BIOENGINEERING
UNDERGRADUATE STUDENT HANDBOOK

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NORTH CAROLINA AGRICULTURAL AND TECHNICAL STATE UNIVERSITY

DEPARTMENT OF CHEMICAL, BIOLOGICAL AND BIOENGINEERING

COLLEGE OF ENGINEERING

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Notice

This handbook was prepared for use by undergraduate students in Bioengineering 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 student.

ACCREDITATION

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

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 BSBME 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 bioengineering 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 following ABET outcomes expected at the time of graduation from the Bachelor of Science in Bioengineering program will prepare graduates to attain the educational objectives.

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.

Bioengineering Curriculum Requirements for Graduation

Bioengineering 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
BMEN 220

To graduate with B.S. degree in Bioengineering 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 .....46 credits:
   Math 131, 132, 231, 341 (15 credits)
   Biology 101, 301 (8 credits)
   Chemistry 106, 116, 107, 117, 221, 223 (12 credits)
   Physics 241, 242, 251, 252 (8 credits)
   Science or Engineering Elective (3 credits)

3. Engineering Support Courses .....24 credits:
   GEEN 100, 111, 121, 161 (6 credits)
   MEEN 104, 230 (5 credits)
   ECEN 340 (3 credits)
   CHEN 300, 312 (7 credits)
   Engineering Elective (3 credits)

4. Bioengineering Courses .....32 credits
   BMEN: 220, 218, 310, 311, 320, 321, 322, 325, 411, 480, 481

B.S. BIOENGINEERING (Regular or *Innovation Option* Equivalent)

Freshman Year			
Semester 1 (Fall) Courses	**Cr**	**Semester 2 (Spring) Courses**	**Cr**
GEEN 111 Colloquium I	1	ENGL 101 Ideas & their Expressions II	3
ENGL 100 Ideas & their Expressions I	3	BIOL 101 Concepts in Biology I or *BMEN 101 Biol Fund Biomed Sci Eng*	4
CHEM 106 Gen. Chemistry VI	3	PHYS 241 General Physics I	3
CHEM 116 Gen. Chemistry VI Lab	1	PHYS 251 Physics Lab I or *BMEN 225 Biophysics Design Lab*	1
MATH 131 Calculus I	4	MATH 132 Calculus II	4
GEEN 100 Engineering Design and Ethics	2	GEEN 121 Colloquium II or *BMEN 132 Analytic Design Lab*	1
Semester Total	**14**	**Semester Total**	**16**
Sophomore Year			
Semester 3 (Fall) Courses	**Cr.**	**Semester 4 (Spring) Courses**	**Cr**
BMEN 220 Intro to Biomed Eng Desig	3	BMEN 218 Stat Chem Bio Eng Data	3
CHEM 107 Gen. Chemistry VII	3	MATH 341 Intro to Differential equations	3
CHEM 117 Gen. Chemistry VII Lab	1	CHEM 221 Organic Chemistry I	3
MATH 231 Calculus III	4	CHEM 223 Organic Chemistry I Lab or *BMEN 223 Biochemical Design Lab*	1
MEEN 104 Graphics for Engineers	2	GEEN 161 Comp Prog Matlab for Eng	2
SBS/HFA/GA/AACH*	3	SBS/HFA/GA/AACH*	3
Semester Total	**16**	**Semester Total**	**15**
Junior Year			
Semester 5 (Fall) Courses	**Cr**	**Semester 6 (Spring) Courses**	**Cr**
BMEN 310 Biomaterials	3	BMEN 320 Engineering Analysis of Human Physiological Systems	3
CHEN 300 Fluid Mechanics	3	BMEN 325 Bioengineering Lab	2
MEEN 230 Statics and Mech. of Materials	3	ECEN 340 Electrical Circuits and Systems	3
BIOL 301 Molecular Biology (4 cr) or *BMEN 350 Molecular Bioeng (3 cr) + BMEN 231 Geometric Desig Lab (1 cr)*	4	BMEN 311 Biomedical Imaging and Devices	3
PHYS 242 General Physics II	3	BMEN 321 Biomechanics	3
PHYS 252 Physics Lab II or *BMEN 252 Bio Energy Lab*	1	BMEN 322 Linear Systems in Bioengineering	3
Semester Total	**17**	**Semester Total**	**17**
Senior Year			
Semester 7 (Fall) Courses	**Cr**	**Semester 8 (Spring) Courses**	**Cr**
SBS/HFA/GA/AACH*	3	SBS/HFA/GA/AACH*	3
BMEN 480 Senior Capstone Design I	3	BMEN 481 Senior Capstone Design II	3
BMEN 411 Bio-transport	3	Advance Engineering Elective	3
CHEN 312 Thermodynamics	4	Advance Science or Engineering Elective	3
Semester Total	**13**	**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).

Innovation Courses and Regular Courses:

- BIOL 101(4) = *BMEN 101(4)*
- BIOL 301(4) = *BMEN 350 (3) + BMEN 231(1)*
- CHEM 223(1) = *BMEN 223(1)*
- PHYS 251(1) = *BMEN 225(1)*
- PHYS 252(1) = *BMEN 252(1)*

Minimum C- grade requirement:

- MATH 131; MATH 132; MATH 231
- PHYS 241
- BMEN 220

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

Major Courses Requirements

MINIMUM 'C-' GRADE POLICY

- **MATH 131; MATH 132; MATH 231**
- **PHYS 241**
- **BMEN 220**

When a bioengineering class has one or more of the above listed 5 (C- minimum) courses as it's prerequisite (s), the prerequisite course or courses must be passed with C- or higher grade before the student may take the bioengineering course. A grade of below "C-" does not satisfy this requirement.

Academic Advising

A faculty member in the Bioengineering program will serve as your academic advisor. Information about your advisor can be obtained from the CBBE office (Room 341, McNair Hall). You should consult with your advisor regarding questions about your program and course scheduling. It is important that you plan your academic program such that you graduate in the minimum possible time.

Registration

Students are supposed to register themselves. If a student has trouble registering for a course, then the student should request help from the CBBE staff in 341 McNair. Students should use the following procedure.

1. Fill in the Course Request Form available in the CBBE office by referring to the class schedule in Aggie

Access Online

2. Schedule a time to meet your advisor. Students should bring to the advising appoint their unofficial transcript, the curriculum guide that the student is following and mid-term grades or standing in the courses in which the student is currently enrolled.
3. Bring the completed Course Request Form to your advisor for approval and signature. Do not take courses out of sequence. Refer to the prerequisites indicated for each course.
4. On-line course registration can be conducted during the registration period. To learn about registration resources see https://www.ncat.edu/registrar/registration/
5. You must obtain an alternate PIN (personal identifying number) from a secretary in the CBBE Office by presenting the course request form signed by your advisor.

Checking Prerequisite/Corequisite Requirements

All BMEN students are responsible for ensuring that they are taking courses for which the prerequisite/corequisite requirements are satisfied. If a student takes a course without proper prerequisites or corequisites, he or she will receive an "F" grade in that course. To help ensure that you satisfy prerequisites, your instructors may ask you to show your grade reports to them. At the beginning of each semester, it is the student's responsibility to verify prerequisite requirements with your instructors prior to the last day to add so that you will have time to add the needed prerequisite or an equivalent course. The student must complete and sign a course request form showing the changed schedule (added classes) and have this form signed by their adviser. If no correction is made to the schedule, the department will administratively drop the student from courses where prerequisites or required C- grades have not been met.

Approved Substitute Courses

Policy on Deviations

Students generally must complete all required courses that are listed in the curriculum guide in order to receive the BS Bioengineering degree. In exceptional circumstances a student may take a course that is not listed in the program guide as a substitute for the listed course. The following courses are approved to substitute for listed courses.

BIOL 301= BMEN 350 plus one credit Lab
GEEN 161= ECEN 101, MEEN 210
MEEN 230 = MEEN231+MEEN 232
GEEN 111= FRST 101
GEEN 121= BMEN 132

Course Load

The course load in Bioengineering is 14-18 semester credit hours. For full time status, an undergraduate student is required to carry a minimum of 12 credit hours; however, carrying just this minimum load will mean that you will require more than 8 semesters to complete your degree requirements.

To enroll in more than 18 semester hours, students must have approval from the department head and the dean, and have a cumulative grade point average of 3.0 or higher, or a 3.2 semester grade point average while earning 12 or more credit hours in the semester prior to the one for which an overload is requested. The maximum course overload for any student is 21 credit hours. The maximum course load for one 5-week summer session is 7 credit hours.

The maximum course load for a student with a GPA less than 3.0 is 18 hours.

Maximum Course Load for a Student on Academic Probation

The maximum course load for a student on academic probation is 15 hours.

Repetition of Courses (University Policy)

A student who has received a passing grade of "D" or better in a course may not repeat that course. Students may repeat a course in which they earned a grade of "D" if it is a prerequisite course requiring a minimum grade of "C-", or if a minimum grade of "C-" is a requirement in the student's declared major. Students who do not receive a passing grade in a course may repeat that course. During a student's academic career at the University a maximum of 16 credit hours may be repeated.

No single undergraduate course may be repeated more than two (2) times to include withdrawals (Ws), for a maximum of three (3) attempts. All grades received will be recorded on the student's permanent academic record. Any undergraduate student who has exhausted their three (3) attempts and has not passed a required course in their major field of study will be dismissed from that major.

More details can be found in the university website:
https://www.ncat.edu/provost/academic-affairs/center-for-academic-excellence/academic-expectations.php

Academic Suspension/Readmission

A student suspended for academic reasons must stay out one full semester. A suspended student wishing to re-enroll must apply in writing, a minimum of 30 days prior to the semester for which readmission is requested. The department will support readmission requests only if the requestor and advisor have prepared an individualized comprehensive plan of study that affords the student a reasonable chance of success.

Any student who is placed on academic suspension at the end of the spring semester may attend both sessions of summer school to remove academic deficiencies. However, if the suspended student does not raise his or her grade point average to the required minimum, the student will remain suspended.

Tuition Surcharge

Please note that in an effort to improve the four-year graduation rate, the Board of Governors of the University of North Carolina system has mandated a tuition surcharge of 50 percent on students who attempt more than 140 degree credit hours to complete a four year baccalaureate degree. See the Undergraduate Bulletin for additional details relating to these requirements. https://www.ncat.edu/registrar/student-info/tuition-surcharge.html

Maximum Semester Hours Attempted

A student is eligible to continue to work toward an undergraduate degree if he or she is in good academic standing and until he or she has attended eleven (11) semesters as a full-time student (not including summer session) or until he or she has attempted 152 semester hours. At that point the student becomes ineligible to continue at the University unless approved by the Dean of the College.

Graduating Under a Given Catalog

A student may expect to earn a degree in accordance with the requirements of the curriculum outlined in the catalog in force when he or she first entered the University, provided the courses are being offered. Moreover, he or she must complete these requirements within six years. In addition, he or she may graduate under any subsequent catalog published while he or she is a student. If a student elects to meet the requirements of a catalog other than the one in force at the time of his or her original entry, he or she must meet all requirements

of the catalog he or she elects.

Transfer Students

A student who wishes to transfer into the Bioengineering Program from another accredited College or University must meet the following requirements:

1. The student must meet all of the University requirements for transfer (see the University Bulletin).
2. The student must have a cumulative GPA (grade point average) of 2.5 or above.
3. The University does not accept transfer credit for course work where grades of P/F have been given. No transfer credit is accepted for a course in which a grade below "C" was earned.
4. If the student has taken courses listed in the "Major Courses Requirements" section (including prerequisites), the student must have achieved a "C" or better in those courses listed.
5. The maximum number of transferable credits is 80 semester hours from a 4 year program and 64 semester hours from a 2 year program.

Students attending community colleges who intend to transfer to the BMEN program should be enrolled at their community college in programs for their Associate Degree in Science or Pre Engineering.

Change of Major

Students may transfer from other departments of the University to the Bioengineering Program with written approval and acceptance of the Chairperson of the Department and the Dean of the College of Engineering. The proper forms needed to apply for such a change can be obtained from the Office of the Registrar and must be executed at least six weeks prior to the beginning of the semester in which the student plans to begin the new major. New transfer students should report to the Bioengineering Chairperson or Program Director with the required form and a transcript clearly showing prior coursework, for advising. The following department requirements must be satisfied by any student considering changing his/her major to Bioengineering:

1. The student must have a 2.5 or higher overall grade point average.
2. If the student has taken courses listed in the "Major Courses Requirements" section (including prerequisites), the student must have achieved a "C-" or better in those courses listed.
3. A student may be disqualified from transferring to Bioengineering if he/she has taken any courses out of sequence or without the proper prerequisites.

Mathematics Courses

MATH 131 - Calculus I. Limits and continuity of functions, the derivative, applications of the derivative, the definite integral and applications of the definite integral will be studied. Prerequisites: MATH 102 or MATH 110 or MATH 111 or an SATM score at least 550 or an SAT Math Level II score at least 540 or an ACT Math score at least 22 or a Math Dept Precalc test score at least 17. (F;S;SS)
4 Credit hours. 4 Lecture hours

MATH 132 - Calculus II. 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)
4 Credit hours. 4 Lecture hours

MATH 231 - Calculus III. 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)
4 Credit hours. 4 Lecture hours

MATH 341 - Introduction to Differential Equations. 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)
3 Credit hours. 3 Lecture hours

Basic Sciences Courses

CHEM 106 - General Chemistry VI. 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)
3 Credit hours. 3 Lecture hours

CHEM 116 - General Chemistry VI Lab. 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
1 Credit hours. 1 Lab hour

CHEM 107 - General Chemistry VII. 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)
3 Credit hours. 3 Lecture hours

CHEM 117 - General Chemistry VII Lab. 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)
1 Credit hour. 1 Lab hour

CHEM 221 - Organic Chemistry I. 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)
3 Credit hours. 3 Lecture hours

CHEM 223 - Organic Chemistry I Lab. 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)
2 Credit hours. 2 Lab hours

BIOL 101 - Concepts in Biology I. 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)
4 Credit hours. 4 Lecture hours

BIOL 301 - Molecular Biology. This course examines the molecular events in cell function using molecular genetics, cell biology, and fundamental biochemistry; using both prokaryotic and eukaryotic systems. The laboratory will emphasize fundamental techniques used in molecular biology. Prerequisites: BIOL 101 and CHEM 107. (F;S;SS)
4 Credit hours. 4 Lecture hours

PHYS 241 - General Physics I. PHYS 241 is a calculus-based physics course that covers the fundamental principles of Newtonian mechanics, heat, and thermodynamics. Corequisites: MATH 132, PHYS 251.
3 Credit hours. 3 Lecture hours
PHYS 251 - General Physics I Lab. 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.
1 Credit hour. 1 Lab hour

PHYS 242 - General Physics II. 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)
3 Credit hours. 3 Lecture hours

PHYS 252 - General Physics II Lab. This course is a continuation of PHYS 251. Corequisite: PHYS 242. (F;S;SS)
1 Credit hour. 1 Lab hour

Engineering Courses

GEEN 100 - Engineering Design & Ethics. 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)
2 Credit hours. 2 Lecture hours

GEEN 111 - College of Engi Colloquium I. This course includes lectures, seminars, and activities important to the retention and maticulation 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)
1 Credit hour. 1 Lecture hour

GEEN 121 - College of Engi Colloquium II. 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)
1 Credit hours. 1 Lecture hours

GEEN 161 - Comp Prgm Mat Lab for Engineer. This course introduces computer programming using Mat Lab. Topics include flow chart construction and interpretation, procedural control flow, algorithm coding development, and spreadsheets. (F;S;SS)
2 Credit hours. 2 Lecture hours

MEEN 104 - Graphics For MEEN. This is an introductory course in computer aided graphics and design for mechanical engineers. This course will familiarize students with conventions of 2-D graphical representation of mechanical components and 3-D solid modeling. Prerequisites: None. (F;S)
2 Credit hours. 2 Lecture hours

MEEN 230 - Statics & Mechanics Materials. 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)
3 Credit hours. 3 Lecture hours.

ECEN 340 - Electrical Circuits and Sys. 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 (C-), MATH 341. (F;S;SS)
3 Credit hours. 3 Lecture hours

CHEN 218 - Analysis of Chemi Process Data. 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. Prerequisite: MATH 132 (With C or higher grade) (F;S)
3 Credit hours. 3 Lecture hours

CHEN 300 - Fluid Mechanics. 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 (both with C or higher). (F;S;SS)
3 Credit hours. 3 Lecture hours

CHEN 312 - Chem Engi Thermodynamics. 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 (Both with C or higher grade) or consent of instructor Corequisites. (F;S;SS)
4 Credit hours. 4 Lecture hours

Bioengineering Courses

BMEN 101. Biol Fund Biomed Sci Eng Honor **Credit 4(3-2)**
This combined lecture and laboratory course provides an introduction to biological knowledge that is useful for creation of engineering solutions to problems in biomedicine and healthcare. Lectures emphasize the fundamental bioprocesses important for production of biologics, antibiotics and bioactive chemicals, design of bioreactors, synthetic biological systems, biomimetics and engineered biomedical devices. In the laboratory, students consider real biomedical problems impacting society, and create engineered prototypes to solve the problems. Students perform experiments to test biological principles used in designs and to validate prototypes. Prerequisite: None. (F;S)

BMEN 132. Analytic Design Lab **Credit 1(0-2)**
Topics in analytical 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. In the laboratory, students apply quantitative analytical methods to engineering research and design problems. Prerequisite: MATH 131. **(F;S)**

BMEN 218. Stat Analysis of Chemical and Bio Engn 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 and biomedical engineering analysis. Statistical methods including error analysis, curve fitting and regression, analysis of variance, confidence intervals, hypothesis testing, and control charts are covered. In the laboratory, students apply analyses to contemporary engineering research and design problems. Prerequisite: MATH 132 (With C or higher grade). **(F;S)**

BMEN 220. Introduction to Biomedical Engineering Design **Credit 3(2-2)**
This course is an introduction to the application of engineering principles to solve problems in biomedicine and healthcare. Engineered approaches to diagnosis and treatment of human organ system diseases are discussed. Students examine bioethics and IP issues in emerging life science applications and research. In the laboratory, students consider a real biomedical problem and its solution criteria. Students perform experiments to test biomedical principles used in design and to evaluate a prototype. Prerequisite: BMEN 101 and MATH 131 (Both with C or higher grades). **(F;S)**

BMEN 223. Biochemical Design Lab **Credit 1(0-2)**
This laboratory course emphasizes the design of bioactive compounds and the measurement of their physical, chemical and functional properties. Modern instrumentation such as gas and column chromatography, infrared and ultraviolet analyses, and bioreactive assays are used. Corequisite: CHEM 221. **(F;S)**

BMEN 225. Biophysics Design Lab **Credit 1(0-2)**
Students perform experiments to gain research skills and understanding of biophysical fundamentals. Experimental technique and evaluation of experimental results are emphasized. Students apply biophysical principles to design and evaluate a solution to a real-world problem. Prerequisite: None. **(F;S)**

BMEN 231. Geometric Design Lab **Credit 1(0-2)**
This course covers plane curves and polar coordinates, vector and solid geometry, vector valued functions, partial differentiation, multiple integrals and vector analysis. In the laboratory, students apply quantitative geometric analyses to engineering research and design problems. Prerequisite: MATH 132. **(F;S)**

BMEN 252. Bio Energy Interactions Lab **Credit 1(0-2)**
In this course students apply physical principles to measure energy fields and their interactions with biological materials. Corequisite: PHYS 242. **(F;S)**

BMEN 310. Biomaterials **Credit 3(2-2)**
This course is designed to introduce various biomaterials such as polymers, metals, and ceramics with the focus on their synthesis, characterization, structure-property relationship and surface modification. The biocompatibility issues of biomaterials will be discussed from different aspects such as protein adsorption, foreign body reaction, immune and inflammatory response and sterilization. In the laboratory, students design processes and material compositions to enhance properties of biomaterials. Prerequisite: BIOL 101 (or BMEN 101), BMEN 220, CHEM 221. **(F;S)**

BMEN 311. Biomedical Imaging and Devices **Credit 3(2-2)**
In this course, students learn about the major imaging modalities used in clinical medicine and biomedical research. The physical principles including photon absorption, acoustic reflection, and nuclear magnetic resonance that produce contrast in each modality, and the devices, signals and analyses used to acquire images are discussed. Each student performs direct measurements on and analyzes data from living systems using an imaging system or device. Prerequisites: BMEN 220. Corequisites: BMEN 320, ECEN 340. **(F;S)**

BMEN 320. Engineering Human Physiological Systems **Credit 3(2-2)**
In this course engineering analyses are applied to cellular systems, the electrical and mechanical activity of the heart, the structure and function of the respiratory, nervous and cardiovascular systems, and basic reaction kinetics, pharmacokinetic modeling and tracer kinetics. Differential equations and quantitative predictive approaches such as those used in modeling electronics, fluid dynamics, solid mechanics and control theory describe organ system functions and parameters, integration into the larger function of homeostasis, adaptations during disease, and responses to medical devices and other therapies. In the laboratory, students design systems for measurement of human physiological parameters. Prerequisites: BMEN 220 and MATH 341. **(F;S)**

BMEN 321. Biomechanics **Credit 3(3-0)**
This course applies concepts of statics, dynamics, and mechanics of materials to human activities and tissues. Course topics will include musculoskeletal anatomy; analysis of forces in static biological systems; linear and angular dynamics of human movement; application of stress and strain analysis to biological tissues. Prerequisite: BMEN 220, MEEN 230. **(F;S)**

BMEN 322. Linear Systems in Bioengineering **Credit 3(3-0)**
Fundamentals of linear systems analysis as applied to problems in biomedical modeling and instrumentation. Topics covered include properties of biomedical systems and signals; representation of continuous- and discrete-time signals and system response; convolution; Fourier analysis in continuous and discrete domains; Laplace transform; Frequency response and its application in biomedical systems; filter design; circuit analogs to mechanical and thermodynamics systems and their applications in modeling biomedical systems; applications in biomedical instrumentation; use of MATLAB to simulate and analyze biomedical linear systems. Prerequisites: GEEN 161, BMEN 310. **(F;S)**

BMEN 325. Bioengineering Lab **Credit 2(1-2)**
This course provides the student with the ability to perform measurements on and analyze data from living systems. Principles of bioengineering are applied in multiple laboratory modules oriented toward in-vivo measurements and data analysis. Each student performs laboratory experiments and creates a professional-quality laboratory report including tables and graphs, images, data analysis, and statistics that document each module. Students identify limitations of measurement methods and design improvements. Prerequisite: BMEN 220, BMEN 218 **(F;S)**

BMEN 350. Molecular Bioengineering **Credit 3(2-2)**
This course examines the molecular basis of major cell functions, alterations caused by diseases, and the molecular mechanisms of treatments. In the laboratory, students examine biomolecules using imaging techniques and design methods to alter the molecules. Prerequisite: CHEM 107, CHEM 117 **(F;S)**

BMEN 411. Biotransport **Credit 3(3-0)**
This course explores the similarities between the fundamental principles of momentum, heat, and mass transfer, develops analogies between the fundamentals that apply at microscopic and macroscopic scales, and uses the fundamentals in conjunction with conservation laws to develop mathematical descriptions of physiological and engineering systems. Prerequisites: CHEN 300. Corequisite: CHEN 312. **(F;S)**

BMEN 412. Introduction to Tissue Engineering **Credit 3(3-0)**
This course is designed to introduce students to an understanding of tissue engineering (TE), and the biomaterials, cells and growth factors used in TE. Specific applications include skin, nerve, bone, and soft tissue regeneration. Throughout the course ties are made between the topic of study and clinically relevant situations. Prerequisites: Senior standing or consent of instructor. **(F;S)**

BMEN 421. Biomechanics of Organs, Tissues and Cells **Credit 3(3-0)**
Biomechanics encompasses the mechanics of the human body all the way to the cellular and molecular levels. This course covers the application of solid mechanics to describe the mechanical behavior of organs, soft biological tissues, and cells. The course introduces at the undergraduate level fundamental concepts and techniques of mechanics (e.g. stress, strain, constitutive relations), and of the structure and composition of tissues and cells. Prerequisites: Senior standing or consent of instructor. **(F;S)**

BMEN 480. Senior Capstone Design I **Credit 3(2-2)**
In this first course in a two-semester design course sequence, students synthesize and extend the skills and knowledge acquired during undergraduate education toward a biomedical product or service in a team environment. Students learn key facets of medical product design including needs identification, engineering standards, identification of multiple realistic constraints, user requirements, prototyping and alternative solutions. By the end of this course students have an understanding of the unique requirements of this profession. Prerequisite: BMEN 325, BMEN 310, BMEN 320, BMEN 321. **(F;S)**

BMEN 481. Senior Capstone Design II **Credit 3(1-4)**
This is the second half of the two-semester design course sequence in which the student synthesizes and extends the skills and knowledge acquired during undergraduate education toward designing a biomedical product or service. Student teams implement key facets of the medical product design process involving needs and user requirements, analyses leading to designs that meet stated constraints, appropriate codes and engineering standards, and consideration of alternative solutions. Prerequisite: BMEN 480. **(F;S)**

BMEN 485. Special Topics/Projects in Bioengineering **Credit 3(1-4)**
Selected Bioengineering topics of interest to students and faculty. The topics will be selected before the beginning of the course and will be pertinent to the programs of the students enrolled. Projects may include design, analysis, testing, and/or experimental work. Prerequisites: Senior standing in BMEN or consent of instructor. **(F;S)**

BMEN 498. Co-op Industrial Experience in Engineering **Credit 3-6(0-12)**
This course is a supervised learning experience in a private or governmental medical facility or a company that produces Biomedical products or services for the Biomedical industries. Students must complete a combination of three co-op/internships with at least one session being a semester co-op. Course requirements include the student's evaluation of each co-op/intern session and an oral report summarizing the work experiences will be presented to a faculty committee. Prerequisites: Senior standing in BMEN or consent of instructor. **(F;S)**

English Courses

ENGL 100 - Ideas & Their Expressions I. 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)
3 Credit hours. 3 Lecture hours

ENGL 101 - Ideas & Their Expressions. 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)
3 Credit hours. 3 Lecture hours

Social/Behavioral Sciences, Humanities/Fine Arts, Global Awareness, and African American Culture/History Courses

A separate three-credit course is required for each of the following: Social/Behavioral Sciences (SBS), Humanities/Fine Arts (HFA), Global Awareness (GA), and Knowledge of African-American Culture and History (AACH).
Courses must be selected from the approved general education list of courses.
The approved list is available at
https://www.ncat.edu/provost/general-education-resources/gec-list.php

Science or Engineering Elective Courses

The Bioengineering program includes 1 advanced science or engineering elective course and1 advanced engineering elective course and 1 open elective course.

Science electives must be 300-level or above and selected from courses primarily focused on the natural sciences (e.g., biology, chemistry, physics). Courses from other STEM fields such as mathematics, computer science, technology may be considered on a case-by-case basis, provided they have substantial scientific content. Engineering electives can be any 300-level or above and selected from courses offered by college of engineering.

These courses may be selected from the following list. This list will be updated as new courses are developed.

BMEN 412 - Introduction to Tissue Engi. This course is designed to introduce students to an understanding of tissue engineering (TE), and the biomaterials, cells and growth factors used in TE. Specific applications include skin, nerve, bone, and soft tissue regeneration. Throughout the course ties are made between the topic of study and clinically relevant situations. Prerequisites: Senior standing or consent of instructor. (F;S)
3 Credit hours. 3 Lecture hours

BMEN 421 - Biome of Organs, Tis, and Cell. Biomechanics encompasses the mechanics of the human body all the way to the cellular and molecular levels. This course covers the application of solid mechanics to describe the mechanical behavior of organs, soft biological tissues, and cells. The course introduces at the undergraduate level fundamental concepts and techniques of mechanics (e.g. stress, strain, constitutive relations), and of the structure and composition of tissues and cells. Prerequisites: Senior standing or consent of instructor. (F;S)
3 Credit hours. 3 Lecture hours

BMEN 485 - Special Topics/Proj in Bioen. Selected Bioengineering topics of interest to students and faculty. The topics will be selected before the beginning of the course and will be pertinent to the programs of the students enrolled. Projects may include design, analysis, testing, and/or experimental work. Prerequisites: BMEN Senior standing in or consent of instructor. (F;S)
1 to 3 Credit hours. 1 to 3 Lecture hours

BMEN 498 - Co-op Industry Experi in Engi. This course is a supervised learning experience in a private or governmental medical facility or a company that produces Biomedical products or services the Biomedical industry. Students must complete a combination of three co-op/internship with at least one session being a semester co-op. Course requirements include the student's evaluation of each co-op/intern session and an oral report summarizing the work experiences will be presented to a faculty committee. Prerequisites: Senior standing in BMEN or consent of instructor. (F;S)
3 to 6 Credit hours. 3 to 6 Lecture hours

BIOL 366 - Principles of Genetics. This course is a study of the traditional, classical areas of genetics as well as an introduction to gene action at the molecular level, including DNA and RNA structure, function and interactions in cellular systems. The laboratory features exercises with Drosophila. Prerequisite: BIOL 102, CHEM 106 and CHEM 116.Credit hours 3(2-2)

CHEM 451 - Biochemistry I. Biochemistry I- A study of the structures, properties of biological molecules, amino acids, proteins and enzymes, carbohydrates, nucleic acids, lipids, and membranes. Also the bioenergetics of biological reactions, and enzyme catalysis, with particular emphasis on the underlying chemical principles, including thermodynamics and kinetics will be included. Prerequisites. Prerequisite: CHEM 222 and BIOL 100 or BIOL 101. Credit hours 3(3-0)

CHEM 452 - Biochemistry I Laboratory. 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.
Credit hours 2(0-6)

PHYS 450 - Wave and Optics. This course explores wave phenomena. It covers the propagation, reflection, and refraction of light and includes studies of lenses and optical instruments, interference, diffraction, polarization, line spectra, and thermal radiation.
Prerequisites: PHYS 242.
Credit hours 3(3-0)

CHEN 320 - Heat Transfer. 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 (with a grade of "D" or higher).
Credits 3(2-2)

CHEN 409 - Introduction to Bioseparations. 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. Prerequisites: Senior standing in CHEN or consent of instructor.
Credit hours (3)

CHEN 455 - Engi Appli of Nanostruc Materials. 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. Prerequisites: Senior standing in CHEN, or consent of instructor.
Credit hours (3)

CHEN 465 - Introduction to Polymer Science and Engineering. 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. Senior standing or consent of instructor.
Credit hours 3(3-0)

CHEN 470 - Intro to Sol Proc and Par Tech. 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. Prerequisites: Senior standing in CHEN, or consent of instructor.
Credit hours (3)

CHEN 490 - Independent Study in CHEN. 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)

ECEN 320. Electronics I. This course is an introduction to electronic circuit design. It covers basic amplifiers, diode circuits, dc biasing and mid-frequency response of bipolar junction transistor (BJT) and field effect transistor (FET) amplifiers. The terminal behavior, and linear and nonlinear modeling of these devices are emphasized. Prerequisite: ECEN 200.
Credit 3 (3-0)

ECEN 327. Digital Logic. This course involves the study of fundamental combinational and sequential logic circuit analysis/design. Combinational concepts covered include Boolean algebra, k-maps, basic logic gates, and small/medium scale integrated circuits. Sequential concepts covered include basic latches/flip-flops, counters, memory registers, and basic synchronous systems.
Credit 3 (3-0)

ISEN 471. Ergonomics. This course introduces ergonomics and biomechanics concepts. Topics include psychomotor work capabilities, anthropometry, environmental stressors, physical workload, safety, hazard and risk factor identification, work station design, and material handling. Data collection methods and report writing are emphasized. Lab projects are required. Prerequisite: Junior standing.
Credit 2(1-2)

ISEN 472. Cognitive Human Factors Engineering. This course introduces elements of cognitive human factors. Topics include human sensation and perception, cognition, information processing, attention, signal detection theory, mental workload, and decision-making. Lab projects are required. Prerequisite: Junior standing.
Credit 2(1-2)

MEEN 360. Fundamentals of Materials Science. This course deals with the relationships between the structure of materials and their properties and performance. Topics include: (1) atomic structure and chemical bonding, (2) crystal structure, (3) defects, (4) phase diagrams, and (5) physical properties including mechanical, electrical, and magnetic. Prerequisites: CHEM 106 and MATH 131. Credit 3(3-0)

Faculty and Staff Directory

Faculty	Office	Phone	email
Dr. Knisley	342 McNair	285-2653	sbknisle@ncat.edu
Dr. Bhattarai	416 MERIC	285-3652	nbhattar@ncat.edu
Dr. Yun	417 MERIC	285-3226	yyun@ncat.edu
Dr. Yoo	119 IRC	285-3322	eyoo@ncat.edu
Dr. Chandrasekaran	347 McNair	285-3721	achandra@ncat.edu
Dr Aryal	327 McNair	285-2616	maryal@ncat.edu

Staff	Office	Phone	email
Courtney Chavis	341 McNair	285-2639	cychavis@ncat.edu
Portia Cohen	331-A McNair	285-3661	pcohen@ncat.edu
Fazazi Atchabao	107 McNair	285-3654	fatchaba@ncat.edu
Lynda McGee	345 McNair	285-2596	lmmcgee@ncat.edu

Code of Behavior for Engineering Students

As a student in the College of Engineering, you are expected to uphold the highest standards of academic integrity, professionalism, and respect. These expectations reflect both university policies and the ethical responsibilities of the engineering profession.

1. Academic Integrity

- Violations of academic integrity will be addressed according to the NCA&T Academic Dishonesty Policy and the College of Engineering Academic Integrity Committee.
- All work submitted must be your own. Cheating, plagiarism, falsification of data, or unauthorized collaboration is strictly prohibited. If generative AI is used for completion of an assignment, project, or report, it's use will be explicitly referenced and cited (See Item 4 below).
- Violations of academic integrity may result in the loss of credit for the specific assignment, quiz, individual project, or exam, or possibly a grade of "F" for the course. Repeated academic integrity violations may lead to dismissal from the University per the NCA&T Academic Dishonesty Policy and the College of Engineering Academic Integrity Committee.

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2. Respectful Conduct

- Treat all classmates, faculty, and staff with courtesy and respect.
- Disruptive behavior, harassment, or discrimination of any kind will not be tolerated.

3. Professionalism

- Demonstrate honesty, fairness, and responsibility in all academic and professional activities.
- Uphold engineering ethics: prioritize safety, health, and welfare of the public; act with integrity and impartiality.
- Students are expected to dress in a manner that supports a respectful and focused learning environment. While personal expression is valued, attire should reflect the professional standards of the engineering discipline and maintain safety requirements for labs and workshops.

4. Technology Use

- Electronic devices (phones, laptops, tablets) may only be used for class-related purposes, with explicit approval and authorization by the instructor.
- Unauthorized recording or use of devices during exams or lectures is prohibited.
- **Generative AI:** *The use of generative AI tools in the course will be at the discretion of the instructor. Students must adhere to the guidelines provided by the instructor. Violations of the AI use protocol in the course will result in the appropriate academic actions.*

5. Attendance and Participation

- Regular attendance and active participation are required.
- Notify the instructor in advance for excused absences and provide documentation when necessary.

6. Safety and Responsibility

- Follow all laboratory safety protocols, cleaning protocols for the laboratory after use, and use equipment responsibly.
- Report unsafe conditions immediately to the instructor or lab supervisor.

- All students should have supervision in laboratory or design spaces with a staff member, faculty member, graduate student, or trained designated student leader
- Exhibit a high level of awareness of the safety and security of yourself and of all classmates, faculty, and staff. Practice responsible procedures of security, including restricting access of unauthorized people to labs and buildings.

7. Compliance with University Policies

- Adhere to all university regulations, including Title IX, FERPA, and Sexual Misconduct policies.
- Adherence to the Code of Conduct expectations in the **NCA&T Student Handbook** (refer to Appendix A)**.**