduation is on the web at [http://www2.ncsu.edu/ncsu/reg\\_records/grad\\_inf.htm](http://www2.ncsu.edu/ncsu/reg_records/grad_inf.htm).

Requirements for graduation with academic honors:

- *Cum Laude* - for grade point averages of 3.25 through 3.499;
- *Magna Cum Laude* - for grade point averages of 3.5 through 3.749; and
- *Summa Cum Laude* - for grade point averages of 3.75 and above

At least 48 of the last 60 hours towards a degree must be taken at NCSU. Here is the link to the policy: <http://www.ncsu.edu/provost/hat/current/ch06/08.html>. To be eligible for degree honor designations, students must have completed at least two semesters and at least 30 credit hours at NC State.

## **GRIEVANCES IN GRADING**

Grievances related to a grade in a course should first be discussed with the instructor, then with your advisor, and then with the head of the department offering the course. If you feel that the response of these individuals is unsatisfactory, you may pursue a more formal complaint through the college council, grievance committee, or Department Head or Dean for Academic Affairs in your college.

**HONORS COURSES IN CHEMICAL ENGINEERING** - Eligible students (minimum GPA = 3.5) may complete designated CHE courses for Honors credit, even if those students are not in the CHE Honors Program. Students in the Engineering Scholars program may request Scholars Option enrollment for CHE courses in semesters where no Honors sections are scheduled.

**PLAN OF WORK** – Each student must complete a plan of work, to be approved by his or her advisor. This is done through MyPack portal.

**PROGRESS TOWARD DEGREE** – The objective of this regulation is to encourage timely matriculation into degree programs and reasonable progress toward graduation. Therefore, at the end of each Spring semester all degree-seeking students will be monitored for satisfactory progress toward undergraduate degree completion. *Students who enroll for the first time during a Spring semester will not be reviewed until the end of the following Spring semester. [Unless specified otherwise the term semester in this regulation refers only to Fall and Spring semesters and does not include summer sessions]*. The records of students not meeting minimum university requirements for satisfactory progress (see sections 1 - 4) will be flagged and notification will be sent to the student and to relevant academic college(s)/department(s), that a progress review resulting in a final determination of satisfactory or unsatisfactory academic progress must be made at the department level.

If it is determined in the progress review that a student has failed to make satisfactory progress toward undergraduate degree completion, the student will be placed on “Progress Warning” status for one semester (see section 5). Failure to reinstate satisfactory progress status during the semester on progress warning will result in loss of status as a degree-seeking student.

A student wishing to appeal sanctions imposed as a result of failure to meet satisfactory academic progress requirements must do so to the Academic Associate Dean in the student's college of enrollment.

Upon admission as a degree-seeking student, a NC State undergraduate student is expected to make satisfactory progress in a planned and deliberate way toward graduation. This expectation of satisfactory progress translates into the following University minimum requirements:

- Development and registering of a Plan of Study that serves as a planning tool for completing degree requirements for the major(s) in which the student is matriculated, or in the case of the student enrolled in the First Year College (and other undeclared or undesignated programs), expects to matriculate, or transfer. The Plan of Study can include plans for tailoring the academic experience. Therefore, a student's intent to pursue multiple majors, minors, cooperative education, study abroad, and other specialized academic opportunities should be reflected in the registered Plan of Study.
- Enrollment in course work consistent with the student's Plan of Study.
- Continuous full-time enrollment (a minimum of 12 credit hours) during consecutive semesters (i.e., Fall, Spring) until graduation, and successful completion of at least 24 credit hours of NC

State or transferable course work each academic year, unless otherwise justified by an approved Plan of Study.

- Matriculation into a degree program by the beginning of classes in the first semester that the student has junior status (i.e. 60 credit hours earned - criteria established in Classification of Undergraduate Degree Students regulation).

### **Failure of Make Satisfactory Progress**

The records of students not meeting minimum university requirements for satisfactory progress (see sections 1 - 4) will be flagged and notification will be sent to the student and to relevant academic college(s)/department(s), that a progress review resulting in a final determination of satisfactory or unsatisfactory academic progress must be made at the department/program level.

If it is determined in the progress review that a student has failed to make satisfactory progress toward undergraduate degree completion, the student will be placed on “Progress Warning” status. The student will then have one semester (Fall or Spring) to

- work with an adviser to develop and implement a specific plan of action that restores “satisfactory progress” status in the current major, *or*
- matriculate or transfer into an alternative major that has capacity and for which the student meets matriculation or intra-campus transfer requirements.

Failure to return to satisfactory progress status by the beginning of the next semester will result in change in the student’s enrollment status as defined below.

### **Enrollment Status Change**

A student who fails to meet the requirements for satisfactory progress toward a degree after one semester on Progress Warning status will not be permitted to enroll further as an undergraduate degree-seeking student. Students removed from degree seeking status must, through the readmission process, apply for admission into a degree program that has capacity and for which the student meets the matriculation or intra-campus transfer requirements in effect at that time.

A student who wishes to continue to take course work after being removed from degree seeking status may do so through the NC State Lifelong Education program. A student taking courses under the newly created category for enrollment will be permitted to enroll in a maximum of two courses plus a Physical Education course in any semester or summer session until such time as the student qualifies for matriculation or intra-campus transfer into a major that has capacity to accept students and from which the student plans to graduate.

A student registered in the new category for enrollment will be a Lifelong Education student and subject to the same limitations as all other Lifelong Education students for purposes of registration priority, financial aid, on-campus housing, parking, eligibility for participation on inter-collegiate athletic teams, etc.

### **Exceptions**

The following situations will result in a student’s being exempted from the 24 credit hour per academic year requirement only in the year that they occur:

- Receipt of a late or retroactive withdrawal for a semester.

- Service as a military reservist called to active duty.
- Other unanticipated leave of absence granted by the dean's office of the college in which the student is enrolled.

The other progress toward degree completion requirements will continue to apply unless specifically waived by the dean in the student's college of enrollment. All exceptions must be documented in the student's approved Plan of Study.

## **SCHOLARSHIPS FOR CHEMICAL AND BIOMOLECULAR ENGINEERING STUDENTS**

- The scholarship program for students in chemical engineering is generally divided into four levels:

1) **University-level merit scholarships.** These scholarships are awarded in a campus-wide competition coordinated by the NCSU Caldwell Programs and the Park Scholars Office. Many of these scholarships (i.e. the Park and Caldwell Fellow Scholarships) are typically highly competitive. The Park Scholarship is awarded to incoming freshmen, while the Caldwell Fellow Scholarships are usually awarded to students who have completed one semester of studies at NCSU.

2) **College of Engineering scholarships.** Through its Scholarship Committee, the College of Engineering (COE) awards a number of scholarships each year to students in all engineering programs in the college. The selection criteria for these scholarships are established by the donors who provide the financial support for the scholarships. Many of these scholarships are targeted to recognize strong academic performance by minority or female engineering students. Other scholarships are provided for students with strong academic records and demonstrable financial need.

Financial need has typically been assessed by the scholarship committee based on information supplied by the NCSU Financial Aid Office. In addition to scholarly excellence at NC State, examples of other criteria which are required by some donors in the selection of scholarship recipients include evidence of leadership skills and geographic location of the scholar's home. To assist in the evaluation of a student's suitability as a recipient of a particular scholarship, the COE mails each Spring, to all students above a minimum target GPA, scholarship information forms to be completed by the student and returned to the COE. If you have not received and completed a scholarship information form and wish to do so, these forms may be obtained by any student on-line at <http://www.engr.ncsu.edu/students/eligibility/eligibilityForm.php>. The information in these forms, along with overall academic records and financial aid information, is used in selecting the candidate who most closely matches the profile specified by the donor of a particular scholarship. These forms are due on **March 1** of each year and should be updated every year in order for the student to be eligible for these scholarships.

Most COE-level scholarship selections are made in the late Spring, typically in late April or early May, and recipients are notified by mail shortly thereafter. A few scholarships will usually be available for award in the Fall semester, and the recipients are notified by mail.

3) **Chemical and Biomolecular Engineering Department Scholarships.** The Department offers a small number of highly competitive scholarships which are reserved for chemical engineering students. The selection criteria for these scholarships are similar to those for the COE scholarships (i.e. academic merit, financial need, minority status, female students, etc.) Most ChE scholarship decisions are made in the Fall.

Many of the ChE scholarships are provided by corporate sponsors who have typically hired chemical engineers from NC State. Most of the ChE scholarships are targeted by the donors for junior and senior level students. In this regard, the ChE department offers no scholarships for incoming freshmen. The information used to match students with scholarships includes academic records, financial aid information, and additional information on the COE scholarship information form. Dr. Bullard coordinates the scholarship program in the Department, and students are encouraged to contact her if they have questions regarding the scholarship program.

4) **Other Sources of Scholarships.** In addition to the three sources of scholarships mentioned above, some chemical engineering students will have scholarships from other sources. These sources include but are not limited to: grants and loans from the Financial Aid Office to qualified students, scholarships from other departments for students pursuing more than one degree (i.e. double majors in Polymer and Color Chemistry and Chemical Engineering), and scholarships from external sources (i.e. National Merit Scholarships, some companies offer scholarships to children of employees, etc.).

Because the Air Force needs a large number of engineers, the Air Force ROTC has a number of programs designed to help engineering students get through college, including the two types of scholarship programs. Over 70% of Air Force scholarships are awarded to engineering students. To learn more about the programs available at NCSU, stop by Room 133A in Reynolds Coliseum or call the Air Force ROTC Unit Admissions Officer 515-8777.

**TRANSFER CREDIT** - Students who wish to take courses at another institution should obtain prior approval from Dr. Bullard in order to insure that the transfer credits will apply toward fulfilling specific graduation requirements. Information about transfer course equivalencies at a large number of institutions appears at: <https://www.acs.ncsu.edu/scripts/ugadmiss/trnsfcrs>.

**TUTORING** - A number of tutoring programs are available on campus. Students are encouraged to seek tutoring help for subjects in which they are weak. It is very important that the student not wait until late in the semester to start with a tutor for two reasons:

- 1) There are a limited number of tutors available on campus.
- 2) The later it is, the more material will have to be covered to catch up.

NC State maintains a central Tutorial Services website at [http://www.ncsu.edu/tutorial\\_center/](http://www.ncsu.edu/tutorial_center/). This is probably the best starting point if you are seeking tutorial assistance. There are many campus resources to help you if you would like academic assistance:

**Advising Central** -- [http://www.ncsu.edu/advising\\_central/](http://www.ncsu.edu/advising_central/)

**Counseling Center** -- [http://www2.ncsu.edu/ncsu/stud\\_affairs/counseling\\_center/](http://www2.ncsu.edu/ncsu/stud_affairs/counseling_center/)  
2401 Student Health Services Building, 515-2423

**Disability Services** -- [http://www.ncsu.edu/provost/offices/affirm\\_action/dss/](http://www.ncsu.edu/provost/offices/affirm_action/dss/)  
1900 Student Health Center, 515-7653

**Online Writing Lab** -- <http://www.ncsu.edu/ncsu/grammar/>

**Physics Tutorial Center** -- <http://www.ncsu.edu/ncsu/pams/physics/ptc/index.html>  
132 Withers Hall, 515-7087

**Supplemental Instruction (SI)** -- [http://www.ncsu.edu/tutorial\\_center/si/](http://www.ncsu.edu/tutorial_center/si/)

**Undergraduate Tutorial Center** -- [http://www.ncsu.edu/tutorial\\_center/](http://www.ncsu.edu/tutorial_center/)  
147 Leazar Hall, 515-3163

**UNDERGRADUATE RESEARCH PROJECTS** - Students who plan to attend graduate school should consider completing an undergraduate research project under the supervision of a faculty advisor. Projects normally require at least one semester to complete, and the student is normally required to prepare oral and written reports that document and present their work. To receive academic credit for the research project work, students must enroll in either CHE 497 (3 credits) or CHE 498 (1-3 credits). Before enrolling in either of these courses, you should consult with Dr. Bullard to understand the requirements. Typically 10/hrs week or 150 hours total over the course of the semester are required.

**ON-LINE LEARNING STYLE QUESTIONNAIRE:**  
<http://www.engr.ncsu.edu/learningstyles/ilsweb.html>

**LEARNING STYLES AND STRATEGIES**

Richard M. Felder  
Hoechst Celanese Professor of Chemical Engineering  
North Carolina State University

Barbara A. Soloman  
Coordinator of Advising, First Year College  
North Carolina State University

**ACTIVE AND REFLECTIVE LEARNERS**

- Active learners tend to retain and understand information best by doing something active with it--discussing or applying it or explaining it to others. Reflective learners prefer to think about it quietly first.
- "Let's try it out and see how it works" is an active learner's phrase; "Let's think it through first" is the reflective learner's response.
- Active learners tend to like group work more than reflective learners, who prefer working alone.
- Sitting through lectures without getting to do anything physical but take notes is hard for both learning types, but particularly hard for active learners.

*Everybody is active sometimes and reflective sometimes.* Your preference for one category or the other may be strong, moderate, or mild. A balance of the two is desirable. If you always act before reflecting you can jump into things prematurely and get into trouble, while if you spend too much time reflecting you may never get anything done.

**How can active learners help themselves?**

If you are an active learner in a class that allows little or no class time for discussion or problem-solving activities, you should try to compensate for these lacks when you study. Study in a group in which the members take turns explaining different topics to each other. Work with others to guess what you will be asked on the next test and figure out how you will answer. You will always retain information better if you find ways to do something with it.

**How can reflective learners help themselves?**

If you are a reflective learner in a class that allows little or no class time for thinking about new information, you should try to compensate for this lack when you study. Don't simply read or memorize the material; stop periodically to review what you have read and to think of possible questions or applications. You might find it helpful to write short summaries of readings or class notes in your own words. Doing so may take extra time but will enable you to retain the material more effectively.

## **SENSING AND INTUITIVE LEARNERS**

- Sensing learners tend to like learning facts, intuitive learners often prefer discovering possibilities and relationships.
- Sensors often like solving problems by well-established methods and dislike complications and surprises; intuitors like innovation and dislike repetition. Sensors are more likely than intuitors to resent being tested on material that has not been explicitly covered in class.
- Sensors tend to be patient with details and good at memorizing facts and doing hands-on (laboratory) work; intuitors may be better at grasping new concepts and are often more comfortable than sensors with abstractions and mathematical formulations.
- Sensors tend to be more practical and careful than intuitors; intuitors tend to work faster and to be more innovative than sensors.
- Sensors don't like courses that have no apparent connection to the real world; intuitors don't like "plug-and-chug" courses that involve a lot of memorization and routine calculations.

*Everybody is sensing sometimes and intuitive sometimes.* Your preference for one or the other may be strong, moderate, or mild. To be effective as a learner and problem solver, you need to be able to function both ways. If you overemphasize intuition, you may miss important details or make careless mistakes in calculations or hands-on work; if you overemphasize sensing, you may rely too much on memorization and familiar methods and not concentrate enough on understanding and innovative thinking.

### **How can sensing learners help themselves?**

Sensors remember and understand information best if they can see how it connects to the real world. If you are in a class where most of the material is abstract and theoretical, you may have difficulty. Ask your instructor for specific examples of concepts and procedures, and find out how the concepts apply in practice. If the teacher does not provide enough specifics, try to find some in your course text or other references or by brainstorming with friends or classmates.

### **How can intuitive learners help themselves?**

Many college lecture classes are aimed at intuitors. However, if you are an intuitor and you happen to be in a class that deals primarily with memorization and rote substitution in formulas, you may have trouble with boredom. Ask your instructor for interpretations or theories that link the facts, or try to find the connections yourself. You may also be prone to careless mistakes on test because you are impatient with details and don't like repetition (as in checking your completed solutions). Take time to read the entire question before you start answering and be sure to check your results

## **VISUAL AND VERBAL LEARNERS**

Visual learners remember best what they see--pictures, diagrams, flow charts, time lines, films, and demonstrations. Verbal learners get more out of words--written and spoken explanations. Everyone learns more when information is presented both visually and verbally.

In most college classes very little visual information is presented: students mainly listen to lectures and read material written on chalkboards and in textbooks and handouts. Unfortunately, most people are visual learners, which means that most students do not get nearly as much as they would if more

visual presentation were used in class. Good learners are capable of processing information presented either visually or verbally.

### **How can visual learners help themselves?**

If you are a visual learner, try to find diagrams, sketches, schematics, photographs, flow charts, or any other visual representation of course material that is predominantly verbal. Ask your instructor, consult reference books, and see if any videotapes or CD-ROM displays of the course material are available. Prepare a concept map by listing key points, enclosing them in boxes or circles, and drawing lines with arrows between concepts to show connections. Color-code your notes with a highlighter so that everything relating to one topic is the same color.

### **How can verbal learners help themselves?**

Write summaries or outlines of course material in your own words. Working in groups can be particularly effective: you gain understanding of material by hearing classmates' explanations and you learn even more when you do the explaining.

## **SEQUENTIAL AND GLOBAL LEARNERS**

- Sequential learners tend to gain understanding in linear steps, with each step following logically from the previous one. Global learners tend to learn in large jumps, absorbing material almost randomly without seeing connections, and then suddenly "getting it."
- Sequential learners tend to follow logical stepwise paths in finding solutions; global learners may be able to solve complex problems quickly or put things together in novel ways once they have grasped the big picture, but they may have difficulty explaining how they did it.

Many people who read this description may conclude incorrectly that they are global, since everyone has experienced bewilderment followed by a sudden flash of understanding. What makes you global or not is what happens before the light bulb goes on. Sequential learners may not fully understand the material but they can nevertheless do something with it (like solve the homework problems or pass the test) since the pieces they have absorbed are logically connected. Strongly global learners who lack good sequential thinking abilities, on the other hand, may have serious difficulties until they have the big picture. Even after they have it, they may be fuzzy about the details of the subject, while sequential learners may know a lot about specific aspects of a subject but may have trouble relating them to different aspects of the same subject or to different subjects.

### **How can sequential learners help themselves?**

Most college courses are taught in a sequential manner. However, if you are a sequential learner and you have an instructor who jumps around from topic to topic or skips steps, you may have difficulty following and remembering. Ask the instructor to fill in the skipped steps, or fill them in yourself by consulting references. When you are studying, take the time to outline the lecture material for yourself in logical order. In the long run doing so will save you time. You might also try to strengthen your global thinking skills by relating each new topic you study to things you already know. The more you can do so, the deeper your understanding of the topic is likely to be.

### **How can global learners help themselves?**

If you are a global learner, it can be helpful for you to realize that you need the big picture of a subject before you can master details. If your instructor plunges directly into new topics without bothering to explain how they relate to what you already know, it can cause problems for you.

Fortunately, there are steps you can take that may help you get the big picture more rapidly. Before you begin to study the first section of a chapter in a text, skim through the entire chapter to get an overview. Doing so may be time-consuming initially but it may save you from going over and over individual parts later. Instead of spending a short time on every subject every night, you might find it more productive to immerse yourself in individual subjects for large blocks. Try to relate the subject to things you already know, either by asking the instructor to help you see connections or by consulting references. Above all, don't lose faith in yourself; you will eventually understand the new material, and once you do your understanding of how it connects to other topics and disciplines may enable you to apply it in ways that most sequential thinkers would never dream of.

## PROFESSIONAL AND PERSONAL DEVELOPMENT

### STUDENT CHAPTER OF THE AMERICAN INSTITUTE OF CHEMICAL ENGINEERS

The American Institute of Chemical Engineers (AIChE) is the national professional organization for chemical engineers. The primary objective of the student chapter of AIChE is to promote the professional development of the members by programs and relations with other student chapters. Secondly, the chapter contributes to the development of chemical engineering at NCSU through activities involving the faculty and student members. While membership is extended only to those students in chemical engineering, other interested engineering students are heartily invited to the chapter's programs. Chemical engineering freshmen are urged to join the chapter. The chapter helps to give each student an understanding of their future, in school as well as after graduation.

**Student Lounge:** EB1 2013

**Mission:** To promote the development and reputation of our members and the department in industry and academia.

**Membership:** Membership is open to all undergraduate and graduate students enrolled in chemical engineering or chemical engineering undesignated. Dues are \$20 per year or \$10 per semester if participating in the co-op program. There is also a discount for sophomores and freshman (\$10/year in past years) as an incentive to join.

**Activities/Benefits:** The student chapter schedules several luncheons, usually two per week, mostly during the fall semester. These luncheons are funded by companies that actively recruit chemical engineers from N.C. State, and are open to all AIChE members. The sponsoring company provides food and information about its operations, recruiting, career opportunities, benefits, etc. Regular sponsors of the luncheons include Alcoa, Procter & Gamble, ExxonMobil, Hoffman-LaRoche, Merck, Monsanto, International Paper, Shell, and several others.

The chapter prepares a resume book in the fall for those seeking full-time, co-op, or internship positions. Copies of the resume book are distributed to various companies through the department head and to all companies sponsoring luncheons. The resume book is a very successful recruiting tool.

For students interested in graduate school, AIChE sponsors an information session conducted by several chemical engineering faculty members. The information session covers topics including applications, requirements, graduate schools, graduate studies and more.

The chapter also attends the national and regional annual conferences. The national conference is usually held in November, and the regional conference is in March or April. Some previous conference sites have included San Francisco, St. Louis, Tallahassee, Miami, and New Orleans. The conferences provide the opportunity to learn more about the chemical engineering profession and current research efforts, and gives exposure to other schools and companies. It's also a great opportunity to meet other ChE's and have a lot of fun.

Social events are scheduled throughout the year. During homecoming weekend, members are encouraged to join N.C. State Chemical Engineering alumni for the football game and a pre-game picnic. Other social events may include Durham Bulls baseball, Raleigh Icecaps hockey, Charlie Goodnight's comedy club, etc. The chapter may also organize fundraisers to assist departmental projects or charitable causes. Depending on participation, the chapter sponsors intramural teams (basketball, volleyball, softball, etc.).

- **Leadership/Organization:** The chapter is lead and managed by a group of officers, with the help of several committee members and the guidance of a faculty advisor. Every spring, the chapter members nominate and elect officers to lead the chapter in the following school year. At the beginning of the fall semester, the new officers recruit members to serve on various committees that help manage the chapter's activities.

**How to Join:** If you're interested in joining the student chapter of AIChE, attend any of the luncheons or chapter meetings announced in class or on notices in EB1 2-013. The web site for more information is <http://www.che.ncsu.edu/aiche/>

## **OMEGA CHI EPSILON: THE CHEMICAL ENGINEERING HONOR SOCIETY**

Omega Chi Epsilon is an organization created to support the academic life of students in chemical engineering.

**Mission:** The mission of Omega Chi Epsilon is the following:

1. To recognize the achievements of outstanding chemical engineering students.
2. To promote academic pursuits within chemical engineering.
3. To create awareness of chemical engineering among other disciplines.

**Membership:** The membership of Omega Chi Epsilon is currently restricted to the top 20% of the junior class and the top 25% of the senior class in chemical engineering.

**Activities:** Members of Omega Chi Epsilon are expected to take an active role in the organization by assisting the Society in its mission within the department. Some of the activities that are planned include:

- **Graduate School Information Session:** A session is planned to bring faculty and students together for a lively discussion of going to graduate school. Faculty and graduate students will discuss questions such as, "How do I apply," "When should I start applying?" and "Why should I pursue graduate study?"
- **Open House:** The organization will assist the department in preparing for the College of Engineering Open House. Most of the recruiting of students into the CHE curriculum occurs at this very important event.
- **Undergraduate Research:** We are compiling a list of faculty members who need students to work in their research programs.

**How to Join:** If you are eligible based on the criteria for membership, you will be contacted by the secretary of the honor society in the spring. If you are interested and have not been contacted, please email Dr. Bullard or one of the officers for a membership application.

## **THE INTERNATIONAL SOCIETY FOR PHARMACEUTICAL ENGINEERING**

The NC State student chapter of the International Society for Pharmaceutical Engineering (ISPE) was founded in the fall semester of the 1995-96 school year. ISPE is a national organization which supports engineers working in the pharmaceutical industry. Each month, the N.C. State student chapter hosts luncheons featuring speakers from the pharmaceutical industry. The speakers focus on their specific work experiences within the industry as well as featured technical topics. These technically-based luncheons complement many of the recruiting-oriented luncheons featured by AIChE. In addition to the luncheons, students are invited to attend two tours of pharmaceutical facilities each semester. These tours are sponsored by the professional Carolina Chapter of ISPE and offer great opportunities to see the actual work environment and to network with professional engineers. Dr. Steven Peretti serves as faculty advisor to the ISPE.

**PRE-LAW** – Students who are interested in attending law school should contact Mary Alice Tetro, Coordinator of Pre-Law Services for more information (515-5830 or [mary\\_tetro@ncsu.edu](mailto:mary_tetro@ncsu.edu))

**PRE-MED** – Students who are interested in attending medical, dental, pharmacy, or other health-related professional program should utilize to the on-line “Health Professions Advising Center” at [http://harvest.cals.ncsu.edu/health\\_pac/index.cfm?pageID=815](http://harvest.cals.ncsu.edu/health_pac/index.cfm?pageID=815)

**STUDY ABROAD** - Students interested in Study Abroad opportunities should go to the Study Abroad office and fill out an application packet. In that packet will be a "Request for NC State Academic Approval" form, which the student should take to Brian Koehler (118/120 Page Hall) to complete and sign. The web site for more information is [http://www2.ncsu.edu/ncsu/stud\\_affairs/study\\_abroad/](http://www2.ncsu.edu/ncsu/stud_affairs/study_abroad/).

**COOPERATIVE ENGINEERING EDUCATION PROGRAM**  
(OFFICE – 300 CLARK HALL)

The cooperative education program enhances and broadens the student's academic experience by alternating periods of academic study with periods of employment. It is a five-year plan with the freshman year on campus. Sophomores, juniors, and often seniors alternate semesters of school and work, with a minimum of 12 months of work experience. A typical schedule is illustrated below.

	<u>1st Year</u>			<u>2nd Year</u>			<u>3rd Year</u>			<u>4th Year</u>			<u>5th Year</u>	
	Fa	Sp	Su	Fa	Sp	Su	Fa	Sp	Su	Fa	Sp	Su	Fa	Sp
Student A	S	S	W	S	W	S	W	S	W	S	W	S	S	S
Student B	S	S	S	W	S	W	S	W	S	W	S	W	S	S

S=School W=Work

A student may begin the first co-op work period as late as the second semester of the junior year. In this case, the student's graduation may be extended in order to complete twelve months work experience required for program completion.

**BACKGROUND**

A sound curriculum that combines theoretical and practical training in chemical engineering principles and design coupled with professional work experience is the basis of NC State's Cooperative Education Program. The Cooperative Education Program at NC State provides outstanding undergraduates with terms of full-time study interspersed with up to five semesters and summer sessions of full-time engineering-related employment.

During the past year, 37 chemical engineering majors participated in the Co-op program. The students are full-time employees of the sponsoring company during their terms of work. During 2008-2009, the average monthly salary for Co-op chemical engineers during their first work rotation was \$2,720. A high percentage of Co-op students receive offers of professional employment after graduation. Approximately 350 employers in North Carolina and throughout the nation participate in the Co-op program, thus providing a good cross-section of opportunities for industrial experience.

AMGEN	FMC CORPORATION	NATIONAL GYPSUM
BEKAERT	FUJI FILM	NATIONAL STARCH
BIOGEN IDEC	GE	NOVOZYMES
BOEHME FILATEX	GEORGIA PACIFIC	O'BRIEN AND GERE
BOWATER	GILEAD SCIENCE	ENGINEERS
CIRRUS PHARMACEUTICAL	GLAXOSMITH KLINE	PCA
CLOSURE MEDICAL	HERSHEY	PERFORMANCE FIBERS
COGNIS	HONEYWELL	PHILIP MORRIS
CURTIS PAPER	INTERNATIONAL PAPER	PROGRESS ENERGY
DOMTAR INDUSTRIES	INVISTA	ROBERT E. MASON
DOW CHEMICAL	KIMBERLY CLARK	TAKATA INC
DSM PHARMACEUTICAL	MARRANCA ENGINEERING	WEYERHAEUSER
DUPONT	MEAD WESTVACO	WYETH VACCINES
EASTMAN CHEMICAL	MILLIKEN	ZETTACOR
EXXONMOBIL	NASA KENNEDY	

## **ADVANTAGES FOR CO-OP STUDENTS**

1. Co-op provides for career exploration and confirmation of career choice.
2. The co-op job is a learning laboratory that often provides state-of-the-art equipment that universities cannot afford to purchase.
3. The co-op job provides students the opportunity to develop their human relations and communication skills while working in unique situations with professionals in their field.
4. The co-op experience enhances the marketability of students at graduation.
5. The co-op engineering students (75% of all co-ops) had substantial earnings that helped to defray their educational expenses.
6. The NCSU Co-op Program is accredited by ABET. This allows students to use the work experience toward meeting requirements to obtain a license as a professional engineer.
7. NCSU co-op students have a higher rate of graduation than non co-ops.

## **ENTRY REQUIREMENTS**

The applicant must be enrolled as a full-time student in the College of Engineering, must complete the department admission requirements prior to the first scheduled work period, must have a minimum overall grade point average of 2.25/4.00, and should have enough semesters remaining prior to graduation to arrange for a minimum of twelve months work experience. The student should apply at the co-op office early in the semester prior to the first work period. To remain in the program, students must maintain a minimum grade point average of 2.0/4.0 and perform satisfactorily for the employer. Some companies require a higher GPA.

## **EMPLOYERS--WHO AND WHERE**

Employers may be private industry, federal or state agencies, or any firm requiring engineering talent. Geographically, the employers may be anywhere in the USA or even in a foreign country if it can be arranged. Students who are willing to accept co-op jobs outside of North Carolina will find that they have a larger choice of companies and opportunities and less competition for positions than in the Triangle.

## **EMPLOYER SELECTION**

When students make application for the co-op plan, the Co-op Coordinator ascertains the student's interests and strives to match those interests with employer needs, also taking into consideration geographic preferences when possible. Resumés are sent to employers chosen by the student and the coordinator. Interested employers will arrange interviews when feasible. Offers are made and students with more than one offer have a choice. Students are free to suggest employers even though they may not be among those listed with the co-op office.

## **REGISTRATION**

Students going on a co-op job the next semester must register for that semester (as a co-op) during the usual registration period and are considered full-time students while on the job. No academic credit is given for the work period, but a grade of "satisfactory" or "unsatisfactory" is recorded on the student's transcript.

## **HOUSING**

Students are responsible for obtaining housing. Employers are helpful and a few have housing arrangements for their co-ops.

## **GENERAL**

Each student is required to complete a brief work report, and the employer's evaluation of each work period is discussed with the student following the work semester. When co-op students graduate, they are under no obligation to work for their co-op employers, and the employers are under no obligation to offer jobs to the graduating students. A certificate is awarded to graduating students who have satisfactorily completed twelve or more months of co-op work experience and who have submitted a subsequently approved work report for each co-op session. Also, a notation is made on the permanent record for these students indicating the months of work experience obtained.

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## PROFESSIONAL DEVELOPMENT TOPICS

### ELECTRONIC ETIQUETTE

#### Why do you need email etiquette? (1)

A company needs to implement etiquette rules for the following three reasons:

- Professionalism: by using proper email language your company will convey a professional image.
- Efficiency: emails that get to the point are much more effective than poorly worded emails.
- Protection from liability: employee awareness of email risks will protect your company from costly law suits.

#### What are the etiquette rules?

There are many etiquette guides and many different etiquette rules. Some rules will differ according to the nature of your business and the corporate culture. Below we list what we consider as the 32 most important email etiquette rules that apply to nearly all companies. (Note: Items 1-32 are all from source 1).

##### **1. Be concise and to the point.**

Do not make an e-mail longer than it needs to be. Remember that reading an e-mail is harder than reading printed communications and a long e-mail can be very discouraging to read.

##### **2. Answer all questions, and pre-empt further questions.**

An email reply must answer all questions, and pre-empt further questions – If you do not answer all the questions in the original email, you will receive further e-mails regarding the unanswered questions, which will not only waste your time and your customer's time but also cause considerable frustration. Moreover, if you are able to pre-empt relevant questions, your customer will be grateful and impressed with your efficient and thoughtful customer service. Imagine for instance that a customer sends you an email asking which credit cards you accept. Instead of just listing the credit card types, you can guess that their next question will be about how they can order, so you also include some order information and a URL to your order page. Customers will definitely appreciate this.

##### **3. Use proper spelling, grammar & punctuation.**

This is not only important because improper spelling, grammar and punctuation give a bad impression of your company, it is also important for conveying the message properly. E-mails with no full stops or commas are difficult to read and can sometimes even change the meaning of the text. And, if your program has a spell checking option, why not use it? [Note: avoid using common IM acronyms unless you are writing to a close friend – many in the older generation will be clueless as to what you are trying to say].

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1 <http://www.emailreplies.com/#why>

#### **4. Make it personal.**

Not only should the e-mail be personally addressed, it should also include personal i.e. customized content. For this reason auto replies are usually not very effective. However, templates can be used effectively in this way, see next tip.

#### **5. Use templates for frequently used responses.**

Some questions you get over and over again, such as directions to your office or how to subscribe to your newsletter. Save these texts as response templates and paste these into your message when you need them. You can save your templates in a Word document, or use pre-formatted emails. Even better is a tool such as [ReplyMate for Outlook](#) (allows you to use 10 templates for free).

#### **6. Answer swiftly.**

Customers send an e-mail because they wish to receive a quick response. If they did not want a quick response they would send a letter or a fax. Therefore, each e-mail should be replied to within at least 24 hours, and preferably within the same working day. If the email is complicated, just send an email back saying that you have received it and that you will get back to them. This will put the customer's mind at rest and usually customers will then be very patient!

#### **7. Do not attach unnecessary files.**

By sending large attachments you can annoy customers and even bring down their e-mail system. Wherever possible try to compress attachments and only send attachments when they are productive. Moreover, you need to have a good virus scanner in place since your customers will not be very happy if you send them documents full of viruses!

#### **8. Use proper structure & layout.**

Since reading from a screen is more difficult than reading from paper, the structure and lay out is very important for e-mail messages. Use short paragraphs and blank lines between each paragraph. When making points, number them or mark each point as separate to keep the overview.

#### **9. Do not overuse the high priority option.**

We all know the story of the boy who cried wolf. If you overuse the high priority option, it will lose its function when you really need it. Moreover, even if a mail has high priority, your message will come across as slightly aggressive if you flag it as 'high priority'.

#### **10. Do not write in CAPITALS.**

IF YOU WRITE IN CAPITALS IT SEEMS AS IF YOU ARE SHOUTING. This can be highly annoying and might trigger an unwanted response in the form of a flame mail. Therefore, try not to send any email text in capitals. [Likewise, do not eliminate all capital letters unless you're e.e. cummings].

#### **11. Don't leave out the message thread.**

When you reply to an email, you must include the original mail in your reply, in other words click 'Reply', instead of 'New Mail'. Some people say that you must remove the previous message since this has already been sent and is therefore unnecessary. However, I could not agree less. If you receive many emails you obviously cannot remember each individual email. This means that a 'threadless email' will not provide enough information and you will have to spend a frustratingly

long time to find out the context of the email in order to deal with it. Leaving the thread might take a fraction longer in download time, but it will save the recipient much more time and frustration in looking for the related emails in their inbox!

## **12. Add disclaimers to your emails.**

It is important to add disclaimers to your internal and external mails, since this can help protect your company from liability. Consider the following scenario: an employee accidentally forwards a virus to a customer by email. The customer decides to sue your company for damages. If you add a disclaimer at the bottom of every external mail, saying that the recipient must check each email for viruses and that it cannot be held liable for any transmitted viruses, this will surely be of help to you in court (read more about [email disclaimers](#)). Another example: an employee sues the company for allowing a racist email to circulate the office. If your company has an [email policy](#) in place and adds an email disclaimer to every mail that states that employees are expressly required not to make defamatory statements, you have a good case of proving that the company did everything it could to prevent offensive emails.

## **13. Read the email before you send it.**

A lot of people don't bother to read an email before they send it out, as can be seen from the many spelling and grammar mistakes contained in emails. Apart from this, reading your email through the eyes of the recipient will help you send a more effective message and avoid misunderstandings and inappropriate comments.

## **14. Do not overuse Reply to All.**

Only use Reply to All if you really need your message to be seen by each person who received the original message.

## **15. Mailings > use the Bcc: field or do a mail merge.**

When sending an email mailing, some people place all the email addresses in the To: field. There are two drawbacks to this practice: (1) the recipient knows that you have sent the same message to a large number of recipients, and (2) you are publicizing someone else's email address without their permission. One way to get round this is to place all addresses in the Bcc: field. However, the recipient will only see the address from the To: field in their email, so if this was empty, the To: field will be blank and this might look like spamming. You could include the mailing list email address in the To: field, or even better, if you have Microsoft Outlook and Word you can do a mail merge and create one message for each recipient. A mail merge also allows you to use fields in the message so that you can for instance address each recipient personally. For more information on how to do a Word mail merge, consult the Help in Word.

## **16. Take care with abbreviations and emoticons.**

In business emails, try not to use abbreviations such as BTW (by the way) and LOL (laugh out loud). The recipient might not be aware of the meanings of the abbreviations and in business emails these are generally not appropriate. The same goes for emoticons, such as the smiley :-). If you are not sure whether your recipient knows what it means, it is better not to use it.

## **17. Be careful with formatting.**

Remember that when you use formatting in your emails, the sender might not be able to view formatting, or might see different fonts than you had intended. When using colors, use a color that is easy to read on the background.

**18. Take care with rich text and HTML messages.**

Be aware that when you send an email in rich text or HTML format, the sender might only be able to receive plain text emails. If this is the case, the recipient will receive your message as a .txt attachment. Most email clients however, including Microsoft Outlook, are able to receive HTML and rich text messages.

**19. Do not forward chain letters.**

Do not forward chain letters. We can safely say that all of them are hoaxes. Just delete the letters as soon as you receive them.

**20. Do not request delivery and read receipts.**

This will almost always annoy your recipient before he or she has even read your message. Besides, it usually does not work anyway since the recipient could have blocked that function, or his/her software might not support it, so what is the use of using it? If you want to know whether an email was received it is better to ask the recipient to let you know if it was received.

**21. Do not ask to recall a message.**

Biggest chances are that your message has already been delivered and read. A recall request would look very silly in that case wouldn't it? It is better just to send an email to say that you have made a mistake. This will look much more honest than trying to recall a message.

**22. Do not copy a message or attachment without permission.**

Do not copy a message or attachment belonging to another user without permission of the originator. If you do not ask permission first, you might be infringing on copyright laws.

**23. Do not use email to discuss confidential information.**

Sending an email is like sending a postcard. If you don't want your email to be displayed on a bulletin board, don't send it. Moreover, never make any libelous, sexist or racially discriminating comments in emails, even if they are meant to be a joke.

**24. Use a meaningful subject line.**

Try to use a subject that is meaningful to the recipient as well as yourself. For instance, when you send an email to a company requesting information about a product, it is better to mention the actual name of the product, e.g. 'Product A information' than to just say 'product information' or the company's name in the subject.

**25. Use active instead of passive.**

Try to use the active voice of a verb wherever possible. For instance, 'We will process your order today', sounds better than 'Your order will be processed today'. The first sounds more personal, whereas the latter, especially when used frequently, sounds unnecessarily formal.

## **26. Avoid using URGENT and IMPORTANT.**

Even more so than the high-priority option, you must at all times try to avoid these types of words in an email or subject line. Only use this if it is a really, really urgent or important message.

## **27. Avoid long sentences.**

Try to keep your sentences to a maximum of 15-20 words. Email is meant to be a quick medium and requires a different kind of writing than letters. Also take care not to send emails that are too long. If a person receives an email that looks like a dissertation, chances are that they will not even attempt to read it!

## **28. Don't send or forward emails containing libelous, defamatory, offensive, racist, or obscene remarks.**

By sending or even just forwarding one libelous, or offensive remark in an email, you and your company can face court cases resulting in multi-million dollar penalties.

## **29. Don't forward virus hoaxes and chain letters.**

If you receive an email message warning you of a new unstoppable virus that will immediately delete everything from your computer, this is most probably a hoax. By forwarding hoaxes you use valuable bandwidth and sometimes virus hoaxes contain viruses themselves, by attaching a so-called file that will stop the dangerous virus. The same goes for chain letters that promise incredible riches or ask your help for a charitable cause. Even if the content seems to be bona fide, the senders are usually not. Since it is impossible to find out whether a chain letter is real or not, the best place for it is the recycle bin.

## **30. Keep your language gender neutral.**

In this day and age, avoid using sexist language such as: 'The user should add a signature by configuring his email program'. Apart from using he/she, you can also use the neutral gender: 'The user should add a signature by configuring the email program'.

## **31. Don't reply to spam.**

By replying to spam or by unsubscribing, you are confirming that your email address is 'live'. Confirming this will only generate even more spam. Therefore, just hit the delete button or use email software to remove spam automatically.

## **32. Use cc: field sparingly.**

Try not to use the cc: field unless the recipient in the cc: field knows why they are receiving a copy of the message. Using the cc: field can be confusing since the recipients might not know who is supposed to act on the message. Also, when responding to a cc: message, should you include the other recipient in the cc: field as well? This will depend on the situation. In general, do not include the person in the cc: field unless you have a particular reason for wanting this person to see your response. Again, make sure that this person will know why they are receiving a copy.

### **33. Remember that email is not always the best form of communication.(2)**

There are many subjects that are too sensitive to discuss over email mainly because misinterpretation could have serious consequences. Some topics that should generally be resolved outside of email are:

- Disciplinary action
- Conflicts about grades or personal information
- Concerns about fellow classmates/workmates
- Complaints

When it appears that a dialogue has turned into a conflict, it is best to suggest an end to the swapping of email and for you to talk or meet in person. If you receive a flaming email try to respond in a short and simple response. If that does not appease the flamer, then make contact with him or her outside the virtual realm.

### **33. For your personal accounts, use a user ID that comes across as professional.**

A potential employer who is trying to contact you regarding a position will not be impressed if they are sending their email to [thicnspicy@hotmail.com](mailto:thicnspicy@hotmail.com) or [amishburrito@aol.com](mailto:amishburrito@aol.com). Choose a user name that would not be offensive or childish to a potential employer.

And finally, two very important items to remember:

### **34. Never send an email when you are angry.**

Don't send an angry or sarcastic message without first giving yourself a few hours or overnight to make sure you really want to send it. Remember that an email can be forwarded to your boss or others or used as evidence in court!

This is closely followed by:

### **35. Remember that email is a public document. (3)**

Stop right where you are and set aside a couple of brain cells for the following statement: there is no such thing as a private e-mail. The reason? Keep reading.

With some e-mail systems, the e-mail administrator has the ability to read any and all e-mail messages. If this is the case where you are located, you better hope that there is an honest and respectable person in that position.

Some companies monitor employee e-mail (as well as internet usage). The reasons for this obtrusive behavior range from company management wanting to make sure users are not wasting time on frivolous messages to making sure that company secrets are not being leaked to unauthorized sources.

E-mail software is like all software in that occasionally things go wrong. If this happens, you may end up receiving e-mail meant for another person or your e-mail may get sent to the wrong person. Either way, what you thought was private is not private anymore.

So where does this leave us. First: there is no such thing as a private e-mail. Got it? Second, don't send anything by e-mail that you would not want posted on the company bulletin board. If it's safe

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2 [http://owl.english.purdue.edu/handouts/pw/p\\_emaillett.html#flame](http://owl.english.purdue.edu/handouts/pw/p_emaillett.html#flame)

3 <http://www.iwillfollow.com/email.htm>

enough for the bulletin board, it's safe enough for e-mail. Finally, if you are debating whether or not to send something personal by e-mail, either deliver it by hand or send it by snail mail.

### **Voice Mail Etiquette (4)**

Voice mail is this decade's answering machine. It is an efficient way to communicate valuable information. Statistics show that only 70% of phone calls are ever completed on the first try, therefore voice mail is an important communication tool. Here are eight tips to ensure that your voice mail messages are effective and do not create professional problems for you.

- Yes, it's basic, but...don't forget to give your name and phone number.
- Keep messages short and to the point.
- Never leave a harsh or negative message on voice mail. This can lead to major problems. Unlike a conversation the receiver can redirect it to other people.
- Don't record anything that can be misinterpreted or is confidential.
- If you find yourself reading a prepared memo or announcement over the phone stop. It is better to just send the memo out.
- Always be prepared to leave a message. Statistics show that 70% of the time the individual you wish to speak with will not be available.
- Avoid flippant messages, even in jest.
- Remember to check your voice mail at least twice a day, especially if you receive time sensitive messages.
- Don't leave messages from noisy restaurants, parties or bars, background noise can be heard clearly.

## **American Institute of Chemical Engineers (AIChE) Code of Ethics**

Members of the American Institute of Chemical Engineers shall uphold and advance the integrity, honor, and dignity of the engineering profession by: being honest and impartial, and serving with fidelity their employers, their client, and the public; striving to increase the competence and prestige of the engineering profession; and using their knowledge and skill for the enhancement of human welfare.

To achieve these goals, members shall:

1. Hold paramount the safety, health and welfare of the public in performance of their professional duties.
2. Formally advise their employers or clients (and consider further disclosure, if warranted) if they perceive that a consequence of their duties will adversely affect the present or future health or safety of their colleagues or the public.
3. Accept responsibility for their actions and recognize the contributions of others; seek critical review of their work and offer objective criticism of the work of others.
4. Issue statements or present information only in an objective and truthful manner.
5. Act in professional matters for each employer or client as faithful agents or trustees, and avoid conflicts of interest.
6. Treat all colleagues and coworkers fairly, recognizing their unique contributions and capabilities.
7. Perform professional services only in areas of their services.
8. Build their professional reputations on the merits of their services.
9. Continue their professional development throughout their careers, and provide opportunities for the professional development of those under their supervision.

## **RESUMES AND COVER LETTERS**

### **Characteristics of a resume that gets results**

- Professional in appearance
- Clear, concise, and well-organized
- One page preferred, two pages only if extensive work experience
- White or off-white paper
- 10-12 pt. font size
- Tailored for the organization or position
- Career-related projects, skills, and interests
- Relevant paid and unpaid experiences
- Demonstrated accomplishments
- Involvement on campus or in the community

## Resume Tips (5)

- **CONTACT INFORMATION:** Don't forget to list a reliable email address and phone number, and include you're your school address and permanent home address. Some employers may need to contact you after you leave campus for a summer position. Note: if you don't use your unity email address, make sure that your personal email address sounds professional (see electronic etiquette article, above) and have a professional message on your voicemail.
- **What's the FASTEST way to improve a resume?** Remove everything that starts with "responsibilities included ..." and replace it with on-the-job ACCOMPLISHMENTS.
- **What the COMMONEST MISTAKE made by resume writers?** Leaving out their Job Objective! (Equivalent to: Somebody knocks on your door. You open it and say, "Hello, what do you want?" They say, "Duh ...")
- **What's the FIRST STEP in writing a resume?** Decide on a job target (or "job objective") that can be stated in about 5 or 6 words. Anything beyond that is "fluff" and indicates lack of clarity and direction.
- **HOW FAR BACK should you go in your Work History?** Far enough; and not TOO far. College students should list high school work experience, but the high school items will probably drop off after college graduation.
- **Don't include "Hobbies" on a resume...UNLESS** the activity is somehow relevant to your job objective. OR it clearly reveals a characteristic that supports your job objective. (A hobby of Sky Diving (adventure, courage) might seem relevant to some job objectives (Security Guard?) but not to others.)
- **Employers HATE parchment paper and pretentious brochure-folded resume "presentations."** They think they're phony, and toss them out.
- **Don't fold a laser-printed resume right along a line of text.** The "ink" could flake off along the fold.
- **Don't MYSTIFY the reader about your SEX; they'll go nuts til they know whether you're male or female.** And while they're worrying about that, they're NOT thinking about what you can do for them. So if your name is Lee or Robin or Pat or anything else not clearly male or female, use a Mr. or Ms. prefix.
- **What if you don't have any EXPERIENCE in the kind of work you want to do?** GET SOME! Find a place that will let you do some VOLUNTEER work right away. You only need a brief, concentrated period of volunteer training (for example, 1 day/week for a month) to have at least SOME experience to put on your resume. Also, look at some of the volunteer work you've done in the past and see if any of THAT helps document some skills you'll need for your new job.
- **What if you have GAPS in your work experience?** You could start by LOOKING at it differently. If you were doing ANYTHING valuable (though unpaid) during those so-called "gaps," you could just insert THAT into the work-history section of your resume to fill the hole--for example: "1993-95 Full-time parent" or "1992-94 Maternity leave and family management" or "Travel and study," or "Full-time student," or "Parenting plus community service."
- **What if you have a fragmented, scrambled-up work history, with lots of short-term jobs?** To minimize the job-hopper image, combine several similar jobs into one "chunk," for example:

- 1993-1995 Secretary/receptionist - Jones Bakery; Micro Corp.; Carter Jewelers.  
OR  
1993-95 Waiter/Busboy - McDougal's Restaurant; Burger-King; Traders Coffee Shop.

ALSO you can just DROP some of the less-important or briefest jobs. But DON'T drop a job, even when it lasted a short time, if that was where you acquired important skills or experience.

- **Students can make their resume look neater by listing seasonal jobs very simply.** Use something such as "Spring 2006" or "Summer 2006" rather than 6/06 to 9/06. (The word "Spring" can be in very tiny letters, say 8-point in size.)
- **What if your job title doesn't reflect your actual level of responsibility?** When you list it on the resume, either REPLACE it with a more appropriate job title (say "Office Manager" instead of "Administrative Assistant" if that's more realistic) OR use "their" job title AND your fairer one together "Administrative Assistant (Office Manager)".
- **Got your degree from a different country?** You can say: "Degree equivalent to U.S. Bachelor's Degree in Economics; Tehran, Iran."
- **What if you don't have your degree yet?** You can say "BS Degree in Chemical Engineering, expected date May, 2009."
- **What if you have several different job objectives you're working on at the same time?** Or you haven't narrowed it down yet to just one job target? Write a different resume for EACH different job target. A targeted resume is much, much stronger than a generic resume.
- **Want to impress an employer?** Fill your resume with "PAR" statements. PAR stands for Problem-Action-Results, in other words, first you state the problem that existed in your workplace, then you describe what YOU did about it, and finally you point out the beneficial results.
  - Here's an example:
    - "Transformed a disorganized, inefficient warehouse into a smooth-running operation by totally redesigning the layout; this saved the company \$250,000 in recovered stock."
  - Another Example:
    - "Improved an engineering company's obsolete filing system by developing a simple but sophisticated functional-coding system. This saved time and money by recovering valuable, previously lost, project records."
- **What if you never had any "real" paid mainstream jobs - just self-employment or odd jobs?** Give yourself credit, and create an accurate, fair job-title for yourself. For example, "A&S Hauling & Cleaning (self-employed)" or "Household Repairman--Self-employed," or "Child-Care--Self-employed." Be sure to add "Customer references available on request" and then be prepared to provide some very good references of people you worked for.

## Tips on Cover Letters (6)

### Who Needs a Cover Letter?

Everyone who sends out a resume does! Even if the cover letter never "came up" in conversation or wasn't mentioned in an advertisement, it's expected that you will write one. It is regarded as a sign of laziness (sorry about that) to send out a cover letter that is not tailored to the *specific* company. In the days before word processors, you could *maybe* get away with it. Not anymore.

Yes, it adds to the wear and tear of looking for a job! But the good news is: the cover letter gives you **another** chance to emphasize what you have to contribute to the company or organization. Don't give the person screening the resumes a second to entertain the thought: "**But how can this person help US?**" Your cover letter will answer that question in your own words. Your resume will also answer that question but in a somewhat more rigid format.

### What makes a *Good* Cover Letter?

1. **No spelling or typing errors.** Not even one.
2. **Address it to the person who can hire you.** Resumes sent to the personnel department have a tougher time of it. If you can find out (through networking and researching) exactly who is making the hiring decision, address the letter to that person. Be sure the name is spelled correctly and the title is correct. A touch of formality is good too: address the person as "Mr.," "Ms.," "Mrs.," "Miss," "Dr.," or "Professor." (Yes, life is complicated.)
3. **Write it in your own words** so that it sounds like you--not like something out of a book. Employers are looking for knowledge, enthusiasm, focus.
4. **Being "natural" makes many people nervous.** And then even **more** nervous because they are trying to avoid spelling errors and grammatical mistakes. If you need a little help with grammar (do they still teach grammar?)--check out the classic work on simple writing, Strunk & White's [Elements of Style](#), published in 1918 and now online. A good place to begin is "[Chapter 5: Words and Expressions Commonly Misused.](#)"
5. **Show that you know something about the company and the industry.** This is where your research comes in. Don't go overboard--just make it clear that you didn't pick this company out of the phone book. You know who they are, what they do and *you* have chosen them!
6. **Use terms and phrases that are meaningful to the employer.** (This is where your industry research and networking come in.) If you are applying for an advertised position, use the requirements in the ad and put them in **BOLD** type. For example: the ad says--  
*"2 years' experience processing magnetic media (cartridge, tape, disc); interface with benefit plan design, contracts and claims; and business background with strong analytical & technical skills--dBase, Excel, R&R, SQL."*

Make sure your cover letter contains each of these requirements and shows how you measure up.

## INTERVIEW TIPS FOR STUDENTS (7)

### *What to Expect in a Typical On-Campus Interview*

- Interviews are usually 30 minutes in length – arrive 10 minutes early so the interview can begin promptly.
- The interviewer will usually spend a few minutes at the beginning introducing himself/herself and giving some information about the company and job openings – it is fine for you to take notes.
- The interviewer will ask questions based on the student's resume – he/she will want to hear specific examples of behaviors from past experiences, not hypothetical or vague answers.
- Time will be left at the end for your questions – be sure to have specific questions about the job openings or location, etc.
- If you want to highlight or point out something you've accomplished that didn't come out in the interview, mention it to the interviewer at the end if there is time.
- Ask for the interviewer's business card if he/she hasn't already given you one.

### *Do's and Don'ts*

- Answer questions honestly, thoroughly, and sincerely – if you don't know the answer, indicate that.
- Do not try to tell the interviewer what you think he/she wants to hear.
- Don't be afraid to discuss your successes and most positive traits.
- Be careful about saying negative things about past experiences (e.g. insult a company that you interned with).
- Don't display a negative or arrogant attitude.
- Be polite, tactful, and sincere – eye contact is also important.
- Be neatly and appropriately dressed in professional business attire (conservative, not trendy).
- Do not be late unless there is an emergency!

### *How to Prepare Ahead of Time*

- Confirm the date, time, and location for your interview with Career Services or via their online information.
- Review the company's website and any literature you've obtained – know the latest "news" about the company.
- Talk to any students on campus that has interned/co-oped with the company (Career Services or the co-op office can tell you).
- Generate quality questions to ask about the company based on what you've read and heard – don't just ask questions for the sake of asking them – make them count.
- Review your resume again to make sure everything is accurate and that you're prepared to answer any questions pertaining to it.
- If for any reason you must cancel or withdraw from an interview, contact the company and/or Career Services promptly – don't be a "no-show".
- If the company needs an employment application or other forms filled out before the interview, do this as soon as you receive them and submit them by the deadline.
- Find out whether you need to bring your transcripts to the interview (Career Services should be able to tell you).

- Even though the interviewer already has your resume, bring an extra copy to the interview just in case he/she needs another one.

### *Follow-up*

- Email or write a "thank-you" note to the interviewer – email is perfectly acceptable.
- Provide the interviewer with updated contact information if it's changed since you last communicated with him/her.
- If you are receiving other offers/have deadlines and need to hear back from the company, contact the interviewer to get an updated status and explain your timeframe.
- If you think of any questions that you forgot to ask during the interview, don't hesitate to email them to the interviewer!

### *Final Notes*

Many companies have a team that will be responsible for 'researching' information on candidates via phone screens, Facebook, MySpace, etc. Depending on the subject matter, it is safe to say that the impact could play a role in whether or not someone is viewed as being the type of employee we would want on our team. Pictures of groups, outings, friends, etc. - all well and good. Those that would probably not be so helpful - well, we know what those look like.

Last Spring we had a group of candidates that were on a plant tour, and a couple of the candidates let their guard down and were trying to be either funny or the center of attention, not realizing that the tour guide provided input to the interview team. This behavior was viewed as immature and not someone that we would want to hire. Students should realize that their interactions with Company employees, be it the assistant that makes and confirms their travel plans, to the Staffing Reps, to the dinner hosts, all the way up to the Hiring Manager, are constantly trying to make a hiring decision given a short amount of time with the candidate. Their interactions with all of these people add up to an impression. Even the company's drivers who take you to and from the airport provide feedback.

## Interview Cheat Sheet (8)

This is a document you prepare before important meetings. It is a personal briefing to you, from you. It helps you remember key facts, such as your major accomplishments, and serious questions or concerns. You don't read from the sheet, but you do keep it handy, and if convenient, you may want to review it as your meeting is ending to be certain you didn't forget anything critical.

Day and Date:

Meeting With:

Name  
Title  
Company  
City, State Zip  
Telephone  
FAX  
Mobile/Pager  
E-mail

Major Accomplishments:

- 1.
- 2.
- 3.
- 4.
- 5.
- 6.

My Work Style:

- 1.
- 2.
- 3.
- 4.
- 5.
- 6.

Things You Need to Know About Me:

- 1.
- 2.
- 3.
- 4.

Answers to Difficult Questions:

- 1.
- 2.
- 3.
- 4.

My Strengths/Weaknesses:

- 1.
- 2.
- 3.

Questions to Ask Interviewer:

- 1.
- 2.
- 3.
- 4.
- 5.
- 6.

Things I Can Do For You:

- 1.
- 2.
- 3.
- 4.
- 5.
- 6.

## **INTERVIEW CHECKLIST (9)**

### **Preparation - Two to three days before the interview**

- I have collected information about the business.
- I know the first and last name of the person(s) who will be interviewing me.
- I know why I want to work for this company.
- I have prepared some answers to common interview questions. I know how I am going to answer these questions and/or I have created a cheat sheet.
- I have prepared a list of questions that I would like to ask the interviewer.
- I have an up-to-date resume with complete references ready to take to the interview.
- I know exactly where the interview will take place and how long it will take me to get there.
- I have decided what to wear to the interview.
- I have scheduled a full night's sleep before the interview.

### **The Day of the Interview**

- I have a copy of my resume and names of my references.
- I have paper and pen for notes.
- I have my cheat sheet and/or my list of questions.
- I have paid special attention to personal hygiene and my choice of clothing.

### **The Interview - Travel time and Arrival**

- I am leaving early in case of traffic jams or unforeseen problems. I do not arrive more than 10 minutes early.
- I am relaxed, friendly and business-like with everyone I meet.
- I introduce myself to the receptionist, and confirm my appointment.

### **The Interview - Setting the scene**

- I greet the interviewer by name and shake their hand.
- I maintain positive body language. e.g. I don't cross my arms and I maintain eye

contact

### **The Interview - Exchanging Information**

- I stay on topic and ask for clarification where necessary and when appropriate.
- I use specific examples rather than general statements when giving information about my education, training, transferable skills, and work experience.

### **The Interview - Conclusion**

- I ask any suitable questions that have not already been answered.
- I summarize, with enthusiasm, my interest in the position and the business.
- I state my appreciation for the interview.
- I confirm, if already noted, their response date. If this date is not definite, I make arrangements to contact them.
- I shake hands if appropriate and say goodbye.

### **Interview - Follow-up**

- I keep my cell phone with me the day they said they would call.
- If I have arranged to call them back on a certain date, I make sure that I have reviewed my telephone protocol.
- I write and send the interviewer(s) a thank-you letter.
- If offered a position I give them a written answer (whether it be to accept or to decline) within the week, or by their stated deadline.

## EXAMPLES OF INTERVIEW QUESTIONS (10)

### Samples of Traditional Interview Questions

- Tell me about yourself.
- What are your strengths and weaknesses?
- What kind of work environment do you like best?
- Why did you apply for this job?
- What jobs have you enjoyed the most? The least? Why?
- What have you done that shows initiative and willingness to work?
- What are your short-range and long-range goals?
- Why did you choose your area of study?
- Do you prefer working with others or by yourself?
- What do you know about our company?
- What qualifications do you have that make you think that you will be successful?
- What have you learned from participation in extracurricular activities?
- What academic subjects do you like the best? Least?

### Samples of Behavior Description Interview Questions

- Give me an example of a time when you did more than was required in your job. What was the result?
- Describe the most stressful situation you have encountered. How did you handle it? What was the outcome?
- How do you set priorities?
- Describe a situation where you wished that you had behaved differently. What was the outcome?
- We've all had to work with someone who was difficult. Tell me about the most difficult situation that you have experienced and how you handled it. What was the result?
- How do you define doing a good job?
- Tell me about a time when you did not meet your own standards of performance. What did you do to change that?
- Tell me about the most enjoyable job you've had. What was there about it that made you feel this way?
- Describe a position where you felt that you learned a lot. What advantage was that to you? How have you used those skills?
- Describe the ideal job for you. What tasks would be required?
- Tell me about a situation that occurred as a result of a lack of communication.
- Have you ever had to rely on information given verbally in order to carry out your task? Give some examples. Did this ever cause a problem?
- Describe a situation where you had to change your work plan very quickly in order to accommodate a more urgent situation. How did you feel about that?
- Do you find yourself taking charge of situations? How?

# Tips for Students on Attending Career Fairs

## *Why You Should Attend*

- Provides an opportunity to meet and interact with a large number of companies at one time
- Provides an opportunity to market your knowledge, skills, and abilities to a targeted group of employers
- You will be able to meet and talk to people who already work for the companies you are interested in
- Contacts as career fairs can serve as a starting point for you to develop relationships with companies

## *What Companies are Looking For*

- Solid GPA
- Relevant work experience (co-op/internship)
- Strong communication skills
- Demonstrated leadership abilities
- Involvement in extra-curricular activities
- Track record of achievement

## *What to Expect*

- Spend significant time at the event
- Pace yourself
- Distribute a large number of résumés
- Manage what you carry

## *Preparation Checklist*

- Visit Career Services website & office
- Know your target companies
- Buy the proper attire
- Rehearse your introduction
- Create a polished résumé(s)
- Develop a plan for follow-up

## *Do Your Homework*

- Know which companies are attending
- Know which companies are hiring your major
- Know which companies are not hiring your major
- Prepare for a career fair as if you were going to an interview

## *What to Wear*

- Two-piece matched business suit
- Navy, black, or dark gray
- Pants or skirt acceptable for females
- Conservative blouse for females/conservative tie for males
- Comfortable shoes

## *Introduction*

- Be proactive if the recruiter doesn't start the conversation
- Tell the recruiter your name, class, major, and type of position you're seeking
- Practice – but don't sound like you're reading a script

## *Follow-up*

- Follow-up within 48 hours with recruiters from companies you are interested in
- Email or handwrite a thank-you note
- Customize your note to each recruiter, drawing on some memorable aspect of your conversation
- Ask a follow-up question

## USEFUL WEB SITES

<a href="http://www.che.ncsu.edu/">http://www.che.ncsu.edu/</a>	NCSU CHE Department
<a href="http://www2.ncsu.edu:8010/ncsu/reg_records/">http://www2.ncsu.edu:8010/ncsu/reg_records/</a>	Records and Registration
<a href="http://www.fis.ncsu.edu/UGA/course.htm">http://www.fis.ncsu.edu/UGA/course.htm</a>	Course Equivalency Database (transfer credits)
<a href="http://www.engr.ncsu.edu/students/">http://www.engr.ncsu.edu/students/</a>	COE Degree Info
<a href="http://www2.ncsu.edu:8010/ncsu/co-op_ed/">http://www2.ncsu.edu:8010/ncsu/co-op_ed/</a>	Co-op Program
<a href="http://www.fis.ncsu.edu/career/">http://www.fis.ncsu.edu/career/</a>	Career Center
<a href="http://www2.ncsu.edu/ncsu/stud_affairs/study_abroad/">http://www2.ncsu.edu/ncsu/stud_affairs/study_abroad/</a>	Study Abroad Program
<a href="http://www.ncsu.edu/undergrad_affairs/AECsubj.html">http://www.ncsu.edu/undergrad_affairs/AECsubj.html</a>	On-Campus Tutoring
<a href="http://sasw.chass.ncsu.edu/fl/place.htm">http://sasw.chass.ncsu.edu/fl/place.htm</a>	Foreign Language Requirement
<a href="http://www.fis.ncsu.edu/nse/">http://www.fis.ncsu.edu/nse/</a>	National Student Exchange
<a href="http://www2.ncsu.edu/ncsu/reg_records/grad_inf.htm">http://www2.ncsu.edu/ncsu/reg_records/grad_inf.htm</a>	NCSU Graduation Information
<a href="http://www.gre.org/">http://www.gre.org/</a>	GRE Information
<a href="http://members.theglobe.com/rockmba/mba.htm">http://members.theglobe.com/rockmba/mba.htm</a>	GMAT Information
<a href="http://www.cals.ncsu.edu/booklet/">http://www.cals.ncsu.edu/booklet/</a>	Pre-med Information
<a href="http://members.theglobe.com/rockmba/mba.htm">http://members.theglobe.com/rockmba/mba.htm</a>	MBA Application Information
<a href="http://www2.ncsu.edu:8010/student_affairs/osc/">http://www2.ncsu.edu:8010/student_affairs/osc/</a>	Office of Student Conduct
<a href="http://www2.ncsu.edu:8010/ncsu/reg_records/trans.html">http://www2.ncsu.edu:8010/ncsu/reg_records/trans.html</a>	Transcript Request Form
<a href="http://www.ncsu.edu/provost/ugcat/front/index.htm">http://www.ncsu.edu/provost/ugcat/front/index.htm</a>	Undergraduate Catalog
<a href="http://www2.acs.ncsu.edu/reg_records/crs_cat/directory.html">http://www2.acs.ncsu.edu/reg_records/crs_cat/directory.html</a>	Course Catalog
<a href="http://www.nsf.gov/home/crssprgm/reu/reu98eng.htm">http://www.nsf.gov/home/crssprgm/reu/reu98eng.htm</a>	NSF Research Experience for Undergrads
<a href="http://www.aiche.org/careers/">http://www.aiche.org/careers/</a>	Careers in CHE
<a href="http://www.ncbels.org/">http://www.ncbels.org/</a>	NC Engineering Board (FE Exam)
<a href="http://www.fis.ncsu.edu/slc/">http://www.fis.ncsu.edu/slc/</a>	Student Leadership, Ethics, & Public Service
<a href="http://www.graduatingengineer.com/">http://www.graduatingengineer.com/</a>	Graduating Engineer magazine
<a href="http://www.cgibin.ncsu.edu/cep-bin/ckbin/ck.pl">http://www.cgibin.ncsu.edu/cep-bin/ckbin/ck.pl</a>	Career Key
<a href="http://www2.ncsu.edu/campus_map/index.htm">http://www2.ncsu.edu/campus_map/index.htm</a>	NCSU Campus Map
<a href="http://www.aiche.org/">http://www.aiche.org/</a>	AICHe (National)
<a href="http://www2.ncsu.edu/eos/info/aiche_info/mosaics/web/">http://www2.ncsu.edu/eos/info/aiche_info/mosaics/web/</a>	AICHe (NCSU Student Chapter)

## **LAST BUT NOT LEAST...**

### **MY PROFESSIONAL AND PERSONAL GOALS WHILE AT NC STATE**

In order to be successful, it's important to set goals early in your academic career and then developing a plan to achieve them. List some of your goals below and talk with your advisor about how to prepare yourself for the career you envision.

- I would like to have a GPA at graduation of \_\_\_\_\_
- I would like to get work experience via summer internships or co-ops at companies like:
  
- I would like to get involved in campus activities such as:
  
- I would like to get involved in community activities like:
  
- I would like to develop my leadership skills by:
  
- After graduation, I can see myself....
  
- Besides my schoolwork, personal goals include:
  
- 3 things I want to accomplish at NC State: