Biomedical Engineering Program

Chair
Prof. Ashutosh Chilkoti
(ashutosh.chilkoti@duke.edu)

Director of Undergraduate Studies
Prof. Marc Sommer
(marc.sommer@duke.edu)

Associate Director of Undergraduate Studies
Dr. Elizabeth (Libby) Bucholz
(elizabeth.bucholz@duke.edu)

Freshman Advising Consultant
Dr. Chelsea Salinas
Chelsea.salinas@duke.edu

Staff Assistant
Ms. Susan Story
(ssshstory@duke.edu)

Matriculating Class of 2014

8/21/2014

bme.duke.edu
Welcome!

What I’ll talk about this morning

- Why major in BME? For that matter, what is it?
- The BME curriculum at Duke
- Options for specialization
- So, what should I take this year?
- Where can I find more info?
  - On research areas
  - On curriculum and advising for next term
Why major in BME?

- Want to go to Medical school
- Want to get rich
- Parents told you to
- It seems popular
✓ Want to build cyborg zombie hunters
Why major in BME?

First we need to understand what BME is, exactly.

Something to do with Biology + Medicine + Engineering.

But - let’s be more specific.
What is BME?

BME uses the “hard sciences”,
- Physics
- Chemistry
- Mathematics
- Computational Science
to study and improve human
- Biology
- Medicine
- Behavior
- Health

bme.duke.edu
Example: Helping the heart

Bian et al. 2014, from Bursac Lab in Duke BME
Example: Helping the mind

PSYCHIATRIC HELP 54

THE DOCTOR IS IN
Example: Helping the mind

Mueller et al. 2014, from Sommer & Grill labs in Duke BME
BME Undergrads do this research

Mueller et al. 2014, from Sommer & Grill labs in Duke BME

Melina Smith, Duke BME Class of 2015
Pratt Fellow and Grand Challenge Scholar

bme.duke.edu
BME Undergrads do this research
Example: Seeing inside the body


Carotid ARFI– soft plaque

PW = Proximal wall, ICA = Internal carotid artery, DW = Distal wall

Diffusion Tensor MRI of a mouse brain

Courtesy Evan Calabrese, G Allan Johnson, CIVM Duke

bme.duke.edu
Some Interesting Facts

- BME around for 3000 yrs.
- Rooted in electrophysiology
- about 32,000 bioengineers working in various areas of health technology
- highest percentage of female students in all of the engineering specialties

*The Lancet, Vol 356 2000*
Business/Industry Sectors
Senior exit survey

- 19.6% medical/pharmaceutical
- 23.6% engineering
- 13.7% consulting
- 2% military
- 9.8% health care
- 9.8% IT
- 13.7% financial serv

bme.duke.edu
Type of Degrees Pursued
Senior exit survey

- Other Master’s: 3%
- MS, MA, MEng: 27.9%
- PhD: 14.7%
- Medical: 20.6%
- No degree, undecided: 26.5%
- Other degree: 7.3%
Core Undergraduate Curriculum (liberal arts & “hard sciences”)

1\textsuperscript{st} year specific:
- Digital Computation (Egr 103L in the Fall)
- Undergraduate Writing

- 5 Humanities & Social Sciences (depth & breadth)
- 2 Chemistry (Chem 101DL + Chem 201DL/210DL)
- 2 Physics (Phys 151L + 152L)
- 5 Math (Math 111L + 112L + 212 + 216 + 353)
- 2 Life Science (Bio 201L + Life Science Elective)
- 2 Unrestricted Electives
Core Courses for BME (specifically engineering/BME)

**Materials & Mechanics**
- EGR 201L Mechanics
- ME 221L Materials

**Physiology**
- BME 244L Quant Physiology with Bio statistics
- BME 260L Modeling Cellular and Molecular Systems

**BME Area Courses**
- BME Area Core I
- BME Area Core II

**Systems and Instrumentation**
- ECE 110L Fund of Electrical and Computer Egr
- BME 271 Signals & Systems
- BME 354L Intro to Medical Instrumentation

**Capstone Design (1)**
- BME 432 Biomech of Vehicle Safety Egr
- BME 436 Biophotonics Instrumentation
- BME 460 Devices for People with Disabilities
- BME 462 Design for the Developing World
- BME 464 Medical Instrument Design
Core Courses for BME (specifically engineering/BME)

BME Area Courses

- BME Area Core I
- BME Area Core II

bme.duke.edu
The BME Area Core courses are:
- BME 301, Bioelectricity
- BME 302, Fund of Biomaterials and Biomechanics
- BME 303, Modern Diagnostics Imaging Systems
- BME 307, Transport Phenom. in Biological Systems

In Junior year, you take 2 of these courses.
My advice: keep an open mind!
In Senior year, you explore your favorite area in depth with 2 core elective courses.
Double Engineering Majors offered:
- BME and ECE
- BME and ME
- BME and CEE (environmental)

Cannot minor in BME
- BME does not offer a certificate
Specialization in BME: Trinity College

- Second majors, minors and certificates outside Engineering
  - Majors usually require 8 additional courses
  - Minors: 5 courses
  - Certificates: 6+ courses

- Most popular
  - Economics
  - Math
  - Chemistry
  - Neuroscience
  - History (3-4 SSH courses can be taken in one dept.)
  - Management and Markets certificate
  - Energy and Environment certificate
  - New: Global Health major/minor
Preparing for Medical School

- Office of Health Professions Advising:
  http://prehealth.duke.edu/
  orientation: Fri, Aug. 22

- Take the MCAT in the summer after 3rd year

Med schools will expect:

- 4 Chemistry courses with labs
  - Biochemistry will be included in MCAT in 2015
- 2 Biology courses with labs: Bio 201L + elective
  - Physiology: BME 244L
- 2 Physics courses with labs: Phys 151L + 152L
  - Consider taking Physics 153L or study topics on your own
- 2 English/Lit courses: Writing 101 + elective
- Recommended:
  - Behavioral science course: Psy 101
<table>
<thead>
<tr>
<th>Term</th>
<th>Subject</th>
<th>Course Code</th>
<th>Term</th>
<th>Subject</th>
<th>Course Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fall-Freshman</td>
<td>Chem</td>
<td>101DL</td>
<td>Spring-Freshman</td>
<td>Bio</td>
<td>201L</td>
</tr>
<tr>
<td></td>
<td>Math</td>
<td>111L</td>
<td></td>
<td>Math</td>
<td>112L</td>
</tr>
<tr>
<td></td>
<td>EGR</td>
<td>103L</td>
<td></td>
<td>Phys</td>
<td>151L</td>
</tr>
<tr>
<td></td>
<td>Writing</td>
<td>101 / SSH</td>
<td></td>
<td>SSH / Writing</td>
<td>101</td>
</tr>
<tr>
<td>Fall-Sophomore</td>
<td>BME</td>
<td>244L</td>
<td>Spring-Sophomore</td>
<td>EGR</td>
<td>201L</td>
</tr>
<tr>
<td></td>
<td>ECE</td>
<td>110L</td>
<td></td>
<td>Chem</td>
<td>201DL/210DL</td>
</tr>
<tr>
<td></td>
<td>Math</td>
<td>212</td>
<td></td>
<td>Math</td>
<td>216</td>
</tr>
<tr>
<td></td>
<td>Phys</td>
<td>152L</td>
<td></td>
<td>LS</td>
<td>elective</td>
</tr>
<tr>
<td></td>
<td>SSH</td>
<td></td>
<td></td>
<td>SSH</td>
<td></td>
</tr>
</tbody>
</table>

Major: BME
### What should I take this year?

**Major: **BME considering Medical School

<table>
<thead>
<tr>
<th>Fall-Freshman</th>
<th>Spring-Freshman</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chem 101DL</td>
<td>Bio 201L</td>
</tr>
<tr>
<td>Math 111L</td>
<td>Math 112L</td>
</tr>
<tr>
<td>EGR 103L</td>
<td>Phys 151L</td>
</tr>
<tr>
<td>Writing 101 / SSH</td>
<td>SSH / Writing 101</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Fall-Sophomore</th>
<th>Spring-Sophomore</th>
</tr>
</thead>
<tbody>
<tr>
<td>BME 244L</td>
<td>EGR 201L</td>
</tr>
<tr>
<td>ECE 110L</td>
<td>Chem 201DL/210DL</td>
</tr>
<tr>
<td>Math 212</td>
<td>Math 216</td>
</tr>
<tr>
<td>Phys 152L</td>
<td>LS elective</td>
</tr>
<tr>
<td>SSH</td>
<td>SSH</td>
</tr>
</tbody>
</table>

bme.duke.edu
<table>
<thead>
<tr>
<th>Semester</th>
<th>Course Code</th>
<th>Course Title</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Fall-Freshman</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chem 101DL</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Math 111L</td>
<td></td>
<td></td>
</tr>
<tr>
<td>EGR 103L</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Writing 101</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Spring-Freshman</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bio 201L</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Math 112L</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Phys 151L</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SSH</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Fall-Sophomore</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BME 244L</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ECE 110L</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Math 212</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Phys 152L</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chem 201DL</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Spring-Sophomore</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>EGR 201L</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chem 202L</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Math 216</td>
<td></td>
<td></td>
</tr>
<tr>
<td>LS elective</td>
<td></td>
<td></td>
</tr>
<tr>
<td>BME 260L</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### What should I take this year?

**Major: BME**

<table>
<thead>
<tr>
<th>Semester</th>
<th>Course 1</th>
<th>Course 2</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Fall-Freshman</strong></td>
<td>Chem 101DL</td>
<td>Bio 201L</td>
</tr>
<tr>
<td></td>
<td>Math 111L</td>
<td>Math 112L</td>
</tr>
<tr>
<td></td>
<td>EGR 103L</td>
<td>Phys 151L</td>
</tr>
<tr>
<td></td>
<td>Writing 101 / SSH</td>
<td>SSH / Writing 101</td>
</tr>
<tr>
<td><strong>Spring-Freshman</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Fall-Sophomore</strong></td>
<td>BME 244L</td>
<td>EGR 201L</td>
</tr>
<tr>
<td></td>
<td>ECE 110L</td>
<td>Chem 201DL/210DL</td>
</tr>
<tr>
<td></td>
<td>Math 212</td>
<td>Math 216</td>
</tr>
<tr>
<td></td>
<td>Phys 152L</td>
<td>LS elective</td>
</tr>
<tr>
<td></td>
<td>SSH</td>
<td>SSH</td>
</tr>
</tbody>
</table>
### What should I take this year?

**Example Double Major: BME and ECE**

<table>
<thead>
<tr>
<th>Fall-Freshman</th>
<th>Spring-Freshman</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chem 101DL</td>
<td>Bio 201L</td>
</tr>
<tr>
<td>Math 111L</td>
<td>Math 112L</td>
</tr>
<tr>
<td>EGR 103L</td>
<td>Phys 151L</td>
</tr>
<tr>
<td>Writing 101 / SSH</td>
<td>SSH / Writing 101</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Fall-Sophomore</th>
<th>Spring-Sophomore</th>
</tr>
</thead>
<tbody>
<tr>
<td>BME 244L</td>
<td>EGR 201L</td>
</tr>
<tr>
<td>ECE 110L</td>
<td>Chem 201DL/210DL</td>
</tr>
<tr>
<td>Math 212</td>
<td>Math 216</td>
</tr>
<tr>
<td>Phys 152L</td>
<td>LS elective</td>
</tr>
<tr>
<td>SSH</td>
<td>SSH</td>
</tr>
<tr>
<td>Semester</td>
<td>Courses</td>
</tr>
<tr>
<td>---------------</td>
<td>--------------------------------------------</td>
</tr>
<tr>
<td><strong>Fall-Freshman</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Chem 101DL</td>
</tr>
<tr>
<td></td>
<td>Math 111L</td>
</tr>
<tr>
<td></td>
<td>EGR 103L</td>
</tr>
<tr>
<td></td>
<td>Writing 101 / SSH</td>
</tr>
<tr>
<td><strong>Spring-Freshman</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Bio 201L</td>
</tr>
<tr>
<td></td>
<td>Math 112L</td>
</tr>
<tr>
<td></td>
<td>Phys 151L</td>
</tr>
<tr>
<td></td>
<td>SSH / Writing 101</td>
</tr>
<tr>
<td><strong>Fall-Sophomore</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td>BME 244L</td>
</tr>
<tr>
<td></td>
<td>ECE 110L</td>
</tr>
<tr>
<td></td>
<td>Math 212</td>
</tr>
<tr>
<td></td>
<td>Phys 152L</td>
</tr>
<tr>
<td></td>
<td>SSH  EGR 201L</td>
</tr>
<tr>
<td><strong>Spring-Sophomore</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td>ECE230L</td>
</tr>
<tr>
<td></td>
<td>Chem 201DL/210DL</td>
</tr>
<tr>
<td></td>
<td>Math 216</td>
</tr>
<tr>
<td></td>
<td>LS elective</td>
</tr>
<tr>
<td></td>
<td>ECE 280L</td>
</tr>
<tr>
<td></td>
<td>SSH  Compsci 201</td>
</tr>
</tbody>
</table>
Research Opportunities (Independent Studies, Pratt Fellows Program, Grand Challenge Scholar)
- www.pratt.duke.edu/research-opportunities
- www.pratt.duke.edu/experts
- www.pratt.duke.edu/pratt-research-fellow

Research Seminars

BMES Student Chapter (career seminars, attending national conferences, etc.)
- www.bmes.org

Engineering World Health
- www.ewh.org/

Global Education for Undergraduates (study abroad)
- http://studyabroad.duke.edu/
More Info

- **BME Department Website**
  - [www.bme.duke.edu](http://www.bme.duke.edu)

- **Undergraduate Program Handbook**
  - [www.bme.duke.edu/undergrads/curriculum.php](http://www.bme.duke.edu/undergrads/curriculum.php)

- **Meeting with your advisor**

- **Duke Chapter of Biomedical Engineering Society**
  - [www.bmes.pratt.duke.edu](http://www.bmes.pratt.duke.edu)
  - BMES Fall Reception and course registration panels

- **BME Contacts**
  - Ms. Susan Story (sshstory@duke.edu)
  - Associate DUS, Dr. Libby Bucholz (elizabeth.bucholz@duke.edu)
  - DUS, Prof. Marc Sommer (marc.sommer@duke.edu)

- **BME consultation sessions, late October and March**
BME Undergraduate Program Handbook

Note: The handbook is updated every year (every semester, if necessary). We recommend that students and faculty always use the latest version of the handbook.

New for 2014 version, coming soon!
Again: why major in BME?

- Want to go to Medical school
- Want to get rich
- Parents told you to
- It seems popular
✓Want to build cyborg zombie hunters
Again: why major in BME?

Why I think you will find the major rewarding:
Again: why major in BME?

Why I think you will find the major rewarding:

Teaches you to apply engineering techniques to help people in the most fundamental way:
Again: why major in BME?

Why I think you will find the major rewarding:

Teaches you to apply engineering techniques to help people in the most fundamental way: by keeping them healthy and repairing their bodies and minds.
Wait, there’s more!

Introducing

Dr. Chelsea Salinas, Ph.D.
Freshman Advising Consultant
AP/IB CREDITS

What can I get with my AP credits?*

*Get ahead conscientiously, but enjoy yourself at Duke as well!
AP Credits: Chemistry

What is Needed--**2 CU**
- Chem 101DL/110L (Chem I)
- Chem 210DL/201DL (Chem II/Organic)

What can AP do for me?
- AP = 5
  - Credit for Chem 101
- MUST take Chem 210/201

*CU= DUKE + AP*
AP Credits: Physics

What is Needed--2 CU*

- Phys 151DL (Mechanics)
- Phys 152DL (Electro/Magnetism)

*CU= DUKE + AP

**recommended for Premeds

What can AP do for me?

- Phys C test on Mech.
  - AP = 4/5
  - Credit for Phys 151
- Phys C test on Elec/Mag
  - AP=4/5
  - Credit for Phys 152
- IF AP used for BOTH MUST take Phys 153L **,
  264, 361 OR 362
What is Needed -- 5 CU*
- Math 111L (Calc I)
- Math 112L (Calc II)
- Math 212 (Multivariable Calc)
- Math 216 (Linear Algebra/Diff EQ)
- Math 353 (Ordinary & Partial Diff EQ)

What can AP do for me?
- Math AB test
  - AP = 5
  - Credit for Math 111L**
- Math BC test
  - AP = 3
  - Credit for Math 111L
  - AP ≥ 4
  - Credit for Math 111L & 112L

**CU = DUKE + AP
**IB = 6 on higher level exam

HIGHLY recommended to TAKE Math 112L
AP Credits: Social Science/Humanities

What is Needed--5 CU*

- At least one SS
- At least 2 from (ALP, FL, and/or CZ)
- At least 2 from same dept (one being ≥200 level)
- Skill courses do not count

What can AP do for me?

MAX 2 AP credits used

*CU= DUKE + AP
## AP Credits: Life Science

### What is Needed -- **3 CU***
- Biology 201L (Molecular Biology)
- BME 244L (Physiology & Stats)
- Life Science Elec.

### What can AP do for me?
**NO AP credits can be used!!!**

***CU = DUKE + AP***
**Example: AP credits for Math 111L and Phys 151L**

<table>
<thead>
<tr>
<th>Fall-Freshman</th>
<th>Spring-Freshman</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chem 101L</td>
<td>Bio 201L</td>
</tr>
<tr>
<td>Math 111L</td>
<td>Math 112L</td>
</tr>
<tr>
<td>EGR 103L</td>
<td>Phys 151L</td>
</tr>
<tr>
<td>Writing 101</td>
<td>SSH</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Fall-Sophomore</th>
<th>Spring-Sophomore</th>
</tr>
</thead>
<tbody>
<tr>
<td>BME 244L</td>
<td>EGR 201L</td>
</tr>
<tr>
<td>ECE 110L</td>
<td>Chem 201DL/210DL</td>
</tr>
<tr>
<td>Math 212</td>
<td>Math 216</td>
</tr>
<tr>
<td>Phys 152L</td>
<td>LS elective</td>
</tr>
<tr>
<td>SSH</td>
<td>SSH</td>
</tr>
</tbody>
</table>
BEYOND FRESHMAN YEAR

How can I fit in a study abroad?
What should I do during the summer?
How can I market myself as a BME?*

*While the BME program is rigorous, you have many options available. Explore!
Study Abroad

**When:** Fall of Jr. year

**Where:**
‘Approved Programs List’ from GEO website [https://globaled.duke.edu/](https://globaled.duke.edu/)

**How:**
- Start with the step-by-step guide from the GEO website
- Discuss options with your major advisor and GEO advisor
- Complete application at ‘MyGlobalEd’ on GEO website
- Understand which courses will be transferrable [https://courseapproval.studyabroad.duke.edu/cgi-bin/study.pl](https://courseapproval.studyabroad.duke.edu/cgi-bin/study.pl)
**What:**
Domestic/International Programs
Immersion program 8+ wks
Travel/lodging paid for by Duke
Apply engineering knowledge to service the community

**When:** Summer after Frsh/Soph year (2 sem. req)

**Where:**

**How:**
Apply online through DukeEngage website beginning **Oct. 1**
Internships

What:
Put your engineering skills to work for a company
Get vast experience with hands-on, real-world projects
Network with employees/company with which you can land a job when you graduate!!

When: Summer after Freshman year…and beyond (Fall/Spring fairs)

How: Duke eRecruiting
NCBIOTECH/resources
ENGINEERJOBS.com
careerfair
bme.duke.edu
WHAT’S NEXT?

• Enjoy your 1st semester!
• Don’t hesitate to ask any of us. I’m at: chelsea.salinas@duke.edu
• Make an appointment during advising hours before Spring registration