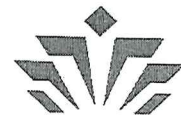


# 2014-2015 LONG SIGNATURE SHEET



UNC CHARLOTTE

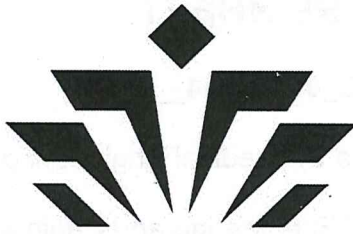
Proposal Number: MEES\_09\_04\_14

Proposal Title: Establishment of a Biomedical Engineering Concentration within Mechanical Engineering and Engineering Science

Originating Department: Mechanical Engineering and Engineering Science

TYPE OF PROPOSAL: UNDERGRADUATE X GRADUATE \_\_\_\_\_ UNDERGRADUATE & GRADUATE \_\_\_\_\_  
(Separate proposals sent to UCCC and Grad. Council)

DATE RECEIVED	DATE CONSIDERED	DATE FORWARDED	ACTION	SIGNATURES
9/4/14	9/4/14	9/4/14	Approved	<u>DEPARTMENT CHAIR</u>  [print name here:] Dr. Scott Smith
9/15/14		9/25/14	Approved	<u>COLLEGE CURRICULUM COMMITTEE CHAIR</u>  [print name here:] Dr. Nicholas Tymvios
			Approved	<u>COLLEGE FACULTY CHAIR (if applicable)</u> [print name here:]
9/25/14	9/25/14	9/25/14	Approved	<u>COLLEGE DEAN</u>  [print name here:] Dr. Bob Johnson
			Approved	<u>GENERAL EDUCATION</u> (if applicable; for General Education courses) [print name here:]
			Approved	<u>HONORS COLLEGE</u> (if applicable; for Honors courses & programs) [print name here:]
10/1/14		10/23/14	Approved	<u>UNDERGRADUATE COURSE &amp; CURRICULUM COMMITTEE CHAIR (for undergraduate content)</u> 
			Approved	<u>GRADUATE COUNCIL CHAIR</u> (for graduate content)
11/19/2014				<u>FACULTY GOVERNANCE ASSISTANT</u> (Faculty Council approval on Consent Calendar) 
				<u>FACULTY EXECUTIVE COMMITTEE</u> (if decision is appealed)



# UNC CHARLOTTE

## LONG FORM COURSE AND CURRICULUM PROPOSAL

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To: Undergraduate Course and Curriculum Committee Chair, Dr. Kim Harris

From: Dr. Gloria Elliott  
Mechanical Engineering and Engineering Science  
704-687-8365  
[gdelliot@uncc.edu](mailto:gdelliot@uncc.edu)

Date: Sept. 4<sup>th</sup>, 2014

Re: "Establishment of a Biomedical Engineering Concentration within Mechanical Engineering and Engineering Science"

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## SUMMARY

The Mechanical Engineering and Engineering Sciences Department (hereafter the MEES department) proposes to offer a Biomedical Engineering (BME) Concentration as an enhancement of the standard undergraduate degree in Mechanical Engineering. The concentration will be built upon the framework of existing classes. One new course (MEGR 2279; 1 credit), entitled "Introduction to Biomedical Engineering" will be introduced to provide cohesion to the program. Two new courses numbers (MEGR 3275 and MEGR 3276) will also be introduced in order to identify senior design projects as having a Biomedical Engineering theme. Students in these courses will attend the same lectures as students enrolled in MEGR 3255 and MEGR 3256 and will have the same deliverables, but the design project will have a Biomedical Engineering focus.

### A. JUSTIFICATION.

1. The proposal seeks to meet the high demand for a curriculum in Biomedical Engineering at UNC Charlotte, while also addressing diversity challenges within MEES and within the College of Engineering (COE).
2. Students will be admitted to the concentration in freshman year, and no admission standards above and beyond the requirements for MEES will be required. Students must be a MEES student in order to enter the concentration. Students will need to maintain an overall GPA of 3.0 to stay in the concentration.
3. Three new courses will be introduced. An "Introduction to Biomedical Engineering" class will be offered at the sophomore level, prior to students beginning senior level technical electives. The proposed course numbering (MEGR 2279) is consistent with a sophomore level class. MEGR 3275 and 3276 are proposed new course numbers for BME Senior Design 1 and 2, respectively.
4. This proposal will formalize a program of study for students that pursue Biomedical Engineering training. These students are currently advised in an ad hoc manner, and programs are self-tailored based on guidance from BME faculty. Creation of the concentration will provide formal guidance to these students, and provide a mechanism for acknowledging their thematic study.

5. Proposed technical elective courses currently being taught as specials topics are summarized below:

MEGR 3090 NANOSCALE SCIENCE AND ENGINEERING (TAUGHT SPRING 2009: 15 STUDENTS, SPRING 2012: 6 STUDENTS, SPRING 2013: 23 STUDENTS)

MEGR 3090 BIOLOGICAL THERMODYNAMICS (FIRST OFFERING SPRING 2015, ENROLLMENT TBD)

MEGR 3090 MICROSCOPY FOR ENGINEERING (FIRST OFFERING FALL 2014, 6 STUDENTS)

MEGR 3090 DESIGN AND MODELLING OF MICROELECTROMECHANICAL SYSTEMS (TAUGHT FALL 2014: 5 STUDENTS, SPRING 2014: 7 STUDENTS, SPRING 2007, 3 STUDENTS)

Overall women are earning 19% of the undergraduate engineering degrees that are being awarded in the nation, and the trend is increasing. Within the disciplines of Environmental Engineering (45.5%) and Biomedical Engineering (39.2%) these percentages are approaching parity, while Mechanical Engineering is still considerably lower, with a national average of 12.4%<sup>1</sup>. In 2012-2013, the number of Mechanical Engineering degrees awarded to women at UNC Charlotte was 6.3% (5 year average: 9.8%), approximately half of the national average, and on a declining trend<sup>2</sup>. The offering of undergraduate programs focused on Biomedical Engineering represents considerable opportunity to impact historical diversity challenges within the College of Engineering.

Development of more educational programs in the Biomedical Engineering area would also allow us to prepare students for the local job market. In North Carolina, economic growth in the BioSciences sector is 3.5 times the national average<sup>3</sup>. Charlotte is also home to a large cluster of Biomedical Device companies, and with the planned growth at Carolinas Medical Center towards increasing clinical trials, the demand for Biomedical Engineering talent will only increase.

Student interest in this discipline remains high amongst potential recruits, incoming freshman, and existing students. Biomedical faculty are active participants in both the summer Research Experience for Undergraduates programs, and senior design projects, and these projects are always in high demand with students.

1. Bryan L. Yoder, "Engineering by the Numbers", publication 11-47 by ASEE.org
2. "Attracting, Retaining, and Advancing Women in Undergraduate Computing", Report prepared by NCWIT Extension and Services as part of grant to UNC CHARLOTTE.
3. [www.NCBIotech.org](http://www.NCBIotech.org), accessed July 17<sup>th</sup>, 1014

**B. IMPACT.** Changes to courses and curricula often have impacts both within the proposing department as well as campus-wide. What effect will this proposal have on existing courses and curricula, students, and other departments/units? Submit an Impact Statement that fully addresses how you have assessed potential impacts and what the impacts of this proposal might be. Consider the following:

1. **Students served.** There will be two groups of students served by this proposal: i) existing Mechanical Engineering students that currently study Biomedical Engineering informally, via existing electives, participation in research laboratory projects and SREU programs, and

by choosing senior design projects with a Biomedical Engineering theme and ii) high school students who are considering UNC Charlotte but decline due to the lack of a formal Biomedical Engineering program.

**2. Effect of the proposal have on existing courses and curricula.**

a. The current offering of technical electives ensures that there are a minimum of two BME approved technical electives available every semester. As we have done when we have offered other new concentrations within the department, MEGR 2279 will be offered for several semesters in a row in order to grandfather in students that have the requirements for the concentration, but need this class to complete the concentration requirements. After that time, the class will be taught once a year.

b. There will be no effect on the content and/or frequency of offering of other courses.

c. The anticipated enrollment in MEGR 2279 is 20-25 students.

d. As the MEGR 2279 class is an add-on to the existing course requirements for the MEES degree, it is not expected that enrollment in other courses will be affected by the addition of this class. It is possible that the identification of some of the electives as BME approved electives will boost enrollment in those classes by a few students, thus other electives may see a moderate decrease. Some of the proposed BME technical electives are struggling with low enrollment, so a boost in enrollment would be a good outcome. Enrollment increases in MEGR 3275 and MEGR 3276 should be mirrored exactly by a decrease in enrollment in MEGR 3255 and MEGR 3256. As all students will be taught in the same classroom, there will be not net change in the physical resources required, but course management will be significantly improved by the formal identification of BME projects and students.

e. The catalog copy would need to be updated to include the concentration, and the proposed new MEGR courses would also need to be added. No changes to the catalog copy outside of the MEGR section is anticipated.

**III. RESOURCES REQUIRED TO SUPPORT PROPOSAL.**

**A. PERSONNEL.** Instructor needed for MEGR 2279, Intro to Biomedical Engineering. MEES faculty able to teach this class: Gloria Elliott, Charles Lee, Nigel Zheng, Ahmed El-Ghannam, Hansang Cho

- B. PHYSICAL FACILITY.** Adequate space is available within MEES to teach MEGR 2279. All other course have already been accommodated.
- C. EQUIPMENT AND SUPPLIES:** No new resources needed to establish the concentration. There will only be one new course with new content introduced and it will be a lecture format.
- D. COMPUTER.** No new resources needed to establish the concentration.
- E. AUDIO-VISUAL.** No new resources needed to establish the concentration. Classrooms and Mosaic labs are already adequately equipped.
- F. OTHER RESOURCES.** Communication, printing and binding costs can be accommodated within the department budget, as has been the case for the others concentrations established within the department.
- G. SOURCE OF FUNDING.** No new financial resources are needed to establish the concentration.

#### IV. CONSULTATION WITH THE LIBRARY AND OTHER DEPARTMENTS OR UNITS

- A. LIBRARY CONSULTATION.** The librarian in charge of Engineering holdings, Mr. Jeffrey MacAdams was consulted to review the Biomedical Engineering holdings. Copy of Consultation on Library Holdings attached.

- B. CONSULTATION WITH OTHER DEPARTMENTS OR UNITS.**

Consultations with faculty and administrative staff in the department of Biology have been ongoing over several months, in order to identify the best freshman course option for BME students, and to circumvent potential enrollment problems. The issue debated was the suitability of BIOL 1110 versus BIOL 2120 as the preferred course for BME students. BIOL 2120 has high standards for admission that BME students can likely meet, but there is an issue of capacity. Biology majors are given priority enrollment for BIOL 2120 and it often fills to capacity early in the registration process. A potential mechanism for identifying and enrolling BME students that meet the entrance requirements was discussed, but capacity issues were still a major concern. It was decided that we would identify both BIOL 1110 and BIOL 2120 as meeting the BME concentration requirement, but enrollment in BIOL 2120 would be encouraged. If capacity problems can be overcome in future years, we will revisit this requirement at a future time, with the possibility of restricting the requirement to BIOL 2120.

Persons contacted on this issue included:

Dr. Martin Klotz, Chair of Biology  
Dr. Stan Schneider, Academic Vice Chair, BIOL 2120 Instructor, Biology  
Dr. Sue Peters, Undergraduate Advising, Biology  
Dr. Tonya Bates, Undergraduate Advising, Biology

Dr. Jennifer Warner, BIOL 2120 Instructor, Biology  
Dr. Mark Clemens, upper level Instructor, Biology

Another issue that was discussed with other units, was the issue of timing for entry into the concentration. With the other concentrations within Mechanical Engineering, entry occurs in the sophomore year. Because of the desire to provide early counselling to Biomedical Engineering students, and to be able to identify these students for possible preferred entry into certain courses that have enrollment problems, it was proposed that providing entry to the concentration at the same time as the students apply for the major would be the best route. Discussions with both Patty Tolley and Gina Robinson ensured that there were no significant challenges to this approach, and they would be able to accommodate enrolling and tracking students within the first year. A 3.0 GPA in the major will be required to stay in the concentration. This requirement will be monitored by the MEES department.

Dr. Kevin Lawton, Undergraduate Advisor, Mechanical Engineering,  
Dr. Patty Tolly, Associate Dean of Engineering,  
Ms. Gina Robinson, Director of Recruiting and Freshman Advising, College of Engineering

(Consultations with Dr. Lawton were frequent and ongoing over the past year. Consultations with Dr. Tolley and Gina Robinson occurred during the last week of August, 2014)

- C. **HONORS COUNCIL CONSULTATION**. In the case of Honors courses or Honors programs indicate written consultation with the Honors Council (if applicable).

## V. INITIATION, ATTACHMENTS AND CONSIDERATION OF THE PROPOSAL

### A. **ORIGINATING UNIT**.

The BME concentration was prepared in consultation with all core BME faculty (Elliott, Lee, El-Ghannam, Zheng, and Cho) and at the request of the department chair, Dr. Scott Smith. The plan was drafted with guidance from the undergraduate co-ordinator, Dr. Kevin Lawton, and the Senior Associate Dean of the College of Engineering, Dr. Ronald Smelser. The plan was presented at the MEES faculty meeting on Sept. 4<sup>th</sup>, 2014, to solicit final input. The plan was approved by a hand vote (29/29 faculty members present voted in favor of the proposal).

### B. **CREDIT HOUR**.

One new credit hour is proposed in order to introduce the new course MEGR 2279, Introduction to Biomedical Engineering

Review statement and check box once completed:

- The appropriate faculty committee has reviewed the course outline/syllabus and has determined that the assignments are sufficient to meet the University definition of a credit hour.

C. ATTACHMENTS.

1. CONSULTATION: Attach relevant documentation of consultations with other units.
2. COURSE OUTLINE/SYLLABUS: For undergraduate courses attach course outline(s) including basic topics to be covered and suggested textbooks and reference materials with dates of publication. For Graduate Courses attach a course syllabus. Please see Boiler Plate for Syllabi for New/Revised Graduate Courses.

(See attached syllabus for proposed course MEGR 2279)

3. PROPOSED CATALOG COPY: Copy should be provided for all courses in the proposal. Include current subject prefixes and course numbers, full titles, credit hours, prerequisites and/or corequisites, concise descriptions, and an indication of when the courses are to be offered as to semesters and day/evening/weekend. Copy and paste the current catalog copy and use the Microsoft Word "track changes" feature (or use red text with "strikethrough" formatting for text to be deleted, and adding blue text with "underline" formatting for text to be added).

*NEW CATALOG COPY:*

## **Bachelor of Science in Mechanical Engineering (B.S.M.E.) with Concentration in Biomedical Engineering**

A major in Mechanical Engineering with a Concentration in Biomedical Engineering consists of a total of 127 credit hours. The B.S.M.E. with a Concentration in Biomedical Engineering program is intended for students interested in specialized and systematic training and education in the area of Biomedical Engineering. Students completing the requirements described in this program receive a special designation on their transcripts showing that they have completed the Concentration in Biomedical Engineering.

Students may apply for admission and may enter the program during their Freshman year, but must maintain an overall GPA of 3.0 to remain in the concentration beyond the freshman year.

### **Degree Requirements**

**General Education Courses (21 hours)**



- ECON 2101 Principles of Economics – Macro (3) or ECON 2102 Principles of Economics – Micro (3)
- LBST 110X The Arts & Society (3)
- LBST 2101 Western Cultural and Historical Awareness (3)
- LBST 2102 Global and Intercultural Connections (3)
- LBST 221X Ethical and Cultural Critique (3)
- UWRT 1101 Writing and Inquiry in Academic Contexts I (3)
- UWRT 1102 Writing and Inquiry in Academic Contexts II (3)

**Mathematics and Science Courses (24 hours)**

- CHEM 1251 General Chemistry I (3)
- CHEM 1251L General Chemistry I Lab (1)
- MATH 1241 Calculus I (3)
- MATH 1242 Calculus II (3)
- MATH 2171 Differential Equations (3)
- MATH 2241 Calculus III (3)
- PHYS 2101 Physics for Science and Engineering I (3)
- PHYS 2101L Physics for Science and Engineering I Lab (1)
- PHYS 2102 Physics for Science and Engineering II (3)
- PHYS 2102L Physics for Science and Engineering II Lab (1)

**Major Courses (64 hours)**

- ECGR 2161 Basic Electrical Engineering I (3)
- ENGR 1201 Introduction to Engineering Practices and Principles I (2)
- ENGR 1202 Introduction to Engineering Practices and Principles II (2)
- ENGR 3295 Multidisciplinary Professional Development (1)
- MEGR 2141 Engineering Mechanics I (3)
- MEGR 2144 Solid Mechanics (3)
- MEGR 2156 Design Projects Lab I (2)
- MEGR 2180 Manufacturing Systems (3)

- MEGR 2240 Computational Methods (3)
- MEGR 2279 Introduction to Biomedical Engineering (1)
- MEGR 3111 Thermodynamics I (3)
- MEGR 3112 Thermodynamics II (3)
- MEGR 3114 Fluid Mechanics (3)
- MEGR 3116 Heat Transfer (3)
- MEGR 3121 Dynamic Systems I (3)
- MEGR 3122 Dynamic Systems II (3)
- MEGR 3152 Mechanics and Materials Lab (2)
- MEGR 3156 Design Project Lab II (2)
- MEGR 3161 Engineering Materials (3)
- MEGR 3171 Measurements and Instrumentation (2)
- MEGR 3171L Instrumentation Lab (2)
- MEGR 3216 Thermal/Fluids Design (3)
- MEGR 3221 Machine Analysis and Design (3)
- MEGR 3251 Thermal/Fluids Lab (2)
- MEGR 3275 Biomedical Engineering Senior Design I (2)\*
- MEGR 3276 Biomedical Engineering Senior Design II (2)\*

*\*Must be an approved Biomedical Engineering-related project.*

**Electives (18 hours)**

- Science Elective (3)\*
- Math Elective (3)\*\*
- Biomedical Engineering Technical Elective (3)\*\*\*
- Biomedical Engineering Technical Elective (3)\*\*\*
- Biomedical Engineering Technical Elective (3)\*\*\*
- Biomedical Engineering Technical Elective (3)\*\*\*

*\*The Science Elective is selected from the following:*

- *BIOL 1110 Principles of Biology I (3)*
- *BIOL 2120 General Biology I (3)*

**\*\*All MEGR students are required to complete: a) a math elective and b) a course with appropriate statistics content. Two options are available:**

*Option 1:*

- *STAT 3128 Probability and Statistics for Engineers (3)*

*Option 2:*

- *MEGR 3282 Statistical Process Control and Metrology (3) (which counts as one Energy Technical Elective), and*
- *MATH 2164 Matrices and Linear Algebra (3)*
- *or MATH 3171 Applied Mathematics (3) (the math elective will not also count as a technical elective)*

**\*\*\*A list of approved Biomedical Engineering Technical Electives is available from the Department of Mechanical Engineering and Engineering Science.**

**NEW CATALOG COPY:**

**MEGR 2279. Introduction to Biomedical Engineering. (1)** Prerequisites: Admission to BSME Biomedical Engineering concentration, GPA of 3.0 or above. An examination of various aspects of Biomedical Engineering.

**MEGR 3275. Biomedical Engineering Senior Design I. (2)** Prerequisites: Admission to Biomedical Engineering concentration; Senior standing in Mechanical Engineering; MEGR 2299 and MEGR 3156, and MEGR 3171L, all with grades of C or above. Pre- or corequisites: MEGR 3152 and MEGR 3251. First of a two-semester sequence leading to a major integrative experience in applying the principles of design and project management to the design of a biomedical engineering system or the solution of a biomedical engineering problem. Teamwork and communication skills are emphasized.

**MEGR 3276. Biomedical Engineering Senior Design II. (2) (O)** Prerequisites: Admission to Biomedical Engineering concentration and MEGR 3275. A continuation of MEGR 3275 including project execution, project reporting and leading to an oral presentation and a final written report.

a. For a new course or revisions to an existing course, check all the statements that apply:

- This course will be cross listed with another course.
- There are prerequisites for this course.
- There are corequisites for this course.
- This course is repeatable for credit.

X This course will increase/decrease the number of credits hours currently offered by its program.

This proposal results in the deletion of an existing course(s) from the degree program and/or catalog.

For all items checked above, applicable statements and content must be reflected in the proposed catalog copy.

*b.* If overall proposal is for a new degree program that requires approval from General Administration, please contact the [facultygovernance@uncc.edu](mailto:facultygovernance@uncc.edu) for consultation on catalog copy.

4. ACADEMIC PLAN OF STUDY (UNDERGRADUATE ONLY): Does the proposed change impact an existing Academic Plan of Study?

X Yes. If yes, please provide updated Academic Plan of Study in template format.

No.

5. STUDENT LEARNING OUTCOMES (UNDERGRADUATE & GRADUATE):

Does this course or curricular change require a change in Student Learning Outcomes (SLOs) or assessment for the degree program?

X Yes. If yes, please provide updated SLOs in template format.

**New Outcome:**

“BME concentration students, upon graduation, will be able to apply the fundamentals of mechanical engineering to solve problems in the fields of biology, medicine, and/or sports.”

6. TEXTBOOK COSTS: It is the policy of the Board of Governors to reduce textbook costs for students whenever possible. Have electronic textbooks, textbook rentals, or the buyback program been considered and adopted?

X Yes. Briefly explain below.

No. Briefly explain below.

Textbook adoptions for classes are reviewed continuously by the MEES Focus Area Improvement Teams (FAITs), which considers textbooks costs. All courses in this proposal are subject to such review.

**IMPORTANT NOTE:** A Microsoft Word version of the final course and curriculum proposal should be sent to [facultygovernance@uncc.edu](mailto:facultygovernance@uncc.edu) upon approval by the Undergraduate Course and Curriculum Committee and/or Graduate Council chair.

Attachments:

- A. Course Syllabus for MEGR 2279
- B. New Plan of Study: BSME with a Biomedical Engineering Concentration
- C. Consultation with the Library form

**MEGR 2279**  
**Introduction to Biomedical Engineering**  
1 Credit, 1 contact hour per week

**Description:**

This course teaches the application of engineering principles in medicine, biology, and surgery, provides an overview of the sub-specialties within biomedical engineering, and emphasizes the types of problems biomedical engineers solve.

The topics include:

1. Complex Organism Organization: Molecule to Organism
2. Contemporary Problems in Biomechanics
3. Contemporary Problems in Biomaterials
4. Contemporary Problems in Biotransport
5. Contemporary Problems in Bioimaging
6. Contemporary Problems in Biomolecular Engineering

**Prerequisites:** CHEM 1251, PHYS 2101

**Objectives:** To understand how the basic concepts of mechanics, materials, and transport are applied to solve Biomedical Engineering problems.

**Recommended Textbook(s):**

1. **Biomedical Engineering: Bridging Medicine and Technology**, Editor: Cambridge Texts in Biomedical Engineering, 2009, by W. Mark Saltzman ISBN-10: 0521840996, ISBN-13: 978-0521840996
2. **Introduction to Biomedical Engineering**, Editor: Academic Press, Third Edition, 2011, by John Enderle and Joseph Bronzino ISBN-10: 0123749794, ISBN-13: 978-0123749796

**Course Learning Outcomes:**

1. Understand the fundamental principles and physiological applications of mechanics, materials, and transport in Biomedical Engineering.
2. Apply knowledge of math, engineering and science to identify, formulate, and solve problems in Biomedical Engineering.
3. Be capable of reading, comprehending, and communicating the content of contemporary technical articles within the sub-specialties of biomechanics, biomaterials, and biotransport.

## PROGRAM SUMMARY

- **Credit Hours:** 126 hours (or 127 hours with a concentration)
- **Concentrations:** Motorsports Engineering; Energy Engineering
- **Declaring the Major:** Freshmen can request entry into the major when applying to the university, but must complete the freshman curriculum within three semesters with a minimum overall GPA of 2.50. Transfer students are required to have a minimum overall GPA of 2.50 and grade of C or higher in pre-calculus or higher math.
- **Advising (For the Major):** Participation in academic advising is mandatory. Freshmen are advised by the Office of Student Development and Success, while sophomores and upper classmen are advised within the department.
- **Advising (For General Education):** General education and major requirements are addressed in academic advising.
- **Minimum Grades/GPA:** Students are required to maintain from the sophomore year through graduation: 2.00 overall GPA and 2.00 major GPA. Students are also required to successfully complete courses within three attempts.
- **Teacher Licensure:** No
- **Evening Classes Available:** Some evening classes are available.
- **Weekend Classes Available:** No
- **Other Information:** No
- **Contact(s):** Department of Mechanical Engineering and Engineering Science, Duke Centennial Hall 380, 704-687-8253

## PROGRAM REQUIREMENTS

The Bachelor of Science in Mechanical Engineering program is accredited by ABET. The BSME curriculum is a four-year curriculum that prepares graduates for careers in the field of mechanical engineering and/or further studies at the graduate level.

Mechanical engineering is possibly the broadest of the engineering disciplines. Among the major concerns of the mechanical engineer are problems related to conversion, utilization, and conservation of our limited energy resources. Additional important areas for the mechanical engineer include the design and analysis of machines, structures, and manufacturing processes related to the industrial output of the nation. Increasingly, this design and analysis is computer based using the techniques of computer-aided design (CAD/CAM).

A sound understanding of the engineering sciences is fundamental to the education of engineers in every discipline. The engineering sciences are generally identified as those areas of engineering that emphasize the application of the fundamental principles of the physical sciences, primarily physics and chemistry, to engineering problems. Some classical and emerging engineering areas that fall within this field include thermodynamics, fluid mechanics, engineering mechanics, engineering materials, nuclear and chemical sciences, microelectronics theory and fabrication, manufacturing, metrology, and the solid state sciences.

Minimum criteria for continuation and graduation are:

- a minimum overall GPA of 2.00
- a minimum GPA of 2.00 in engineering courses
- successful completion of all courses within three attempts

Concentrations within the program include **Biomedical Engineering**, Motorsports Engineering and Energy Engineering. For each concentration, students take an additional one-credit course and focus their technical electives and senior design work within the given area.

The Energy Engineering concentration is intended for students interested in specialized and systematic training and education in the area of power generation. Students completing the requirements described in this program will receive a special designation on their transcripts showing that they have completed the Energy Engineering concentration. Students must apply for admission and may enter the program during their sophomore or junior years only. To be admitted to the concentration, students must have completed Physics I (PHYS 2101 and 2101L), Calculus I, II, and III (MATH 1241, 1242, and 2241), and Engineering Mechanics I (MEGR 2141), all with a grade of C or above and have a minimum GPA of 3.0. In order to remain in the concentration a minimum (overall and program) GPA of 3.0 must be maintained.

The Motorsports Engineering concentration is intended for students interested in specialized and systematic training and education in the area of automotive engineering as it pertains to motorsports. Students completing the requirements described in this program will receive a special designation on their transcripts showing that they have completed the Motorsports Engineering concentration. Students must apply for admission and may enter the program during the sophomore or junior years only. To be admitted to the concentration students must have completed PHYS 2101, PHYS 2101L, MATH 1242, ENGR 1202, and UWRT 1102 (or UWRT 1103), all with grades of C or above and have a minimum GPA of 2.5.

The Biomedical Engineering concentration is intended for students interested in specialized and systematic training and education in the area of biomedical engineering. Students completing the requirements described in this program will receive a special designation on their transcripts showing that they have completed the Biomedical Engineering concentration. Students may declare the concentration as entering freshmen, or they may apply for admission to the concentration during their freshman, sophomore or junior years only. In order to remain in the concentration a minimum overall GPA of 3.0 must be maintained.

Areas	Credit Hours	Description
Pre-Major/ Prerequisites	0	DNA
Major	96	Required courses also fulfill the General Education Communication Skills requirements (Written and Oral Communication).
General Education <i>(not satisfied by other major requirements)</i>	12	These four courses fulfill the General Education Liberal Education requirements: LBST 110X, LBST 2101, LBST 2102, and LBST 221X.
Related Work	0	DNA
Foreign Language	0	DNA
Science Elective	3	Chosen from BIOL 1110, <b>BIOL 2120</b> , CHEM 1252, GEOL 1200 or PHYS 1130
Math Elective	3	*
Electives	12	**Four technical electives provide depth of learning in chosen areas.
Total Credit Hours	126	127 hours with a concentration in either Motorsports Engineering or Energy Engineering

\*All MEGR students are required to complete: a) a math elective and b) a course with appropriate statistics content. Option 1 for fulfilling the combination of the math elective and the statistics requirement is STAT 3128. Option 2 is to use the technical elective MEGR 3282 to fulfill the statistics requirement while also taking MATH 2164 or MATH 3171 as the math elective. The math elective will not also count as a technical elective. For either option, five courses are required to fulfill the requirements of math, statistics and technical electives.

Option 1 – STAT 3128 fulfills math elective and statistics requirements (plus students will need four technical electives).

Option 2 – MEGR 3282 plus MATH 2164 or MATH 3171 (plus students will need three additional technical electives).

\*\*Lists of technical electives, including those approved for the Motorsports Engineering Concentration and the Energy Engineering Concentration, are available in the office of the Department of Mechanical Engineering and Engineering Science. Many technical electives are offered once per year.



# PLAN OF STUDY - BSME

Freshman Year					
Course Number	Course Title	Credit Hours	General Education	W/O Course	Notes
<i>Fall Semester</i>					
ENGR 1201	Introduction to Engineering I	2			Grade of C or better required
CHEM 1251	Chemistry I	3	X		Grade of C or better required
CHEM 1251L	Chemistry I Lab	1	X		Grade of C or better required
MATH 1241	Calculus I	3	X		Grade of C or better required
UWRT 1101	Writing and Inquiry in Academic Contexts I	3	X		Grade of C or better required
LBST 11XX	LBST 1100 Series: Arts and Society	3	X		Grade of C or better required
<i>Spring Semester</i>					
ENGR 1202	Introduction to Engineering II	2			Grade of C or better required
PHYS 2101	Physics I	3	X		Grade of C or better required
PHYS 2101L	Physics I Lab	1			Grade of C or better required
MATH 1242	Calculus II	3	X		Grade of C or better required
UWRT 1102	Writing and Inquiry in Academic Contexts II	3	X		Grade of C or better required
XXXX XXXX	Science Elective	3			

30 Credit Hours for Year

Sophomore Year					
Course Number	Course Title	Credit Hours	General Education	W/O Course	Notes
<i>Fall Semester</i>					
PHYS 2102	Physics II	3			Grade of C or better required
PHYS 2102L	Physics II Lab	1			Grade of C or better required
MEGR 2141	Engineering Mechanics I	3			Grade of C or better required
MATH 2171	Differential Equations	3			Grade of C or better required
ECON 2101 or 2102	Macro Economics or Micro Economics	3	X		
LBST 2101	Western Cultural and Historical Awareness	3	X		
<i>Spring Semester</i>					
MEGR 2180	Manufacturing Systems	3			Grade of C or better required
MEGR 2156	Design Projects Laboratory I	2			Grade of C or better required
MEGR 2144	Introduction to Solid Mechanics	3			Grade of C or better required
MATH 2241	Calculus III	3			Grade of C or better required
ECGR 2161	Basic Electrical Engineering	3			Grade of C or better required
MEGR 2240	Computational Methods for Engineers	3			Grade of C or better required

33 Credit Hours for Year

Junior Year					
Course Number	Course Title	Credit Hours	General Education	W/O Course	Notes
<i>Fall Semester</i>					
MEGR 3111	Thermodynamics I	3			Grade of C or better required
MEGR 3121	Dynamic Systems I	3			Grade of C or better required
MEGR 3161	Introduction to Engineering Materials	3			Grade of C or better required
XXXX XXXX	Mechanical Engineering Technical Elective	3			May also be taken in the seventh semester
MEGR 3171	Introduction to Measurements and Instrumentation	2			
MEGR 3171L	Instrumentation Laboratory	2	X	W	Grade of C or better required
<i>Spring Semester</i>					
MEGR 3112	Thermodynamics II	3			Grade of C or better required
MEGR 3122	Dynamic Systems II	3			Grade of C or better required
MEGR 3116	Introduction to Heat Transfer	3			Grade of C or better required
MEGR 3156	Design Projects Lab II	2			Grade of C or better required
MEGR 3114	Fluid Mechanics	3			Grade of C or better required
MEGR 3152	Mechanics and Materials Laboratory	2	X	W	Grade of C or better required

32 Credit Hours for Year

Senior Year					
Course Number	Course Title	Credit Hours	General Education	W/O Course	Notes
<i>Fall Semester</i>					
MEGR 3255	Senior Design I	2			
XXXX XXXX	Mechanical Engineering Technical Elective	3			
MATH XXXX	Math Elective	3			May also be taken in the fifth semester
LBST 2102	Global and Intercultural Connections	3	X		
MEGR 3221	Machine Analysis and Design I	3			
MEGR 3251	Thermal/Fluids Laboratory	2	X	W	
ENGR 3295	Professional Development	1			
<i>Spring Semester</i>					
MEGR 3256	Senior Design II	2	X	O	
XXXX XXXX	Mechanical Engineering Technical Elective	3			
XXXX XXXX	Mechanical Engineering Technical Elective	3			
LBST 22XX	LBST 2200 Series: Ethical Issues and Cultural Critique	3	X		
MEGR 3216	Thermal/Fluid Design	3			

31 Credit Hours for Year

## PLAN OF STUDY – BSME WITH CONCENTRATION IN MOTORSPORTS ENGINEERING

Freshman Year					
Course Number	Course Title	Credit Hours	General Education	W/O Course	Notes
<i>Fall Semester</i>					
ENGR 1201	Introduction to Engineering I	2			Grade of C or better required
CHEM 1251	Chemistry I	3	X		Grade of C or better required
CHEM 1251L	Chemistry I Lab	1	X		Grade of C or better required
MATH 1241	Calculus I	3	X		Grade of C or better required
UWRT 1101	Writing and Inquiry in Academic Contexts I	3	X		Grade of C or better required
LBST 11XX	LBST 1100 Series: Arts and Society	3	X		Grade of C or better required
<i>Spring Semester</i>					
ENGR 1202	Introduction to Engineering II	2			Grade of C or better required
PHYS 2101	Physics I	3	X		Grade of C or better required
PHYS 2101L	Physics I Lab	1			Grade of C or better required
MATH 1242	Calculus II	3	X		Grade of C or better required
UWRT 1102	Writing and Inquiry in Academic Contexts II	3	X		Grade of C or better required
XXXX XXXX	Science Elective	3			Grade of C or better required

30 Credit Hours for Year

Sophomore Year					
Course Number	Course Title	Credit Hours	General Education	W/O Course	Notes
<i>Fall Semester</i>					
PHYS 2102	Physics II	3			Grade of C or better required
PHYS 2102L	Physics II Lab	1			Grade of C or better required
MEGR 2141	Engineering Mechanics I	3			Grade of C or better required
MATH 2171	Differential Equations	3			Grade of C or better required
ECON 2101 or 2102	Macro Economics or Micro Economics	3	X		
LBST 2101	Western Cultural and Historical Awareness	3	X		
MEGR 2299	Introduction to Motorsports Engineering	1			Grade of C or better required
<i>Spring Semester</i>					
MEGR 2180	Manufacturing Systems	3			Grade of C or better required
MEGR 2156	Design Projects Laboratory I	2			Grade of C or better required
MEGR 2144	Introduction to Solid Mechanics	3			Grade of C or better required
MATH 2241	Calculus III	3			Grade of C or better required
ECGR 2161	Basic Electrical Engineering	3			Grade of C or better required
MEGR 2240	Computational Methods for Engineers	3			Grade of C or better required

34 Credit Hours for Year

Junior Year					
Course Number	Course Title	Credit Hours	General Education	W/O Course	Notes
<i>Fall Semester</i>					
MEGR 3111	Thermodynamics I	3			Grade of C or better required
MEGR 3121	Dynamic Systems I	3			Grade of C or better required
MEGR 3161	Introduction to Engineering Materials	3			Grade of C or better required
XXXX XXXX	Motorsports Technical Elective	3			Grade of C or better required
MEGR 3171	Introduction to Measurements and Instrumentation	2			May also be taken in the seventh semester
MEGR 3171L	Instrumentation Laboratory	2	X	W	Grade of C or better required
<i>Spring Semester</i>					
MEGR 3112	Thermodynamics II	3			Grade of C or better required
MEGR 3122	Dynamic Systems II	3			Grade of C or better required
MEGR 3116	Introduction to Heat Transfer	3			Grade of C or better required
MEGR 3156	Design Projects Lab II	2			Grade of C or better required
MEGR 3114	Fluid Mechanics	3			Grade of C or better required
MEGR 3152	Mechanics and Materials Laboratory	2	X	W	Grade of C or better required

32 Credit Hours for Year

Senior Year					
Course Number	Course Title	Credit Hours	General Education	W/O Course	Notes
<i>Fall Semester</i>					
MEGR 3355	Motorsports Senior Design I	2			
XXXX XXXX	Motorsports Technical Elective	3			
MATH XXXX	Math Elective	3			May also be taken in the fifth semester
LBST 2102	Global and Intercultural Connections	3	X		
MEGR 3221	Machine Analysis and Design I	3			
MEGR 3251	Thermal/Fluids Laboratory	2	X	W	
ENGR 3295	Professional Development	1			
<i>Spring Semester</i>					
MEGR 3356	Motorsports Senior Design II	2	X	O	
XXXX XXXX	Motorsports Technical Elective	3			
XXXX XXXX	Motorsports Technical Elective	3			
LBST 22XX	LBST 2200 Series: Ethical Issues and Cultural Critique	3	X		
MEGR 3216	Thermal/Fluid Design	3			

31 Credit Hours for Year

## PLAN OF STUDY – BSME WITH CONCENTRATION IN ENERGY ENGINEERING

Freshman Year					
Course Number	Course Title	Credit Hours	General Education	W/O Course	Notes
<i>Fall Semester</i>					
ENGR 1201	Introduction to Engineering I	2			Grade of C or better required
CHEM 1251	Chemistry I	3	X		Grade of C or better required
CHEM 1251L	Chemistry I Lab	1	X		Grade of C or better required
MATH 1241	Calculus I	3	X		Grade of C or better required
UWRT 1101	Writing and Inquiry in Academic Contexts I	3	X		Grade of C or better required
LBST 11XX	LBST 1100 Series: Arts and Society	3	X		Grade of C or better required
<i>Spring Semester</i>					
ENGR 1202	Introduction to Engineering II	2			Grade of C or better required
PHYS 2101	Physics I	3	X		Grade of C or better required
PHYS 2101L	Physics I Lab	1			Grade of C or better required
MATH 1242	Calculus II	3	X		Grade of C or better required
UWRT 1102	Writing and Inquiry in Academic Contexts II	3	X		Grade of C or better required
XXXX XXXX	Science Elective	3			

**30 Credit Hours for Year**

Sophomore Year					
Course Number	Course Title	Credit Hours	General Education	W/O Course	Notes
<i>Fall Semester</i>					
PHYS 2102	Physics II	3			Grade of C or better required
PHYS 2102L	Physics II Lab	1			Grade of C or better required
MEGR 2141	Engineering Mechanics I	3			Grade of C or better required
MATH 2171	Differential Equations	3			Grade of C or better required
ECON 2101 or 2102	Macro Economics or Micro Economics	3	X		Grade of C or better required
LBST 2101	Western Cultural and Historical Awareness	3	X		
<i>Spring Semester</i>					
MEGR 2180	Manufacturing Systems	3			Grade of C or better required
MEGR 2156	Design Projects Laboratory I	2			Grade of C or better required
MEGR 2144	Introduction to Solid Mechanics	3			Grade of C or better required
MATH 2241	Calculus III	3			Grade of C or better required
ECGR 2161	Basic Electrical Engineering	3			Grade of C or better required
MEGR 2240	Computational Methods for Engineers	3			Grade of C or better required
MEGR 2499	Introduction to Energy Engineering	1			Grade of C or better required

**34 Credit Hours for Year**

Junior Year					
Course Number	Course Title	Credit Hours	General Education	W/O Course	Notes
<i>Fall Semester</i>					
MEGR 3111	Thermodynamics I	3			Grade of C or better required
MEGR 3121	Dynamic Systems I	3			Grade of C or better required
MEGR 3161	Introduction to Engineering Materials	3			Grade of C or better required
XXXX XXXX	Energy Technical Elective	3			Grade of C or better required
MEGR 3171	Introduction to Measurements and Instrumentation	2			May also be taken in the seventh semester
MEGR 3171L	Instrumentation Laboratory	2	X	W	Grade of C or better required
<i>Spring Semester</i>					
MEGR 3112	Thermodynamics II	3			Grade of C or better required
MEGR 3122	Dynamic Systems II	3			Grade of C or better required
MEGR 3116	Introduction to Heat Transfer	3			Grade of C or better required
MEGR 3156	Design Projects Lab II	2			Grade of C or better required
MEGR 3114	Fluid Mechanics	3			Grade of C or better required
MEGR 3152	Mechanics and Materials Laboratory	2	X	W	Grade of C or better required

**32 Credit Hours for Year**

Senior Year					
Course Number	Course Title	Credit Hours	General Education	W/O Course	Notes
<i>Fall Semester</i>					
MEGR 3455	Energy Senior Design I	2			
XXXX XXXX	Energy Technical Elective	3			
MATH XXXX	Math Elective	3			
LBST 2102	Global and Intercultural Connections	3	X		May also be taken in the fifth semester
MEGR 3221	Machine Analysis and Design I	3			
MEGR 3251	Thermal/Fluids Laboratory	2	X	W	
ENGR 3295	Professional Development	1			
<i>Spring Semester</i>					
MEGR 3456	Energy Senior Design II	2	X	O	
XXXX XXXX	Energy Technical Elective	3			
XXXX XXXX	Energy Technical Elective	3			
LBST 22XX	LBST 2200 Series: Ethical Issues and Cultural Critique	3	X		
MEGR 3216	Thermal/Fluid Design	3			

**31 Credit Hours for Year**

## PLAN OF STUDY – BSME WITH CONCENTRATION IN BIOMEDICAL ENGINEERING

Freshman Year					
Course Number	Course Title	Credit Hours	General Education	W/O Course	Notes
<i>Fall Semester</i>					
ENGR 1201	Introduction to Engineering I	2			Grade of C or better required
CHEM 1251	Chemistry I	3	X		Grade of C or better required
CHEM 1251L	Chemistry I Lab	1	X		Grade of C or better required
MATH 1241	Calculus I	3	X		Grade of C or better required
UWRT 1101	Writing and Inquiry in Academic Contexts I	3	X		Grade of C or better required
LBST 11XX	LBST 1100 Series: Arts and Society	3	X		Grade of C or better required
<i>Spring Semester</i>					
ENGR 1202	Introduction to Engineering II	2			Grade of C or better required
PHYS 2101	Physics I	3	X		Grade of C or better required
PHYS 2101L	Physics I Lab	1			Grade of C or better required
MATH 1242	Calculus II	3	X		Grade of C or better required
UWRT 1102	Writing and Inquiry in Academic Contexts II	3	X		Grade of C or better required
XXXX XXXX	Science Elective	3			Grade of C or better required

**30 Credit Hours for Year**

Sophomore Year					
Course Number	Course Title	Credit Hours	General Education	W/O Course	Notes
<i>Fall Semester</i>					
PHYS 2102	Physics II	3			Grade of C or better required
PHYS 2102L	Physics II Lab	1			Grade of C or better required
MEGR 2141	Engineering Mechanics I	3			Grade of C or better required
MATH 2171	Differential Equations	3			Grade of C or better required
ECON 2101 or 2102	Macro Economics or Micro Economics	3	X		Grade of C or better required
LBST 2101	Western Cultural and Historical Awareness	3	X		
<i>Spring Semester</i>					
MEGR 2180	Manufacturing Systems	3			Grade of C or better required
MEGR 2156	Design Projects Laboratory I	2			Grade of C or better required
MEGR 2144	Introduction to Solid Mechanics	3			Grade of C or better required
MATH 2241	Calculus III	3			Grade of C or better required
ECGR 2161	Basic Electrical Engineering	3			Grade of C or better required
MEGR 2240	Computational Methods for Engineers	3			Grade of C or better required
MEGR 2279	Introduction to Biomedical Engineering	1			Grade of C or better required

**34 Credit Hours for Year**

Junior Year					
Course Number	Course Title	Credit Hours	General Education	W/O Course	Notes
<i>Fall Semester</i>					
MEGR 3111	Thermodynamics I	3			Grade of C or better required
MEGR 3121	Dynamic Systems I	3			Grade of C or better required
MEGR 3161	Introduction to Engineering Materials	3			Grade of C or better required
XXXX XXXX	Biomedical Technical Elective	3			Grade of C or better required
MEGR 3171	Introduction to Measurements and Instrumentation	2			May also be taken in the seventh semester
MEGR 3171L	Instrumentation Laboratory	2	X	W	Grade of C or better required
<i>Spring Semester</i>					
MEGR 3112	Thermodynamics II	3			Grade of C or better required
MEGR 3122	Dynamic Systems II	3			Grade of C or better required
MEGR 3116	Introduction to Heat Transfer	3			Grade of C or better required
MEGR 3156	Design Projects Lab II	2			Grade of C or better required
MEGR 3114	Fluid Mechanics	3			Grade of C or better required
MEGR 3152	Mechanics and Materials Laboratory	2	X	W	Grade of C or better required

**32 Credit Hours for Year**

Senior Year					
Course Number	Course Title	Credit Hours	General Education	W/O Course	Notes
<i>Fall Semester</i>					
MEGR 3275	Biomedical Senior Design I	2			
XXXX XXXX	Biomedical Technical Elective	3			
MATH XXXX	Math Elective	3			
LBST 2102	Global and Intercultural Connections	3			May also be taken in the fifth semester
MEGR 3221	Machine Analysis and Design I	3	X		
MEGR 3251	Thermal/Fluids Laboratory	2	X	W	
ENGR 3295	Professional Development	1			
<i>Spring Semester</i>					
MEGR 3276	Biomedical Senior Design II	2	X	O	
XXXX XXXX	Biomedical Technical Elective	3			
XXXX XXXX	Biomedical Technical Elective	3			
LBST 22XX	LBST 2200 Series: Ethical Issues and Cultural Critique	3	X		
MEGR 3216	Thermal/Fluid Design	3			

**31 Credit Hours for Year**

## ADVISING RESOURCES

- General Education Requirements for ALL Students: [ucol.uncc.edu/general-education](http://ucol.uncc.edu/general-education)
- Undergraduate Catalog: [catalog.uncc.edu](http://catalog.uncc.edu)
- Central Advising website: [advising.uncc.edu](http://advising.uncc.edu)
- William States Lee College of Engineering advising website: [coe.uncc.edu/current-students/advising.html](http://coe.uncc.edu/current-students/advising.html)
- University Advising Center website: [advisingcenter.uncc.edu](http://advisingcenter.uncc.edu)



J. Murrey Atkins Library

Consultation on Library Holdings

To: Gloria Elliott  
From: Jeff McAdams  
Date: 9/3/14  
Subject: B.S.M.E. with a concentration in Biomedical Engineering

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Summary of Librarian's Evaluation of Holdings:

Evaluator: Jeff McAdams Date: 7/8/14

Check One:

- 1. Holdings are superior
- 2. Holdings are adequate
- 3. Holdings are adequate only if Dept. purchases additional items.
- 4. Holdings are inadequate

Comments:

Library holdings should be adequate to support student research for this course (see list of items held by subject heading below). Students will have access to relevant databases including *Compendex*, *IEEE Xplore*, *Institute of Physics*, *Science Direct*, *CRC Press*, and many others. If other materials are needed, students can obtain them quickly through our Interlibrary Loan services.

LC Subject Heading	Books	Journals
Biomedical Engineering	588	107
Technology, Medical	618	73
Medical Physics	107	17
Bio Physics	272	67

Evaluator's Signature

9/3/14

Date