CHEMICAL ENGINEERING
UNDERGRADUATE STUDENT HANDBOOK

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NORTH CAROLINA AGRICULTURAL AND TECHNICAL STATE UNIVERSITY

DEPARTMENT OF CHEMICAL, BIOLOGICAL AND BIOENGINEERING

COLLEGE OF ENGINEERING

GREENSBORO, NORTH CAROLINA 27411

Phone (336) 285-2639

http://www.ncat.edu/coe/departments/cbbe/index.php

Administration and Staff

Department Chairperson:	**Dr. Jianzhong Lou** 336-285-3223 lou@ncat.edu
Chemical Engineering Program Coordinator	**Dr. Mohammad Azad** 336-285-3710 maazad@ncat.edu
Student Services Specialist:	**Ms. Portia Cohen** 336-285-3661 pcohen@ncat.edu
Business Services Coordinator:	**Ms. Lynda McGee** (336) 285-2596 lmmcgee@ncat.edu
Administrative Support Specialist:	**Ms. Courtney Chavis** 336-285-2639 cychavis@ncat.edu
Lab Manager:	**Mr. Fazazi Atchabao** 336-285-3654 fatchaba@ncat.edu

Notice

This handbook was prepared for use by undergraduate students in Chemical Engineering Program at North Carolina A&T State University. It is designed to supplement existing policy and is intended as a guide. However, students are asked to consult with academic advisors and with the appropriate University office for current information and policy. Important changes may occur without notice. The Department attempts to maintain an accurate Undergraduate Student Handbook at all times; however, errors may inadvertently occur. The Department reserves the right to correct such errors when they are found, without further notice. The presence of errors will not affect the application of rules and requirements to students.

ACCREDITATION

The program of study leading to the B.S. in Chemical Engineering (BSChE) is accredited by the Engineering Accreditation Commission of ABET, https://www.abet.org, under the commission's General Criteria and Program Criteria for Chemical Engineering.

Mission Statement

The mission of the Department of Chemical, Biological, and Bioengineering at North Carolina A&T State University is to empower students with innovative problem-solving skills, a strong ethical foundation, and a commitment to sustainability, preparing them to lead advancements in industry and academia while addressing global challenges and contributing positively to society and the environment through collaboration and interdisciplinary approaches.

Program Educational Objectives

The educational objectives of the BSChE program are that, within a few years of program completion, graduates will have utilized the knowledge and skills gained through their academic preparation to:

1. Successfully engage in a chemical engineering role within industry or graduate/professional schools (PEO1).

2. Demonstrate problem-solving skills through leadership, collaboration, and multidisciplinary teamwork (PEO2).

3. Actively participate in community service and professional organizations (PEO3).

4. Pursue continuous professional development through lifelong learning opportunities (PEO4).

Student Outcomes

The Department is guided by a set of student outcomes that must be demonstrated by BSChE program graduates. The student outcomes include general outcomes and chemical engineering outcomes that have been put in place to ensure the continuing improvement of the program and our graduates. The BSChE program student outcomes list the knowledge and skills that graduates are expected to possess at graduation. The chemical engineering graduates will possess

1. An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics

2. An ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors

3. An ability to communicate effectively with a range of audiences

4. An ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic,

environmental, and societal contexts

5. An ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives

6. An ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions

7. An ability to acquire and apply new knowledge as needed, using appropriate learning strategies.

ChE1) A working knowledge of safety and environmental aspects of the chemical engineering profession;

ChE2) A working knowledge of topics and subjects in Chemical Engineering applied to chemical systems and, as appropriate, to biological systems.

PROGRAM OVERVIEW

The chemical engineering curriculum is designed to provide students with a strong foundation in natural sciences attained through courses in chemistry, physics, and mathematics in the early semesters of study, followed by strong disciplinary skills attained through courses in chemical engineering during the later semesters. The program provides you with the knowledge to apply basic skills and sound judgments to develop designs for economically converting materials and energy into useful products for the benefit of our society and culture. The senior design sequence acts as a "capping stone" that coordinates all aspects of the chemical engineering curriculum. A strong component in English, social sciences, and humanities background is included so that you will obtain a broad-based education. The chemical engineering curriculum will prepare you for a career in industry or to go on to graduate school. It is also intended to be flexible enough to accommodate a broad range of educational interests. Sufficient electives have been provided so that you can select additional areas of study based on your interests.

The following discussion provides an overview of what you can expect as you proceed through the program.

A. GENERAL EDUCATION

The general education requirements are as follows:

Written Communications (ENG 100 and ENG 101) required - 6 credit hours
Social/Behavioral Sciences (SBS) electives required - 6 credit hours
Humanities/Fine Arts (HFA) electives required - 6 credit hours

Students are required to take a separate three-credit course for each of the following: Social/Behavioral Sciences (SBS), Humanities/Fine Arts (HFA), Global Awareness (GA), and Knowledge of African-American Culture and History (AA). Courses must be selected from the approved list of general education courses.

B. ORAL AND WRITTEN COMMUNICATION EXPERIENCE

All freshmen must pass ENGL 100 and ENGL 101. These courses provide education in English writing skills beyond the High School level. In addition, the Department provides instruction and practice in report writing and oral communication in two chemical engineering laboratory courses. The students are required to make oral presentations and write reports in the laboratory courses and several of the lecture courses that have projects.

Communication skills will have an important effect on your career performance and advancement. The Department seeks to cultivate good communication skills in its students.

C. MATHEMATICS AND SCIENCE EXPERIENCE

Engineering is founded on the principles of mathematics and science. Studies in mathematics begin with calculus and emphasize mathematical concepts and principles. Your mathematics experience includes a 4-semester sequence, MATH 131 (Calculus I), 132 (Calculus II), 231 (Calculus III), and 341 (Differential Equations), which covers differential calculus and integral calculus along with methods for solving differential equations that are needed to solve many advanced engineering applications. You will also learn about computational and numerical analysis in CHEN 226.

You will complete a two-semester sequence in physics. You will study mechanics, heat, and light in PHYS 241 (General Physics I) and electricity, magnetism, wave motion, and modern physics in PHYS 242 (General Physics II). Since most of your math and physics courses must be completed before you begin your junior year, it is critical to attend summer school if you are behind in mathematics or physics. Sophomores also take a course in materials science (MEEN 260).

Chemical engineering has its roots in chemistry. As such, your experiences in chemistry distinguish you from other engineers and will continue to be important throughout your program. The chemistry courses you take are the same courses taken by chemistry majors in their degree program. Your experience begins with a year of general chemistry (CHEM 106: General Chemistry VI, CHEM 116: General Chemistry VI Lab, CHEM 107: General Chemistry VII, CHEM 117: General Chemistry VII Lab). Your experience in chemistry continues with courses in organic chemistry (CHEM 221) and organic chemistry laboratory (CHEM 223). In addition, you must take a course in physical chemistry (CHEM 441) and an additional three credits of advanced chemistry electives.

D. COMPUTER EXPERIENCE

The use of computers is emphasized throughout the chemical engineering program. You will be introduced to programming and computer-aided numerical methods in CHEN 121 (Intro Comp Dsgn Tools Chem Eng) and CHEN 226 (Computer Design Methods in Chem. Engineering). In your freshman year, you will learn about chemical engineering problem-solving and design using a computational tool such as MATLAB. In the sophomore year, you will be introduced to the ASPEN PLUS flow sheet simulator, which is a design tool used in unit operations and design courses to develop your design skills.

The use of a PC is emphasized in the chemical engineering laboratory sequence. All lab reports are required to be word-processed, and graphs are expected to be computer-generated.

You will use simulators and computer-aided design packages in upper-level courses, including CHEN 340.

E. LABORATORY EXPERIENCE

Laboratory experience is integrated throughout the program. The experience includes two semesters of general chemistry laboratories, which are two 1-credit courses (CHEM 116 and CHEM 117). The curriculum also has an organic chemistry lab (CHEM 223). A two-semester sequence of physics laboratory courses (PHYS 251 and PHYS 252) is also included.

The curriculum contains two courses that have chemical engineering laboratory experiences, CHEN 330 and CHEN 410. They are 2-credit courses that meet twice a week for 2 hour sessions. Part of the chemical engineering laboratory experience is devoted to technical writing, report preparation, oral communication, and laboratory safety. As part of your preparation for these two laboratory courses, you will learn statistical methods to analyze chemical process data in the sophomore course, CHEN 218.

Your safety is of paramount importance. All undergraduate experiments are designed to minimize safety hazards and minimize the use and disposal of chemicals to the environment. The development of laboratory safety awareness and skills is an important part of the chemical engineering laboratory experience. Safety instruction in the laboratory courses includes several lectures by the instructor and the viewing of several videos obtained from industry or from the Center for Chemical Process Safety (a not-for-profit corporate membership organization within the American Institute of Chemical Engineers (AIChE)). Students are also asked to perform a safety audit. Safety sections are included in your pre-lab notebook and lab reports. Laboratory safety is monitored by the laboratory instructor, who includes questions on lab safety as part of the pre-lab oral exam and observes safety practices during experimentation.

Each student has the opportunity to study a wide variety of equipment and instrumentation in the chemical engineering laboratory while working in groups of 3 or 4 students. Each of the experiments is open-ended. Students develop an experimental procedure and plan for their study. Students also complete a laboratory project that can be a scale-up application of the data measured in the lab or a development project on one of the newer experiments.

F. ENGINEERING SCIENCE EXPERIENCE

Your chemical engineering science experience is aimed at using your knowledge of mathematics and science to bridge the gap to engineering practice. The goal of engineering science is creative application. The chemical engineering curriculum is a coherent plan to provide you with instruction and knowledge in chemical engineering science.

Instruction in engineering science begins in GEEN 100 (Engineering Design and Ethics), where you will be given an overview of engineering professions. In CHEN 200 (Chemical Process Principles), you will develop basic skills in material and energy balancing of chemical processes. You will also complete a flowsheet development project in this course. In CHEN 226 (Comp Dsgn Methods in Chem Eng), you will learn to apply numerical methods to the solution of engineering problems. In CHEN 312 (Chemical Engineering Thermodynamics), you will learn the fundamentals of thermodynamics, including the first and second laws of thermodynamics, and apply them to study the thermodynamics of phase and chemical reaction equilibria. You will learn about unit operations and transport processes in CHEN 300 (Fluid Mechanics), CHEN 320 (Heat Transfer), and CHEN 400 (Mass Transfer Operations). In the mass transfer sequence, you will study both stage-wise separation operations and diffusional operations. The concepts of process dynamics and how to control a chemical process will be covered in CHEN 340 (Process Dynamics and Control). In CHEN 422 (Chemical Reaction Engineering), you will study chemical reaction engineering, which is unique to chemical engineers. Finally, you will have one advanced chemical engineering elective course in your senior year.

G. ENGINEERING DESIGN EXPERIENCE

The Chemical Engineering curriculum features a rigorous engineering design experience that builds on foundational knowledge and skills from earlier coursework. The capstone design experience requires students to apply engineering standards while addressing multiple real-world constraints. Emphasizing design as a creative, iterative, and decision-making process, students are challenged to develop systems, components, or processes that meet specific needs within practical limitations. They are trained to identify design opportunities, define requirements, analyze and synthesize information, evaluate multiple solutions, and make informed trade-offs to deliver high-quality outcomes. In doing so, students must consider a range of critical constraints, particularly those related to regulatory compliance, safety, environmental impact, and cost-effectiveness. The Senior Design I & II sequence (CHEN 430 & CHEN 440) ensures that students follow a structured design methodology that integrates mathematics, basic sciences, and engineering principles to produce practical and responsible engineering solutions.

Engineering design is viewed as the process of devising a system, component, procedure, or process to meet desired needs. It is a decision-making process (often iterative), in which the basic sciences, mathematics, and engineering sciences are applied to convert resources optimally to meet a stated objective. Among the fundamental elements of the design process are the establishment of objectives and criteria of the process, synthesis, analysis, construction, testing, and evaluation. The engineering design component of the curriculum includes the following features: development of student creativity, use of open-ended problems, development and use of design methodology, formulation of design problem statements and specifications, consideration of alternatives, feasibility considerations, and detailed system descriptions. In addition, a variety of realistic constraints such as economic factors, safety, ethical, and reliability limitations are included in design projects. An engineering design component is incorporated into many of the undergraduate courses.

Design instruction begins in the freshman year in GEEN 100 (Engineering Design and Ethics), where we introduce you to the design process. In CHEN 121 (Intro Comp Dsgn Tools Chem Eng), computational design tools will be introduced. In CHEN 200 (Chemical Process Principles), you will work individually or in groups to solve an open-ended problem. Your group will develop a flow sheet and complete mass and energy balance calculations. In the transport processes, mass transfer, and reactor design courses, you will complete one or more design projects based on the equipment or procedures studied in the engineering science part of the course.

You will conduct open-ended experimental studies in each of the chemical engineering laboratory courses, CHEN 330 and 410. In each lab experiment, you will be given general statements about the capability of the equipment and you will develop a detailed experimental procedure and list the safety considerations. Finally, you will have an opportunity to complete a semester-long project to design, build, operate or improve a laboratory scale experiment.

In the process control course, an extensive amount of problem solving is done in the selection and design of controllers and control systems. You may also complete a control system design project and extensive control system designs.
A major part of the design component in your program is in the capstone experience, which occurs in a two-course senior sequence and consists of Process Design I (CHEN 430) and Process Design II (CHEN 440). The primary objective of the Process Design I and II course sequence is the development of students' engineering and conceptual abilities to design a process sequence and to evaluate its economic feasibility. One of the most difficult tasks involves the effective use of the library and vendors to research the necessary information. The major process design effort effectively incorporates economic factors, safety, toxicity and environmental hazards, equipment reliability factors, ethics, and social impact during class discussions and group conferences. At least one of the projects in Process Design II will contain an extensive economics and profitability analysis. National Society of Professional Engineers (NSPE) ethics will be reviewed. You will complete your design experience as a senior by selecting a chemical engineering technical elective course that contains engineering design.

H. RESEARCH AND INDUSTRIAL EXPERIENCES

These experiences are optional, but they might be the most important part of your development. Each of the chemical engineering faculty members encourages your involvement in research. Faculty research areas are detailed in the Faculty Profiles later in this handbook. Some of the faculty have financial resources, and all will accept volunteers. Getting involved in a research project will give you insight as to how research is conducted and whether you should pursue an advanced degree. You should also pursue getting industrial experience through one or more summer internships or co-op assignments. Companies are often interested in students with high academic qualifications for these activities. A summer internship does not extend the time to completion of an academic program, but it enhances a student’s competitiveness for future

opportunities. Co-op involves alternating terms in industry and college and is normally completed in five years, but you graduate with about 1½ years of industrial experience that is very attractive to employers. If a student has had at least 3 co-op sessions, the student may receive credit for their chemical engineering elective by completing the requirements for CHEN 498 (Co-operative Industrial Experience in Engineering).

Companies increasingly emphasize industrial experience in selecting graduates for permanent assignments. They cite that students with experience have better insight as to what the student wants and what the industry needs. Employers also feel that students have already learned the industrial culture and have been screened by the industry. Students interested in an industrial assignment should register with career services as soon as their registration is complete.

I. COLLOQUIUM

The purpose of the colloquium is to facilitate good communication between students and faculty and to provide students with career development opportunities. Topics may include advising, scholarships, curriculum, AIChE (American Institute of Chemical Engineers), ISPE (International Society for Pharmaceutical Engineering), SPE (Society of Plastics Engineers), co-op and internship opportunities, career planning, contemporary issues in engineering, and gaining stakeholder input from students. Students complete a 1 credit hour colloquium (GEEN 111) during their freshman year.

ACADEMIC REQUIREMENTS

Chemical Engineering majors must maintain a 2.0 grade point average overall and a 2.0 major grade point average to graduate. A minimum grade of "C-" must be achieved in the following courses before the student can graduate:

MATH 131, MATH 132, MATH 231
PHYS 241
CHEN 200

To graduate with B.S. degree in Chemical Engineering Program, a student needs 120 credit hours, as outlined below:

1. General Education Requirements .....18 credits:
   African American Studies (3 credits)
   Global Awareness (3 credits)
   Social/Behavioral Sciences (3 credits)
   Humanities/Fine Arts (3 credits)
   English 100, 101 (6 credits)

2. Mathematics and Basic Science .....47 credits:
   Math 131, 132, 231, 341 (15 credits)
   Chemistry 106, 116, 107, 117, 221, 223, 441, Advanced Chemistry Elective (18 credits)
   Physics 241, 242, 251, 252 (8 credits)
   BIOL 101 (4 credits)
   MEEN 260 (2 credits)

3. Engineering Support Courses .....9 credits:
   GEEN 100, 111 (3 credits)

MEEN 230 (3 credits)
ECEN 340 (3 credits)

4. Chemical Engineering Courses .....46 credits
CHEN 121, 200, 218, 226, 300, 312, 320, 330, 340, 400, 410, 422, 430, 440, 448, CHEN Senior Elective

PREREQUISITE AND COREQUISITE COURSES

The catalog description of a course indicates any prerequisites or corequisites for that course.
Prerequisites are courses that a student must have completed successfully prior to enrolling in a course. Some courses require a minimum grade of C- for successful completion.
Corequisites are courses that the student must be taking concurrently or have successfully completed prior to taking the course. Corequisite courses become prerequisite courses for course sequels. These prerequisites might not be listed in the catalog. If you drop a course that is a corequisite for a course you are taking, you cannot take the next course until the dropped corequisite course has been completed. For example, MATH 132 is a corequisite for PHYS 241. If a student drops MATH 132, he/she can complete PHYS 241, but PHYS 242 cannot be taken until MATH 132 is passed.

A student who is taking a CHEN course as an elective, and is not a chemical engineering major, may not be held to the CHEN prerequisite provisions. However, permission of the instructor of the course and the department chairperson are required. Students considering changing their major to chemical engineering are advised to follow all CHEN prerequisites.

MINIMUM 'C-' GRADE POLICY

The following courses in the chemical engineering curriculum must be passed with a grade of 'C-' or higher as listed above:
MATH 131, MATH 132, MATH 231
PHYS 241
CHEN 200

CHEMICAL ENGINEERING CLASS ATTENDANCE POLICY

The chemical engineering faculty members feel that class attendance is a critical factor in the learning process. The faculty assumes that students selecting chemical engineering as a major are motivated to master the skills required to practice the profession. In view of these principles, the Department has a compulsory class attendance policy. **All students in chemical engineering courses are required to attend every scheduled class period and be punctual for every class**. Late arrivals by students for class will not be tolerated by the faculty. Tardiness will be considered an absence. Failure to attend class will directly affect performance in class as well as the final grade. The student must assume the responsibility for regular attendance and must accept the consequences of failure to attend class.

Instructor's and Student's responsibilities are detailed below. The student should understand his/her responsibilities to participate in the learning process.

<u>Student's Responsibility</u>

1. The student is expected to report to each class at the beginning of the term with a textbook and a validated registration schedule.
2. It is the student's responsibility to attend every class and to be on time for each class.
3. The student is responsible for all material covered in each course for which he or she is registered. Absence from class does not relieve him or her of this responsibility.
4. The student is also expected to be present for all laboratory periods, scheduled

examinations, and other activities that may require special preparation.

5. The student is responsible for initiating any request to make up an examination, a laboratory exercise, or other work missed because of a class absence. If the instructor requests a statement concerning the reason for the absence, the student should obtain it from the appropriate officer (e.g., the University Physician, the Vice Chancellor for Student Affairs). Make-up work is at the discretion of the instructor.

Instructor's Responsibility

1. At the beginning of the term, the instructor is responsible for explaining to the class any specific consequences for absences or tardiness.
2. By the end of the first week of classes, the instructor is responsible for providing the student with a syllabus, including a schedule of examinations and other class requirements that will provide the basis for evaluating performance.
3. The instructor is responsible for maintaining an attendance record of students in the class.

The chemical engineering faculty recommends that students follow department attendance regulations for all of their classes. For specific regulations concerning non-CHEN courses, the student is referred to their instructors, the student handbook, and the University catalog.

FUNDAMENTALS OF ENGINEERING (FE) EXAMINATION

The FE is the first test that must be passed to begin the process to become a registered professional engineer. **Students are encouraged to take the FE Exam during their senior year.** State boards of professional engineers for Engineer-in-Training (EIT) certification give the examination. For further information, please visit: www.ncees.org .

The chemical engineering curriculum is designed to give students the knowledge and skills needed to pass the FE exam.

ADVISING AND REGISTRATION

When a student is majoring in Chemical Engineering or has indicated that they are working toward becoming a CHEN major, he or she is assigned a faculty advisor by the program director. The advisor: (a) provides information, advice, and recommendations in academic and related areas, (b) directs the student to sources which explain in detail academic regulations, course prerequisites and graduation requirements, (c) helps the new student to understand the extent to which one should be responsible for one's own program planning, (d) provides vocational guidance and occupational information in one's area of specialty, and (e) refers the student to the appropriate individual, office or agency when further assistance is indicated.

The chemical engineering program director or chair advises all transfer students and assures consistency in transfer credit evaluation. In conjunction with the Office of Admissions, the contents of the courses taken elsewhere are carefully examined to make sure that they are equivalent to courses offered at North Carolina A&T State University before they are transferred. When a student requests that a course taken elsewhere be considered for transfer credit, the student should provide the catalog description of the course taken.

Aggie Access is A&T's online registration process. Students utilize this process each semester to register for the courses they will need for the upcoming semester. Each student is assigned a unique Personal Identification Number (PIN) to access Aggie Access. PIN numbers are changed each semester during early registration. Students must obtain their advisor's approval for all course enrollment transactions, including early registration, registration, and course drop/add. At the end of an advising meeting, the advisor will approve the student’s proposed schedule. The student must turn in the approved request form to the department office/advisor to get their PIN number for the registration process. The above policy is strictly

enforced. It is the student's responsibility to ensure that he/she has passed the required prerequisites for each course listed on the course request form and is registered for the co-requisite course(s).

After the end of each semester, students receive their grades. At that point, it is the student's responsibility to check for any failed or dropped courses that may have an impact on their schedule for the next semester. If a problem is detected, the student is to visit with their advisor at the beginning of the next semester (during the registration period) and make the necessary changes to the schedule. Changes include dropping any course for which a requisite is not met. Also, the student is responsible for adding any course that must be taken or retaken to meet a prerequisite requirement. If the student does make a necessary change to the schedule, the department will administratively drop the student from courses where requisites have not been met.

Students are expected to meet with their advisor regularly so they can get to know each other.

All registration or drop/add procedures are initiated by the advising process. Registration is a time designated each semester to allow the student to review his or her record with their advisor and plan a program for the next semester. The student has an opportunity to discuss academic problems with the advisor. Early registration helps to ensure that the courses requested will be available to the students the following semester. Students who are enrolled in the University during the early registration period are expected to register during the period designated for this purpose. **Students who register must pay their bill by a specified date or their registration will be canceled.**

Students are expected to complete registration (including the payment of all required fees) on the dates listed on the University Calendar. The payment of fees is part of the registration process. No student is eligible to attend classes until the required fees have been paid. **Students who fail to complete registration during the scheduled dates will be required to pay a late registration fee.**

DROP/ADD PROCEDURES

Students may change their schedule by dropping or adding courses. A change in a student's program may be made only with the consent of his or her advisor or the program director. Courses may be added or dropped during the drop/add period in the first few days of each semester. Program changes made during the drop/add period do not appear on the student's permanent transcript.

Students can withdraw from courses, after consultation with their advisor, up until the 'last day to withdraw from a course without a grade evaluation,' which is published in the academic calendar for the semester. All courses from which the student has withdrawn will appear on the permanent record with a grade of 'W'. The course credits are also counted in the total used by the University to determine if a student must pay the tuition surcharge. A 'W' is considered a course attempt in the University's policy on repetition of courses, which is at
http://www.ncat.edu/divisions/academic-affairs/bulletin/2014-2015/academic-info-and-regs/repetition-courses.html

Changes in schedule after the last day to withdraw from a course without a grade evaluation are very rarely approved. If a student wants to withdraw after that day, he/she must first complete a change of schedule and obtain support from the advisor. A letter is then written to the program director explaining why a retroactive withdrawal should be granted. If the program director supports the request, the director writes a letter asking for the support of the Dean.

AUDITS

Students may audit a course upon the written approval of the instructor and his or her faculty advisor. They

must register officially for the course and pay an audit fee to the University Cashier. Attendance, preparation, and participation in the classroom discussion and laboratory exercises shall be at the discretion of the instructor. Auditors are not required to take examinations and tests, and they receive no credit. Audited courses do not satisfy prerequisite requirements.

COURSE LOAD

Students must carry a minimum of twelve credit hours in order to be a full-time student. The normal course load in chemical engineering is from 15 to 17 credit hours per semester. The maximum course load for a student with a GPA less than 3.0 is 18 hours. To register for more than 18 hours, a student must get approval from the department head and the dean. Such approval requires a cumulative grade point average of 3.0 or higher, or a 3.2 average in twelve or more hours in the immediate preceding semester. No student may register for more than 21 hours. The maximum course load that a student who is on academic probation may carry is 15 semester hours.

TRANSFER CREDIT

Transfer credit is the awarding of credits at A&T for courses taken prior to matriculation at A&T. When a student transfers to A&T, the Office of Admissions evaluates courses taken at other institutions and awards advanced standing credits at A&T. Generally, a course must contain essentially the same content and have the same (or greater) number of credit hours as the North Carolina A&T State University course for which credit is being awarded. The student must have also earned at least a grade of "C" for the course to be transferred.

A student who wishes to transfer to A&T State University to study chemical engineering must meet all of the University requirements for transfer, and the student must have a cumulative GPA of 2.5 or above. Students who transfer to A&T are expected to attend a new student orientation session prior to beginning classes at A&T. The chemical engineering program director or chair reviews all transfer credits with the new student during the orientation session and advises the student on any appeals to the Admissions Office. Students who choose to change their major to chemical engineering after being enrolled in another program at A&T will have their advanced standing reviewed by the chemical engineering program director to ensure that department and ABET standards are met.

RESOLUTION OF PROBLEMS AND COMPLAINTS

If you have an academic problem with an instructor, you must try to solve the problem at that level. If you have any other problem, you must get help from the Department by seeing the Program Coordinator, Chairperson, or Secretary. If the Department cannot solve the problem to your satisfaction, they will let you know where to go next. If you take a problem to the Dean or higher, you will be told to first follow the above procedure.

PERMISSION TO TAKE COURSES ELSEWHERE

Enrolled A&T students who wish to take a course at another institution, during the summer or while on a Co-op assignment, must obtain **prior** approval from the University. He/she must present a catalog description of the chosen course(s) and make a formal request for approval using the official request form that can be obtained in the Department office. The student must demonstrate to the chemical engineering chairperson that the course is equivalent to a course offered at A&T. Courses approved by the chemical engineering program director are sent to the Dean of Engineering for review and to the Admissions Office for University approval. If the student receives a "C" or better in the approved course, the course will be transferred to A&T. **The student must request that a transcript be sent to the Admissions office to complete the process.** The student is given credit for the course, but no grade is awarded.

Courses may be taken at an accredited junior college only if completed prior to the conclusion of the student's sophomore year at A&T or if the courses are social sciences/humanities electives. In general, students may transfer credit for a maximum of two courses each summer, as long as the student meets the full-time student in residence requirement for graduation, which is stated at.
https://www.ncat.edu/divisions/academic-affairs/bulletin/2018-2019/index.html

COOPERATIVE EDUCATION

Participation in Cooperative Education (Co-op) is highly recommended for students in the Chemical Engineering program. The program is an effective means of providing industrially relevant experience beyond that which can be accomplished in the classroom. Participation in the program serves not only as a form of financial aid for students, but also provides them with an advantage in seeking full-time employment opportunities. To facilitate student participation in the program, some of the chemical engineering courses required for graduation are offered twice per year, with some also offered in the summer. A Co-op requires at least three semesters of work alternating with academic semesters. After qualifying for the Co-op Program in your first year (qualification requires a GPA above 2.8), you continue to be eligible to remain in the program by maintaining satisfactory academic (GPA above 2.8) and work records.

Cooperative Education (co-op) is a carefully organized and supervised program of "Experiential Learning" in which the participating student enriches his or her education by alternating periods of classroom study with periods of work related to his or her academic major. It is **OPTIONAL** on the part of the student. The objective of the program is to enrich the total educational experience of the student. If a chemical engineering student is in a co-op program, the student will normally require five (5) years to complete their chemical engineering degree. Co-op graduates command more job offers and a premium starting salary because of their experience.

Students normally apply for a co-op assignment during their freshman year or early in their sophomore year. Although no minimum GPA is specified by the University, corporate sponsors often set a minimum GPA for their company - generally 2.7 - 3.0. Students must recognize that they are selected for co-op assignment by an industrial sponsor. Chemical engineering majors interested in co-op must plan their schedules with advice from the Program Director so that the courses needed are available when they are in school. Senior co-op students can gain academic credit (3 credit hours toward chemical engineering senior elective requirement) for work completed while on three or more co-op assignments by registering for CHEN 498 and meeting all course requirements.

INDEPENDENT STUDY

Independent Study in Chemical Engineering, CHEN 490, is a senior chemical engineering elective that allows a student to complete a project with an A&T faculty advisor. Students must develop a complete project plan with the help of an advisor, form a three-member faculty committee, and begin work on the project **prior to enrolling in the course.** The chemical engineering program director or chairperson must approve the project plan form. The course will be graded by the project advisor based on the quality of an oral presentation, a written final report, and input from the other members of the committee.
The committee will consist of:

1. Project advisor
2. Faculty members selected by the project advisor and the student.
3. Chemical engineering program director, chairperson, or a faculty member selected by the program director, if both the director and chairperson are already selected.

COLLEGE CONSORTIUM

Seven institutions in the Greensboro area have formed a College Consortium so that students enrolled at

each of the seven colleges can take courses at any of the other colleges during the academic year. North Carolina A&T State University, Bennett College, Guilford College, Guilford Technical Community College, High Point College, Greensboro College, and the University of North Carolina at Greensboro make up the Consortium. During the summer, only A&T and UNCG are in the Consortium. All regulations concerning transfer credit apply to the Consortium except that both the course credits and the grade become part of your record, and a grade of "D" is acceptable if it meets program and College of Engineering requirements.

A&T students who wish to enroll in courses at one or more of the above named institutions may obtain the necessary consortium form from the Office of Registration and Records. Approval of the advisor, department chairperson, and the cashier is required before reporting to the registrar's office. After the registrar has signed the form, the student must take the remaining three copies to the Host Institution's Registrar's office and follow their procedure for registering for the course(s). Students should present the approval forms at the Consortium station in Corbett Hall Gymnasium during regular registration. During late registration, the consortium forms are to be turned in at the Office of Registration and Records in Dowdy Building. The schedule of classes for each of the participating schools is available in the Office of Registration and Records. Consortium students who make changes in their schedules must satisfy the drop/add procedures and deadlines at the home and the host campuses. The student should keep a copy of the consortium form after final approval is obtained, which will be needed for use of library facilities, obtaining a parking decal, and dropping a course.

SCHOLARSHIPS

Scholarship funds are occasionally available to Chemical Engineering undergraduate students as a result of corporate donations to be awarded on the basis of academic performance. Rising sophomores may apply for summer Design Fellowships funded by the Department. Juniors and Seniors may apply for supplemental instructor positions to assist Freshman and Sophomore students. All of these opportunities are for a single semester, or a portion of the summer. Students planning to apply for a chemical engineering scholarship, fellowship, or supplemental instructor position must complete an application form, available in the department office, or online, and are encouraged to apply early. Award decisions are generally made in July for the following academic year, or in January for the summer.

Scholarship standards are a minimum GPA of 3.00, overall and in chemical engineering. Because the demand for scholarships is often greater than the supply of scholarship funds, the GPA needed could be higher than 3.0.

The department expects all students on CHEN scholarships to apply for other corporate scholarships whenever they are announced so that more students can receive financial aid. Also, highly-qualified students are encouraged to apply for national merit scholarships such as the DOD SMART Scholarships described at https://www.nationalmeritscholarships.com/dod-smart-scholarship.html

STUDENT ORGANIZATIONS

AIChE Student Chapter

The American Institute of Chemical Engineers (AIChE) is the official professional society for chemical engineers. The basic objectives of the Institute are "the advancement of chemical engineering in theory and practice and the maintenance of high professional standards among its members." The AICHE:

1. Provides means for the publication and exchange of technical information in the field of chemical engineering.
2. Establishes a professional standard of conduct and draws its members from those who have subscribed to this standard.

3. Provides an organization which promotes the wider recognition of chemical engineering as a profession and which is effective in improving the professional and economic status of chemical engineers individually.
4. Provides forums where members may meet with their colleagues to discuss mutual interest and problems.

The Institute authorizes Local Sections and Student Chapters. The local AIChE Section is the Triad Section. The Triad Section covers the Triad region and meets five times each year. At least one meeting is held on the A&T campus to present the outstanding chemical engineering senior award. The Triad section selects and awards the outstanding senior from our program after interviewing 3-5 seniors nominated by the CHEN faculty. CHEN faculty are active participants in the Triad Section, and most have served as section officers. Members of the Student Chapters are eligible to participate in all the activities of the Local Sections except voting for officers.

The Institute also authorizes AIChE Student Chapters at Universities with accredited programs. We have one Student Chapter at A&T. The objectives of the Student Chapter are: 1) promote professional development of their members by their programs and by their relations with other Student Chapters and with the parent body, the American Institute of Chemical Engineers, 2) contribute to the development of chemical engineering through activities involving the faculty and student members and students, and 3) counsel high school students interested in the chemical engineering profession. The administrative functions of the Student Chapter are carried out by the officers, who are elected annually by the membership. All CHEN majors are eligible for membership in the Student Chapter and National AIChE. The department recommends that all majors join and actively participate in the Student Chapter. Currently, Dr. Md Arif Khan serves as the Chapter's faculty advisor.

Omega Chi Epsilon *(OXE)*
OXE is the national chemical engineering honor society. It promotes and recognizes high scholarship, encourages original investigation in chemical engineering, and recognizes the valuable traits of character, integrity, and leadership. The society serves both undergraduate and graduate students within the Chemical Engineering Department. *OXE* chartered the CHEN honor society as the Beta Gamma Chapter of *OXE* in 1992.

Membership in *OXE* is by invitation based on academic performance. Second-semester junior CHEN majors having an overall grade point average and a chemical engineering average of 3.30/4.00 or more shall be eligible for election. Seventh semester seniors become eligible for membership if they have maintained a 3.20 GPA in CHEN and overall. Eighth semester seniors shall be eligible for election if they have maintained a 3.00 overall grade point average and chemical engineering grade point average. This Beta Gamma chapter of *OXE* is administered by a set of officers and an advisor who are elected annually. Currently, Dr. Mohammad Azad serves as *OXE* faculty advisor.

Society of Plastics Engineers (SPE)
A student section of SPE started in 2004. The objective of the Society is to promote the scientific and engineering knowledge relating to plastics (www.4spe.org). Student member benefits include:
Subscription to *Plastics Engineering* magazine
Newsline, student newsletter
Position Wanted ad in *Plastics Engineering*
Registration to select SPE conferences
Reduced registration for SPE seminars and training programs
Access to SPE scholarship competitions
Dr. Jianzhong Lou serves as faculty advisor.

COLLEGE AND UNIVERSITY ACADEMIC REGULATIONS

The BS chemical engineering program adheres to all policies of the University. Students are expected to follow all policies and regulations including the add and drop period, withdrawal from an individual course, repetition of courses and grade forgiveness, undergraduate academic standing, undergraduate academic honors, minimum requirements for a baccalaureate degree, and grades and grade point average, as well as all other policies and regulations.

Updated policies are available at the web link given below:
http://www.ncat.edu/legal/policies/sec2-acad-affairs/index.html

Academic information and regulations are available at the web-links given below:
https://www.ncat.edu/divisions/academic-affairs/bulletin/2014-2015/academic-info-and-regs/academic-dishonesty-policy.html
https://www.ncat.edu/divisions/academic-affairs/bulletin/2018-2019/index.html

INCOMPLETE GRADES

Students are expected to complete all requirements of a particular course during the semester in which they are registered. However, if at the end of the semester a small portion of the work remains unfinished and should be deferred because of some serious circumstances beyond the control of the student, an incomplete, "I," grade may be submitted.

An "I" for a prolonged illness may be submitted only after the written approval of the Vice Chancellor of Student Affairs has been secured. An "I" for other causes may be submitted only with the approval of the dean of the school/college.

Along with the recording of the incomplete grade, the instructor must also file with the head of the department the student's average grade and a written description of the work which must be completed before the incomplete is removed.

An incomplete grade must be removed within SIX WEEKS after the beginning of the next semester. If the student has not removed the incomplete within the time specified, the incomplete is automatically changed to an "F." Developmental, thesis, and research courses are exempted from the six week time limit. The posted deadline date to remove incompletes for a given semester can be found on the academic calendar.

ACADEMIC DISHONESTY POLICY

North Carolina Agricultural and Technical State University is committed to a policy of academic honesty for all students. Examples of Academic Dishonesty include but are not limited to:

- Cheating or knowingly assisting another student in committing an act of academic dishonesty;
- Plagiarism (unauthorized use of another person's words or ideas as one's own) which includes but is not limited to submitting examinations, theses, reports, drawings, laboratory notes or other materials as one's own work when such work has been prepared by another person or copied from another person.
- Unauthorized possession of examinations or reserve library materials, destruction or hiding of source materials, library materials, or laboratory materials or experiments or any other similar action;
- Unauthorized changing of grades or marking on an examination or in an instructor's grade book, or such change of any grade record;
- Aiding or abetting in the infraction of any of the provisions anticipated under the general standards of student conduct; or
- Assisting another student in violating any of the above rules.

A student who has committed an act of academic dishonesty has failed to meet a basic requirement of satisfactory academic performance. Thus, academic dishonesty is not only a basis for disciplinary action but may also affect the evaluation of the student's level of performance. Any student who commits an act of academic dishonesty is subject to disciplinary action as defined below.

In instances where a student has clearly been identified as having committed an academic act of dishonesty, the instructor may take appropriate punitive action including a loss of credit for an assignment, an examination or project, or award a grade of "F" for the course subject to the review and endorsement of the chairperson and the dean. Repeated offenses can even lead to dismissal from the University.

GRADUATION UNDER A GIVEN CATALOG

A student may expect to earn a degree in accordance with the requirements of the curriculum outlined in the curriculum in force when he or she was first enrolled into the Department, provided the courses are still being offered. Moreover, he or she must complete all requirements within six years. On the other hand, he or she may graduate under any subsequent curriculum published while he or she is a student. If a student elects to meet the requirements of a curriculum other than the one in force at the time of his or her original entrance, he/she must meet all requirements of the curriculum he/she elects.

FINAL EXAMINATIONS

In order that students may complete semester projects, take lab tests, and prepare for final examinations, faculty members are urged to **avoid** giving major tests during the final week of the semester.

Final exam papers are not returned to students, but the instructor shall keep the returned papers at least until the first month of the next regular semester. During this period, any student shall have an opportunity to review his/her exam paper.

Absences from final examinations are not excused without **very exceptional** circumstances, such as serious illness certified by a medical official of the University or other unavoidable conditions beyond the control of the student. A student who misses a final examination must notify the instructor **within 24 hours** after the scheduled time of the examination. Failure to so notify and to present an **acceptable reason** for absence from the examination will result in the student receiving an "F" on the final exam.

GRADUATION WITH HONORS

Undergraduate candidates who complete all requirements for graduation in accordance with the following stipulations earn the following honors:

1. Those who maintain an adjusted GPA within the range of 3.25 to 3.49 will receive CUM LAUDE,
2. Those who maintain an adjusted GPA within the range from 3.50 to 3.74 will receive MAGNA CUM LAUDE, and
3. Those who maintain an adjusted GPA within the range of 3.75 to 4.00 will receive SUMMA CUM LAUDE.

All course hours attempted, excluding W (withdrawal grades), are included in the adjusted grade point average computation for honors. For example, if a course was repeated, both grades are used in the adjusted grade point average computation.

Undergraduate students must earn at least 70 semester hours of resident credit at North Carolina Agricultural and Technical State University to qualify for graduation honor designations. Publication of honors is made at commencement.

CHEMICAL ENGINEERING FACULTY PROFILES

Yusuf G. Adewuyi, Professor, PhD, University of Iowa; AIChE Fellow
Research Interests:

Chemical Reaction Engineering	Catalysis and Benign Chemical Synthesis
Environmental Remediation	Advanced Oxidation Processes

Mohammad A. Azad, Associate Professor, PhD, New Jersey Institute of Technology
Research Interests:

Advanced Manufacturing	Data Analytics
Polymer-based drug delivery	Materials science

Vinayak N. Kabadi, Professor and Chemical Engineering Graduate Director, PhD, Pennsylvania State University
Research Interests:

Thermodynamics by Computer Simulations	Thermodynamics of Coal Liquids
Environmental Engineering	

Md Arif Khan, Assistant Professor, PhD, University of Kentucky
Research Interests:

Biomaterials	Biotechnology
Computational modeling	Energy and environment

Jianzhong Lou, Professor, PhD, University of Utah
Research Interests:

Polymer Processing	Polymer Characterization
Membrane Transport	

Tianjun Xie, Assistant Professor, PhD, Clemson University
Research Interests:

Catalysts	Batteries
Computational modeling	Semiconductors

REQUIRED COURSES IN CHEMICAL ENGINEERING

CHEN 121. Intro Comp Dsgn Tools Chem Eng **Credits 1(0-2)**
This course introduces computational tools for creation and evaluation of designed solutions for problems in chemical engineering. Programming skills, data types, operations and graphical representations of design parameters are introduced. The use of numerical engineering tools including matrix manipulations, vectors and algebraic equation systems is discussed. A case study of a chemical process design is examined using contemporary computational tools. Prerequisite: MATH 131 or permission of instructor **(F;S;SS)**

CHEN 200. Chemical Process Principles **Credit 4(3-2)**
This course is an introduction to the analysis of chemical processes with an emphasis on mass and energy balances. Stoichiometric relationships, ideal and real gas behavior are also covered. Topics also include an introduction to the first law of thermodynamics for open and closed systems and the solution of problems with comprehensive mass and energy balance equations. Prerequisites: CHEM 106, GEEN 100. Corequisites: CHEM 107, MATH 132, and PHYS 241. **(F;S;SS)**

CHEN 218. Analysis of Chemical Process Data **Credit 3(2-2)**
The course introduces contemporary computational methods and tools for designing experiments and analysis of data, frequency distribution and probability concepts. The course covers statistical inference, empirical models, strategies for

efficient experimentation and their applications in chemical engineering process analysis. Statistical methods including error analysis, curve fitting and regression, analysis of variance, confidence intervals, hypothesis testing, and control charts are covered. Prerequisites: MATH 132. **(F;S;SS)**

CHEN 220. Analytical Methods in Engineering **Credit 3(2-2)**

This course introduces contemporary computational methods and tools for numerical analysis in engineering. It includes numerical methods in differentiation, integration, interpolation, root-finding, linear and nonlinear regression. Linear algebra topics include matrix manipulation, solution of linear simultaneous equations, and solution of ordinary differential equations. Each topic involves projects with numerical computations using MATLAB. Prerequisites: MATH 132. **(F;S;SS)**

CHEN 226. Comp Dsgn Methods in Chem Eng **Credit 3(2-2)**

In this course students learn to apply contemporary numerical methods including linear algebraic solutions for chemical engineering design problems. Numerical methods of differentiation, integration, interpolation, root-finding, linear and nonlinear regression, matrix manipulation, linear simultaneous equations, and solution of ordinary differential equations are discussed. Using process simulation software in the lab, students create a design with idealized mixing, reaction, separation, and mass energy balances, and evaluate performance parameters. Prerequisites: CHEN 200, CHEN **(F;S;SS)**

CHEN 300. Fluid Mechanics **Credit 3(2-2)**

This course examines the continuum concept, fluid statics, mass and momentum balances, the Bernoulli Equation, dimensional analysis, pipe flow problems, the design and the selection of pumps and the three forms of drag. Boundary layer flows, compressible flow and flow measurement devices are reviewed. Prerequisites: MATH 231, PHYS 241. **(F;S;SS)**

CHEN 312. Chemical Engineering Thermodynamics **Credit 4(3-2)**

The course is a study of thermodynamics principles with special emphasis on chemical process applications and equilibria. Topics included are the first and second laws, properties of single and multi-component systems, expansion and compression of fluids, heat engines, thermodynamics of flow processes, phase equilibria and chemical reaction equilibria. Prerequisites: CHEN 200, MATH 231 or consent of instructor. **(F;S;SS)**

CHEN 320. Heat Transfer **Credit 3(2-2)**

The course covers the fundamentals of heat conduction, convection, radiation, boiling and condensation, and heat exchangers. Design and safety aspects of heat transfer equipment will be covered. Prerequisites: CHEN 300, MATH 341. **(F;S;SS)**

CHEN 330. Chemical Engineering Laboratory I **Credit 2(0-5)**

Students conduct laboratory studies on unit operations involving fluid mechanics, thermodynamics, and heat transfer. The studies include open-ended experiments and comparisons between theory and experimental results. Statistical analysis of data, experimental design, laboratory safety and quality reporting are stressed. Students are required to complete formal and informal reports and make oral presentations with visual aids. Prerequisites: CHEN 218, Corequisite: CHEN 320. **(F;S)**

CHEN 340. Process Dynamics and Control **Credit 3(2-2)**

The course covers the methods for controlling chemical process equipment including the dynamic response of process equipment and systems. Simulation methods are stressed in the design of control systems. Modes of control, controller characteristics and control loop design are stressed. Computer control and statistical process control are introduced. Prerequisites: MATH 341, CHEN 300 and CHEN 312. Corequisite: CHEN 320. **(S)**

CHEN 400. Mass Transfer Operations **Credit 3(2-2)**

The course is a study of diffusion, diffusional operations and stagewise separation principles. Topics include the quantitative treatment and design of mass transfer equipment involving equilibrium stage contacting. Operations included are distillation, absorption, and extraction. Additional operations, such as, ion exchange, drying, humidification, chromatography and membrane separation may be included at the instructor's discretion. Prerequisite: CHEN 320, CHEN 226, CHEN 312. **(F,S,SS)**

CHEN 410. Chemical Engineering Laboratory II **Credit 2(0-5)**

The course is a continuation of CHEN 330 with emphasis on open-ended laboratory studies and comparisons between theory and experimental results. Topics include mass transfer, process dynamics and control, reaction kinetics, and reactor design. Statistical analysis of data, experimental design, laboratory safety and quality reporting are stressed. Students are required to complete formal and informal reports and make oral presentations with visual aids. Prerequisites: CHEN 320, CHEN 330. Corequisites: CHEN 400, CHEN 422. **(F;S)**

CHEN 422. Chemical Reaction Engineering **Credit 3(2-2)**

This course covers the fundamentals of chemical kinetics, rate theories and chemical reactor design. Homogeneous reactors are emphasized. Heterogeneous systems and catalysis are introduced. Students design chemical reactors for batch and flow systems. Prerequisites: CHEN 320, CHEN 312, CHEM 221. **(F;S)**

CHEN 430. Process Design I **Credit 3(2-2)**

The steps in creating a chemical process design from concept to completion and plant operation are studied. Topics included are engineering economics, simulation, process equipment design, ethics, and process safety. Students complete an open-ended process component design. Prerequisites: CHEN 320, CHEN 312, CHEN 325; Corequisites: CHEN 400, CHEN 422. **(F;S)**

CHEN 440. Process Design II **Credit 3(1-4)**

This capstone design course emphasizes the design of a complete chemical process including a literature survey, mass and energy balances, flow diagrams, equipment selection and design, and cost and economic analysis. Students develop and use computer-aided simulation to model process equipment design. Projects include extensive use of the ASPEN PLUS simulation package. Oral and written presentations of the design projects are required. Prerequisites: CHEN 400, 422, 430, CHEM 441; Corequisite: CHEN 340 **(F;S)**

CHEN 441. Computer-Aided Process Design **Credit 3(2-2)**

Computer models of varying complexity are used to simulate the behavior of many unit-operations. Students complete computer aided mass and energy balances for complete chemical plants. Selecting the best computer model for each process step is stressed. Interrelationships between design and process variables using computer simulation are studied. Optimization methods are applied to chemical process design. A current simulation package is used. Prerequisite: Senior standing in CHEN or consent of instructor. **(F;S;SS)**

CHEN 448. Process Safety, Health and Environment **Credit 3(3-0)**

Fundamentals of chemical process safety and designing for the environment are introduced in this course. Topics include toxicology, industrial hygiene, source models, toxic release and dispersion models, fires and explosions, relief systems, hazard identification and risk analysis, environmental fate and transport, waste generation, pollution prevention, and regulatory requirements. Prerequisite: Senior standing in CHEN or consent of instructor. **(F;S;SS)**

REQUIRED COURSES FROM OTHER DISCIPLINES

Biology (BIOL)

BIOL 101 - Concepts in Biology I **Credits 4 (4-0)**

This course is an introduction to science and the scientific method, basic biochemistry, cell structure and function, energy and metabolism, reproduction and genetics for those students planning to enroll in additional major courses in the biological sciences. The laboratory will emphasize central biological concepts. Prerequisite: Credit or concurrent enrollment in CHEM 106 and 116. (F;S;SS)

Chemistry (CHEM)

CHEM 106 General Chemistry VI **Credits 3 (3-0)**

This is a course which emphasizes basic principles and important theoretical concepts of chemistry. Topics will include atomic structure, electronic configuration, the wave mechanical model of the atom, chemical bonding, states of matter, chemical equilibria, systems of acids and bases, and electrochemistry. Corequisite: CHEM 116. Prerequisites: SAT MATH score of 490, or SAT II MATH Level II score of 470 or ACT MATH score of 19 or CHEM 103 with a grade of C or better. (F;S;SS)

CHEM 107 General Chemistry VII **Credits 3 (3-0)**

This course is a continuation of CHEM 106. It includes the principles of chemical thermodynamics related to physical properties of liquids and solids, and spontaneity of reactions; principles of chemical kinetics; and principles of chemical equilibrium and its applications in acids-bases, coordination chemistry and electrochemistry. Corequisite: CHEM 117/CHEM 190 (CHEM 190-restricted only to CHEM majors.) Prerequisite: CHEM 106 or equivalent. (F;S;SS)

CHEM 116 General Chemistry VI Laboratory **Credits 1 (0-1)**

This is a course which emphasizes quantitative studies of chemical reactions such as acid-base studies, redox reactions, and equilibrium reactions. Emphasis is also placed on the development of manipulative skills in the laboratory. Corequisite: CHEM 106. (F;S;SS)

CHEM 117 General Chemistry VII Laboratory **Credits 1(0-1)**

This is a one semester introductory course designed to make clear the nature of science as an enterprise and illustrate by numerous examples how science really proceeds. Learning experiences are constructed so that they closely approximate real life situations where one has to search for clues and insights from a variety of sources. This course is not open to students who have received credit for CHEM 101, 102, 104, 105, 106, or 107. (F;S;SS)

CHEM 221 Organic Chemistry I **Credits 3 (3-0)**

This course is a study of the hydrocarbons (aliphatic and aromatic) and introduction to their derivatives. Prerequisite: CHEM 102, 105, or 107. (F;S;SS)

CHEM 223 Organic Chemistry I Laboratory **Credits 1 (0-1)**

This laboratory course emphasizes the study of physical and chemical properties of aliphatic and aromatic compounds. Modern instrumentation such as gas and column chromatography, infrared and ultraviolet analyses are used. Corequisite: CHEM 221. (F;S;SS)

CHEM 441 Physical Chemistry I **Credits 3 (3-0)**
This course is a study of the fundamental thermodynamics laws that govern the materials in the three phases, and in solutions. It also covers chemical kinetics and the application of thermodynamics and chemical kinetics on chemical reactions especially chemical equilibrium, and the application of thermodynamic laws on phase diagrams. Prerequisites: MATH 231, PHYS 241, and CHEM 231. (F;S)

Electrical and Computer Engineering (ECEN)

ECEN 340 Electrical Circuits and Systems **Credits 3 (3-0)**
This course covers power and energy concepts; basic R, RC, RL, and RCL circuits; three phase circuits; ideal transformers; diodes and ideal op amp circuits; and logic circuits. The Laplace transform method will be introduced and used to solve circuit problems. Prerequisite: PHYS 242. Corequisite: MATH 341. (F;S;SS)

English (ENGL)

ENGL 100 Ideas and Their Expressions I **Credits 3 (3-0)**
This course is an introduction to college-level expository writing; it provides students with experience in writing and revising compositions. Students will also learn to write résumés, letters of application, short reports, and responses to literature. (F;S;SS)

ENGL 101 Ideas and Their Expressions II **Credits 3 (3-0)**
This course covers the fundamental elements of college-level writing, grammar, organization, structure, and development of ideas. It also covers argumentative writing and concludes with instruction in writing the research paper. Prerequisites: none. (F;S;SS)

General Engineering (GEEN)

GEEN 100 Engineering Design and Ethics **Credits 2 (2-0)**
This course introduces students to engineering and computer science disciplines and functions, professional licensure, the Fundamentals of Engineering exam, code of ethics, safety, the design process, creative thinking, teamwork, and technical writing. A case study on ethics and the application of the design process through a team project are required. (F;S;SS)

GEEN 111 College of Engineering Colloquium I **Credits 1 (1-0)**
This course includes lectures, seminars, and activities important to the retention and matriculation of students in the college of engineering. Students are introduced to various engineering and computer science degree programs and their respective professions, and are also provided with group advisement regarding department, college, and university-level policies and procedures. Prerequisite: None. (F;S)

GEEN 121 College of Engineering Colloquium II **Credits 1 (1-0)**
This course includes lectures, seminars and activities important to the retention and matriculation of engineering students. Topics covered include learning styles, group dynamics, and career development. Students are also provided with group advisement regarding department, college, and university-level policies and procedures. Prerequisite: None. (F;S)

Mathematics (MATH)

MATH 131 Calculus I **Credits 4 (4-0)**
Limits and continuity of functions, the derivative, applications of the derivative, the definite integral and applications of the definite integral will be studied. Prerequisites: SATM score at least 550 or an ACT Math score at least 24 or a Math Dept Precalc test score at least 17, or a "C-" or better in MATH 104, MATH 110 or MATH 111. (F;S;SS)

MATH 132 Calculus II **Credits 4 (4-0)**
Topics in analytic geometry, differentiation and integration of exponential, logarithmic, trigonometric, inverse trigonometric and hyperbolic functions, additional techniques and applications of integration, indeterminate forms, improper integrals, Taylor's Formula and infinite series will be studied. Prerequisite: MATH 131. (F;S;SS)

MATH 231 Calculus III **Credits 4 (4-0)**
This course will cover plane curves and polar coordinates, vector and solid geometry, vector valued functions, partial differentiation, multiple integrals, applications of multiple integrals and vector analysis. Prerequisite: MATH 132. (F;S;SS)

MATH 341 Introduction to Differential Equations **Credits 3 (3-0)**
This course will cover first order differential equations, higher order linear differential equations, matrices and determinants, systems of linear algebraic equations, systems of linear differential equations, and Laplace transforms.

Prerequisite: MATH 132. (F;S;SS)

Mechanical Engineering (MEEN)

MEEN 230 Statics and Mechanics of Materials **Credits 3 (3-0)**

This is an introductory course in statics and mechanics of materials for non-mechanical engineering majors. It provides a just-in-time approach to the study of characteristics of forces and couples, and their effects on equilibrium, strains, and stresses in solid bodies. Relationships between loads and deformations are also presented. Prerequisites: MATH 131, PHYS 241 (F;S)

MEEN 260 Materials Science **Credits 2 (2-0)**

This basic course in materials science covers the fundamental nature of materials including their physical, mechanical and chemical characteristics. Topics include: atomic arrangements and atomic bonding; structure property relationships, phase diagrams, engineering properties and basic failure modes. Prerequisites: CHEM 106 and MATH 131. (F;S)

Physics (PHYS)

PHYS 241 General Physics I **Credits 3 (3-0)**

PHYS 241 is a calculus-based physics course that covers the fundamental principles of Newtonian mechanics, heat, and thermodynamics. Corequisites: MATH 132, PHYS 251.

PHYS 242 General Physics II **Credits 3 (3-0)**

This is a continuation of PHYS 241. It is a calculus-based study of physics, which covers the fundamental principles of electricity, magnetism and optics. The topics include; electricity, electric fields, Gauss law, electric potentials, magnetostatics, magnetic fields, Lenz law. Faraday law, electromagnetic induction, Maxwell's equations, mechanical waves, electromagnetic waves, polarization of light, reflection, refraction, interference and diffraction of light. Corequisite: PHYS 252. Prerequisite: PHYS 241. (F;S;SS)

PHYS 251 General Physics I Laboratory **Credit 1 (0-1)**

This is a laboratory course where a selected group of physics experiments will be performed. Emphasis is placed on the development of experimental technique, analysis of data, and physical interpretation of experimental results. Corequisite: PHYS 241.

PHYS 252 General Physics II Laboratory **Credit 1 (0-1)**

This course is a continuation of PHYS 251. Corequisite: PHYS 242. (F;S;SS)

Elective Courses

The Chemical Engineering Program requires students to complete one advanced Chemical Engineering elective and one advanced Chemistry elective. These elective courses can be chosen from the following lists of Chemical Engineering and Chemistry electives, or courses with the approval of the Chemical Engineering program coordinator or the department chair.

CHEN 310. Fundamentals of Thermodynamics **Credit 3(2-2)**

This is a basic course in fundamental thermodynamic principles. The topics covered include energy, heat and work, thermodynamic properties of substances, real and ideal gases, first and second laws of thermodynamics, introduction of power cycle and refrigeration cycle. Prerequisites: CHEN 200, MATH 231, PHYS 241. **(F;S;SS)**

CHEN 311. Thermodynamics of Chemical and Phase Equilibria **Credit 3(2-2)**

This course consists of a systematic study of chemical reaction equilibria and phase equilibria. Use of fugacity, activity and chemical potential concepts for predicting the effect of such variables as temperature and pressure on equilibrium compositions are studied. Methods for measuring and estimating thermodynamic properties important to equilibrium calculations in real systems are also examined. Single component and multi-component systems are addressed. Students are introduced to the ASPEN PLUS chemical process simulation package and are trained to use the package to access and estimate thermodynamic properties of pure components and mixtures. Prerequisite: CHEN 310. **(F;S)**

CHEN 406. Introduction to Biochemical Engineering **Credit 3(3-0)**

This course explores the use of living organisms or parts of them (e.g., enzymes) for the production of chemical or biological materials. The course emphasis is upon bioprocess development and bioreactor design. Topics covered include enzyme kinetics and biocatalysts, microbial growth and product formation, immobilization of enzymes and whole cells, bioreactor scale-up and design of batch and continuous bioreactors. Students are required to complete a

bioprocess design or project with the option of using a process simulator such as Aspen. Prerequisite: Senior standing in CHEN or permission of instructor **(F;S;SS)**

CHEN 409. Introduction to Bioseparations **Credit 3(3-0)**

The course is an introduction to the separation and purification of biochemicals. Separation processes are characterized as removal of insolubles, isolation of products, and purification or polishing. Processes covered include filtration, centrifugation, cell disruption, extraction, absorption, elution chromatography, precipitation, ultrafiltration, electrophoresis and crystallization. Students are required to complete a design project on a bioseparation process. Prerequisite: Senior standing in CHEN or consent of instructor. **(F;S;SS)**

CHEN 412. Introduction to Green Engineering **Credit 3(3-0)**

Students are introduced to the concept of green engineering and its application through industrial ecology, risk assessment and life-cycle assessment methodologies. Topics include green engineering at the macroscale (industrial sector), mesocale (unit operations), and microscale (molecular interactions). Students will design an engineering process with emphasis on preserving and improving environmental quality. Prerequisite: Senior standing in CHEN or consent of instructor. **(F;S;SS)**

CHEN 415. Overview of Energy and Fuels **Credit 3(3-0)**

Students are exposed to the estimates of past and current fuel consumption in the United States and the world. Future projections of the global energy needs and the fuels likely to be utilized to meet these needs are discussed. These fuels include fossil fuels, synfuels, and fuels from renewable resources, such as, wind, solar and biomass. Students learn about processing of fuels for energy production. The course includes design of a fuel process with emphasis on economic and environmental impact. Prerequisite: Senior standing in CHEN or consent of instructor. **(F;S;SS)**

CHEN 425. Basic Food Process Engineering **Credit 3(3-0)**

This course covers basic food processing and development. Topics include the different food groups, food preparation operations, process operations, new food developments, health hazards and their effects on humans. Prerequisite: Senior standing in CHEN or consent of instructor. **(F;S;SS)**

CHEN 435. Introduction to Process Scaleup **Credit 3(3-0)**

This course is designed to teach students how to 1) scaleup a process or model and 2) perform model, pilot and plant studies for translation of processes from model, laboratory and pilot plant information to the plant. The course will cover the different scaleup methods and how to establish viable process objectives. A general scaleup method is presented and a number of examples are worked as illustrations. Prerequisite: Senior standing in CHEN or consent of instructor. **(F;S;SS)**

CHEN 441. Computer-Aided Process Design **Credit 3(3-0)**

Computer models of varying complexity are used to simulate the behavior of many unit-operations. Students complete computer-aided mass and energy balances for complete chemical plants. Selecting the best computer model for each process step is stressed. Simulation of the computer-aided design of a chemical process is included. Students learn to retrieve and plot physical property, thermodynamic and VLE data. Currently, the ASPEN PLUS simulation package is used. Prerequisite: Senior standing in CHEN or consent of instructor. **(F;S;SS)**

CHEN 445. Introduction to Environmental Remediation **Credit 3(3-0)**

The course introduces students to traditional and developmental methods for removal and detoxification of hazardous wastes at contaminated sites and from industrial waste streams. Chemical, thermal, biological and physical methods of remediation are covered. The course deals with hazardous wastes in soils, groundwater, surface water, wastewater ponds and tanks. The emphasis is on destruction, removal and containment methods using mathematical models for contaminate fate and transport. Recent advances in emerging technologies are also discussed. Each student will complete an environmental remediation design project. Prerequisite: Senior standing in CHEN or consent of instructor. **(F;S;SS)**

CHEN 455. Engineering Applications of Nanostructured Materials **Credit 3(3-0)**

This course introduces students to modern chemical engineering material processing technologies. Chemical vapor deposition, crystallization, electrochemical deposition, electroplating and supercritical fluid-based processing techniques for the production of nanostructured materials are discussed. This course also reviews the effects of parameters (such as lattice structure, material composition, nucleation, crystal growth phenomena, chemical bonding, etc.) on the catalytic, electronic, optical and physical properties of metallic and ceramic materials. Prerequisite: Senior standing in CHEN or consent of instructor **(F;S;SS)**

CHEN 464. Nuclear Fluid Mechanics and Heat Transfer **Credit 3(3-0)**

This course provides discussions of thermal hydraulic characteristics of power reactors, thermal design principles, reactor heat generation, transport equations for single phase flow and two-phase flow. Analyses of fuel elements, two phase flow dynamics, two phase heat transfer, single heated channels, steady state flow and heat transfer analysis are given. Prerequisite: Senior standing in CHEN or consent of instructor. **(F;S;SS)**

CHEN 465. Introduction to Polymer Science and Engineering **Credit 3(3-0)**

This course introduces students to engineering technology of polymeric materials, and science and engineering of large molecules. Students learn about control of significant variables in polymer synthesis, and physical methods for characterization of molecular weight, morphology, rheology and mechanical behavior. Engineering applications include additives, blends and composites, natural polymers and fibers, thermoplastics, elastomers and thermosets, polymer

degradation and stability, polymers in the environment, and polymers for advanced technologies, such as, membrane separations, biomedical devices, electronic and photonic industry. Prerequisite: Senior standing in CHEN or consent of instructor. **(F;S;SS)**

CHEN 470. Introduction to Solids Processing and Particle Technology Credit 3(3-0)

This course is an introduction to solids processing and particle technology. Topics included are properties of particles, size reduction, size enlargement, filtration, drying of solids, crystallization and flotation. Industrial examples will be emphasized. Prerequisite: Senior standing in CHEN or consent of instructor. **(F;S;SS)**

CHEN 474. Interdisciplinary Design Credit 3(1-4)

This course gives senior students the opportunity to work in interdisciplinary teams. Lectures will include ethics, teamwork and professional practice. Student teams complete an industry-based design project that is broader in scope than is normally available in CHEN 440. An oral presentation and a written report are required. This course may be taken as a substitute for CHEN 440. Prerequisite: CHEN 430. **(F;S)**

CHEN 485. Selected Topics in Chemical Engineering Credit 3(3-0)

An in-depth lecture course covering several advanced topics in chemical engineering. Topics will be selected to match student interest and faculty expertise. A specific course description will be available at the beginning of each semester that the course is offered. Prerequisite: Senior standing in CHEN or consent of instructor. **(F;S)**

CHEN 490. Independent Study in Chemical Engineering Credit 3(0-6)

An independent study project is completed on a single topic in chemical engineering. Topics are arranged to fit the mutual interests of the student and a faculty advisor. The study includes the design of an apparatus, a process, or a procedure. Final written and oral presentations of the work to a faculty committee are required. Prerequisites: Permission of instructor. **(F;S)**

CHEN 498. Co-operative Industrial Experience in Engineering Credit 3(3-0)

This course is a supervised learning experience in a specified private or government facility. Students who have completed at least three co-op sessions with the same company may enroll in this course. Course requirements include employer evaluations of the student for each co-op session and student evaluations of the employer for each session. Written reports for each co-op session and an oral report summarizing the work experiences will be presented to a faculty committee. Prerequisite: Senior standing in engineering or permission of instructor. **(F;S;SS)**

CHEM 222 Organic Chemistry II Credits 3 (3-0)

This course is a continuation of the study of derivatives of hydrocarbons and more complex compounds. Prerequisite: CHEM 221. (F;S;SS)

CHEM 224. Organic Chemistry II Laboratory Credit 2(0-6)

This course is a continuation of Chemistry CHEM. However, more emphasis is placed on syntheses and qualitative analysis of organic compounds. Corequisite: CHEM 222. Prerequisite 223. **(F;S;SS)**

CHEM 231 Quantitative Analysis I Credits 3 (3-0)

Titrimetric and gravimetric analyses including theory and calculations associated with acid-base equilibria, oxidation-reduction, nucleation, and precipitation-complexation processes will be covered in this course. Prerequisite: CHEM 107. (F;S)

CHEM 232 Quantitative Analysis I Lab Credits 2 (0-2)

This laboratory course emphasizes the basic principles of chemical separations. Laboratory studies of gravimetric and titrimetric analyses are also encountered. Corequisite: CHEM 231. Prerequisite: CHEM 117. (S)

CHEM 411. Inorganic Chemistry (formerly CHEM 511) **Credit 3(3-0)**

This course is an introductory survey of structure and bonding in inorganic compounds; coordination compounds of the transition metals; donor-acceptor interactions; bonding theories. Prerequisite: CHEM 441. Corequisite: CHEM 442. **(S)**

CHEM 431. Quantitative Analysis II Credit 3(3-0)

This course is a study of the theory and the operational features of some of the more important instruments that are currently being used as analytical tools such as ultraviolet, visible-light, and infrared spectrophotometers, electro-analytical instruments, thermometric titrators, fluorimeters, etc. Prerequisite: CHEM 441. Corequisite: CHEM 442, 444. **(F)**

CHEM 432. Instrumental Analysis Lab Credit 2(0-4)

This laboratory course features the utilization of modern instruments such as ultraviolet, visible and infrared, and atomic absorption spectrophotometers, chromatographs (gas-liquid and liquid), electroanalyzer, and electrophoretic analyzer. Corequisite: CHEM 431. **(F;S)**

CHEM 442 Physical Chemistry II Credits 3 (3-0)

The course is a study of the fundamental concepts of quantum chemistry that include the electronic structure of atoms and chemical bonds, the interaction between atoms and molecules with light in the context of vibrational and electronic spectroscopy as well as magnetic resonance. Prerequisite: CHEM 441. (F;S)

CHEM 443 Physical Chemistry I Laboratory Credits 1 (0-1)

Thermodynamic and kinetic studies are emphasized in this course. Corequisite: CHEM 441. (F)

CHEM 444 Physical Chemistry II Laboratory **Credits 1 (0-1)**

Quantum chemistry and molecular modeling concepts are emphasized in this course. Prerequisite: None. Corequisite: CHEM 442. (F;S)

CHEM 445. Physical Chemistry III (formerly 545) **Credit 3(3-0)**

This course is a study of quantum chemistry and its application to studies of atomic and molecular structure. Prerequisite: CHEM 442. **(S)**

CHEM 451 Biotechniques in Biochemistry **Credits 3 (3-0)**

This course will emphasize the fundamental concepts and basic principles of biological chemistry. Topics will include acid-base properties of amino acids, protein structure and function, kinetic analysis of enzymatic reactions, isolation and characterization of biomolecules, recombinant DNA technology, and computer graphics and structure calculations. Prerequisite: CHEM 222 or permission of the instructor. (F)

CHEM 452 Biotechniques in Biochemistry Laboratory **Credits 2 (0-2)**

This is a laboratory course that introduces the basic principles, technologies, and instrumentation of current biochemical research. Students will acquire practical experiences, and application skills for the isolation and characterization of biomolecules. The course will encompass spectroscopic, chromatographic, electrophoretic, and recombinant DNA technologies. Error analysis and statistical analysis of experimental data will be included. Prerequisites: CHEM 224 and 252, or permission of the instructor. Corequisite: CHEM 451. (F)

CHEM 493. Independent Study (formerly CHEM 504) **Credit 4(0-10)**

This course involves independent study or research in a particular area of chemistry. Students will submit a written report and make an oral presentation with visual aids. Prerequisites: Permission of the department and advanced standing. **(F;S;SS)**

CHEM 494. Chemical Research (formerly CHEM 503) **Credit 4(0-10)**

This course makes use of the laboratory and library facilities in studying minor problems of research. Students will submit a written report and make an oral presentation with visual aids. Prerequisites: Advanced standing and permission of the Department. **(F;S;SS)**

ENGL 331 Writing for Science and Technology **Credits 3 (3-0)**

This course includes the study and practice of the basic techniques of writing and editing scientific and technical materials for both the general audience and the specialist. Prerequisite: ENGL 101. (F;S;SS)

GEEN 161 Computers Programming in MATLAB for Engineers **Credits 2 (2-0**

This course introduces computer programming using MatLab. Topics include flow chart construction and interpretation, procedural control flow, algorithm coding development, and spreadsheets. (F;S;SS)

BS CHEMICAL ENGINEERING

Freshman Year			
Semester 1 (Fall) Courses	**Cr**	**Semester 2 (Spring) Courses**	**Cr**
GEEN 111 Colloquium I – Student Success	1	CHEN 121 Intro Comp Dsgn Tools Chem Eng	1
ENGL 100 Ideas and their Expression I	3	ENGL 101 Ideas and their Expression II	3
MATH 131 Calculus I	4	MATH 132 Calculus II	4
CHEM 106 Gen. Chemistry VI	3	BIOL 101 Concepts of Biology	4
CHEM 116 Gen. Chemistry VI Lab	1	PHYS 241 General Physics I	3
GEEN 100 Engineering Design and Ethics	2	PHYS 251 General Physics I Lab	1
Semester Total	**14**	**Semester Total**	**16**
Sophomore Year			
Semester 3 (Fall) Courses	**Cr.**	**Semester 4 (Spring) Courses**	**Cr**
SBS/HFA/GL/AA*	3	SBS/HFA/GL/AA*	3
MATH 231 Calculus III	4	CHEN 226 Comp Dsgn Methods in Chem Eng	3
CHEM 107 General Chemistry VII	3	MATH 341 Intro to Differential Equations	3
CHEM 117 General Chemistry VII Lab	1	CHEM 221 Organic Chemistry I	3
CHEN 200 Chemical Process Principles	4	CHEM 223 Organic Chemistry I Lab	1
MEEN 260 Material Science	2	CHEN 218 Analysis of Chemical Process Data	3
Semester Total	**17**	**Semester Total**	***16***
Junior Year			
Semester 5 (Fall) Courses	**Cr**	**Semester 6 (Spring) Courses**	**Cr**
SBS/HFA/GL/AA*	3	CHEN 320 Heat Transfer	3
CHEN 300 Fluid Mechanics	3	CHEN 330 Chemical Engineering Lab I	2
CHEN 312 CHEN Thermodynamics	4	CHEN 340 Process Dynamics and Control	3
CHEM 441 Physical Chemistry I	3	MEEN 230 Statics and Mechanics of Materials	3
PHYS 242 General Physics II	3	ECEN 340 Electrical Circuits and Systems	3
PHYS 252 General Physics II Lab	1		
Semester Total	**17**	**Semester Total**	**14**
Senior Year			
Semester 7 (Fall) Courses	**Cr**	**Semester 8 (Spring) Courses**	**Cr**
CHEN 430 Process Design I	3	CHEN 440 Process Design II (Capstone Design)	3
CHEN 400 Mass Transfer Operations	3	CHEN 448 Process Safety, Health & Environment	3
CHEN 410 Chemical Engineering Lab II	2	CHEN Elective	3
CHEN 422 Chemical Reaction Engineering	3	Advanced CHEM Elective	3
SBS/HFA/GL/AA*	3		
Semester Total	**14**	**Semester Total**	**12**
		Program Total	**120**

Note:

To meet the general education requirements for graduation, each student must successfully complete a total of four (4) general education courses, one course from each of the following categories: Social and Behavioral Sciences (SBS), Humanities and Fine Arts (HFA), Global Awareness (GL), and African American Studies (AA).

Equivalent courses:

- Numerical Methods CHEN 226 = CHEN 220/MEEN 210
- Fluids CHEN 300 = MEEN 316
- Heat Transfer CHEN 320 = MEEN 343
- Statistics CHEN 218/BMEN 218 = ISEN 370
- CHEN 121 = GEEN 121

Minimum C- grade requirement:

- MATH 131; MATH 132; MATH 231
- PHYS 241
- CHEN 200

Repetition of courses:

- No more than 16 credit hours

Waiver of GEEN 111:

- With 30 transfer credit hours

Waiver of the 4 general education courses:

- With Associate in Arts or Associate in Science degree

BS Chemical Engineering Prerequisites and Corequisite Guide

Freshman

First Semester

Course	Prerequisites*	Corequisites**	Credits
Written Communications/ ENG 100			3
Freshman Colloquium I/GEEN 111			1
Eng. Design and Ethics/GEEN 100			2
General Chemistry VI/CHEM 106	Standardized tests or CHEM 103	CHEM 116	3
General Chemistry VI Lab/CHEM 116		CHEM 106	1
Calculus I/MATH 131	Various		4
			14

Second Semester

Course	Prerequisites	Corequisites	Credits
Written Communications/ ENG 101	ENG 100		3
Intro Comp Dsgn Tools Chem Eng/ CHEN 121	MATH 131***		1
Concepts of Biology/ BIOL 101		CHEM 106/116	4
General Physics I/PHYS 241		MATH 132, PHYS 251	3
General Physics I Lab/PHYS 251		PHYS 241	1
Calculus II/Math 132	MATH 131***		4
			16

Sophomore

First Semester

Course	Prerequisites	Corequisites	Credits
SBS or HFA[1]			3
Calculus III/ MATH 231	MATH 132		4
General Chemistry VII/CHEM 107	CHEM 106	CHEM 117	3
General Chemistry VII Lab/CHEM 117	CHEM 116	CHEM 107	1
Material Science/ MEEN 260	CHEM 106, MATH 131***		2
Chem Engr Process Principles/CHEN 200	CHEM 106, GEEN 100	CHEM 107, MATH 132, PHYS 241***	4
			17

Second Semester

Course	Prerequisites	Corequisites	Credits
SBS or HFA[1]			3
Comp Dsgn Methods in Chem Eng /CHEN 226	CHEN 200 CHEN 121		3
Analysis of Chem Process Data/CHEN 218	MATH 132***		3
Intro to Differential Equations/MATH 341	MATH 132***		3
Organic Chemistry I/ CHEM 221	CHEM 107		3
Organic Chemistry I Lab/ CHEM 223		CHEM 221	1
			16

Junior

First Semester

Course	Prerequisites	Corequisites	Credits
SBS or HFA[1]			3
Fluid Mechanics/CHEN 300	MATH 231***, PHYS 241***		3
General Physics II/ PHYS 242	PHYS 241***	PHYS 252	3
General Physics II Lab/ PHYS 252		PHYS 242	1
CHEN Thermodynamics/ CHEN 312	CHEN 200***, MATH 231***		4
Physical Chemistry I/ CHEM 441	MATH 231***, PHYS 241***, CHEM 107		3
			17

Second Semester

Course	Prerequisites	Corequisites	Credits
Heat Transfer/CHEN 320	CHEN 300, MATH 341		3
Chem Engr Lab 1/CHEN 330	CHEN 218	CHEN 320	2
Electrical Circuits and Systems/ ECEN 340	PHYS 242, MATH 341		3
Statics and Mechanics of Materials/ MEEN 230	MATH 131***, PHYS 241***		3
Process Dynamics and Control/ CHEN 340	CHEN 300, CHEN 312, MATH 341	CHEN 320	3
			14

Senior

First Semester

Course	Prerequisites	Corequisites	Credits
Mass Transfer Operations/ CHEN 400	CHEN 312, CHEN 320, CHEN 226		3
Chem Engr Lab II/ CHEN 410	CHEN 320, CHEN 330	CHEN 400, CHEN 422	2
Chemical Reaction Engineering/ CHEN 422	CHEN 312, CHEM 221, CHEN 320		3
Process Design I/ CHEN 430	CHEN 312, CHEN 320	CHEN 400, CHEN 422	3
SBS or HFA[1]			3
			14

Second Semester

Course	Prerequisites	Corequisites	Credits
Process Design II/CHEN 440	CHEN 400, CHEN 422, CHEN 430, CHEM 441	CHEN 340	3
Safety, Health & Environment/CHEN 448	CHEN Senior Standing		3
CHEN Elective			3
Advanced CHEM Elective			3
			12

*** Prerequisites must be passed before enrolling in the course.**
**** Corequisities must be taken with the course and are automatic prerequisites for any follow-up course.**
***** Course must be passed with a C- or better.**
[1] A separate three-credit course is required for each of the following four categories: Social/Behavioral Sciences (SBS), Humanities/Fine Arts (HFA), Global Awareness (GL), and Knowledge of African-American Culture and History (AA). Courses must be selected from the approved general education list of courses.