# UConn BMES Meeting #2 (9/28)

TRACK PRESENTATIONS

# Concept of Biomedical Engineering

- Biomedical Engineering is an interdisciplinary application of engineering principals
  - The major is an application of the other fields within engineering towards the medical field
  - The major is ideally one where students take both engineering and biology classes and synthesize their knowledge of both

# Concept of Biomedical Engineering

- The major is designed around this idea
  - Students take:
    - Engineering classes across different departments
    - Life science classes
    - A selection of upper-level engineering classes in a department of your choice (i.e. your track)
    - Upper-level BME classes that synthesize biology and engineering (BME Electives)

# BME Undergraduate Degree at UConn

- Very structured
  - What and when you take the classes you take is chosen for you
- Three distinct places for choice in your classes:
  - General Education classes ('Gen Eds')
  - BME Electives
    - You will take three (3) of your choice
  - Track Classes
    - You will take three (3) of your choice

# List of BME Tracks

- **Biosystems, Imaging and Instrumentation Track**
- **Biomaterials Track**
- **Bioinformatics Track**
- **Biomechanics Track**

# Notes About Tracks

- Know what field of engineering you like best?
  - Picking a track can help specialize you in your area of interest
  - Can help decide what field of BME you want to work in
  - Find research positions in labs outside of BME

# Notes About Tracks

- DON'T know what field of engineering you like best?
  - Your track is not your career
    - It can only help you
  - It is only 3 courses in one field!
  - No one becomes an expert with three courses
  - It is possible to study one track in your undergraduate career and have a different focus for later work/studies

# Map For Choosing a Track

- You should choose your track by Junior year
  - By then you would have taken a class corresponding to almost every track
- Choose based on what you have taken
  - We've made a map!
- Each class has a small correlation to a track

# Map of Tracks

| Track | Classes Taken |
| --- | --- |
| • Biosystems, Imaging, Bioinstrumentation | • ECE2001W, ECE3101 (BME3400) |
| • Biomaterials | • MSE2101 |

# Map of Tracks

| Track | Classes Taken |
| --- | --- |
| • Bioinformatics → | • CSE 1010 |
| • Biomechanics → | • CE2110 (BME3150) |

# Notes

- Track Advisor
  - Dr. Peterson advises to find a professor in your field of interest to advise what classes to take
  - You can ask any professor for advice on your track
- Looking for a track that's not here?
  - ABET Accredidation
  - Make your own!
  - Find a research advisor

# Biosystems, Imaging and Instrumentation Track

BY PETER BOUTROS

# Track Basics

- This is the “ECE Track”
- Founded within the field of Electrical Engineering
  - Your track electives will be in the ECE Department
- Really three tracks consolidated into one
  - Biosystems
  - Imaging
  - Bioinstrumentation

# Biosystems

- Use of electrical engineering to detect, classify and analyze signals produced by the body, and are used in medical devices. Utilizes:
  - Filters
  - Control Systems
  - Biosignal Models
- Courses Taken:
  - ENGR1166: Introduction to Biomedical Engineering (second half)
  - ECE2001W: Electrical Circuits
  - ECE3101: Signals & Systems / BME3400: Biosystem Analysis
  - ECE3500: Biomedical Engineering Measurements
- Track Courses
  - ECE3111: Systems Analysis
  - ECE4111: Communication Systems
  - ECE4121: Digital Control Systems
- BME Electives
  - BME5100: Physiological Modeling
  - BME6120: Neural Information Processing

# Bioinstrumentation

- The use of electronics, measurement principals and innovative biosensors to develop devices for monitoring, diagnosing and treating diseases.
- Courses Taken
  - ENGR1166: Introduction to Biomedical Engineering (first half)
  - ECE2001W: Electrical Circuits
  - ECE3101: Signals & Systems / BME3400: Biosystem Analysis
  - ECE3500: Biomedical Engineering Measurements
- Track Electives
  - ECE 3201: Electrical Circuit Theory and Design
  - ECE 3221: Digital Integrated Circuits
  - ECE 3411: Microprocessor Applications Laboratory
- BME Electives
  - BME 4500: Bioinstrumentation

# Imaging

- The use of bioinstrumentation principals towards medical imaging systems apply energy, such as X-rays, or sound waves, to the body to create detailed pictures of internal structures.
- Courses taken:
  - ENGR1166: Introduction to Biomedical Engineering (first half)
  - ECE2001W: Electrical Circuits
  - ECE3101: Signals & Systems / BME3400: Biosystem Analysis
  - ECE3500: Biomedical Engineering Measurements
- Track Electives:
  - ECE 3001: Electromagnetics Fields & Waves
  - ECE 3223: Optical Engineering
  - ECE 4231: Fiber Optics
- BME Electives:
  - BME 4300 Physiological Control Systems
  - BME 6450: Optical Microscopy and Bio-imaging

# Minor

- Electronics and Systems
  - You will qualify for this minor with no extra courses
- Requirements:
  - ECE 2001W: Electrical Circuits
    - This is a course required for all BME students
  - ECE 3101: Signals & Systems / BME 3400: Biosystem Analysis
    - This is a course required for all BME students
  - Three ECE Courses of your choice
    - Your three track electives!

# Research Opportunities

- Dr. Quing Zhu
  - Optical Tomography
  - Non-invasive breast cancer detection using near-infrared (NIR) diffused light
- Dr. Monty Escabí
  - Discovering the signal processing power of the Inferior Colliculus (IC), a part of the auditory midbrain
  - Developing non-linear models for the encoding of information in neurons

# Biomaterials Track

NICOLE LAVOIE

# What will you learn in the Biomaterials track?

- Appropriate development and selection of materials to place inside the human body
- Physical and chemical properties of materials implied to use within the body.
- Development, testing and research techniques for different materials
- Most common types of biomaterials used today

# Will I like the Track?

- Do you like learning about how the human body reacts and interacts with materials?
- Do you want to learn more about the development and applications of synthetic and organic materials?
- Do you want to learn more about implantable devices in the human body?
- Do you see yourself getting more involved with tissue engineering, implantation or artificial organs/limbs in your future?
- Did you like MSE 2101?

# Classes that Correspond to the Track

- MSE 2101 – Material Sci. and Engr 1 - required class
  - Relation of crystalline structure to chemical, physical and mechanical properties of metals and alloys.
  - Testing, heat treating and engineering applications of alloys
- BME 3700 - Biomaterials - required class
  - Lecture and lab introducing implantable materials, and comparing them to natural materials.
  - Learn about mechanical properties, biocompatibility, degradation and biological responses.
- BME 4701 – Advanced Biomaterials - BME elective
  - Gain in-depth knowledge of biomaterials for various applications
  - Tissue replacements, drug delivery systems and products
- BME 4710 – Intro to Tissue Engineering – BME Elective
  - Presents basic principles of biological, medical, and material science as applied to implantable medical devices, drug delivery systems and artificial organs

# Classes for Track Electives (must take 3)

- CHEG 3156 – Polymeric Materials
- MSE 2002 – Intro to structure, prop, and processing of Materials 2
- MSE 3003 - Phase Trans. Kinetics and Apps.
- MSE 3004 – Mechanical Behavior of Materials
- MSE 4001 – Electrical & Mag. Properties of Mat.
- MSE 4003 – Materials Characterization
- MSE 4034 – Corrosion and Materials Protection
- MSE 4240 – Nanomaterials Synthesis and Design
- MSE 4241 – Nanomaterials Characterization/App.

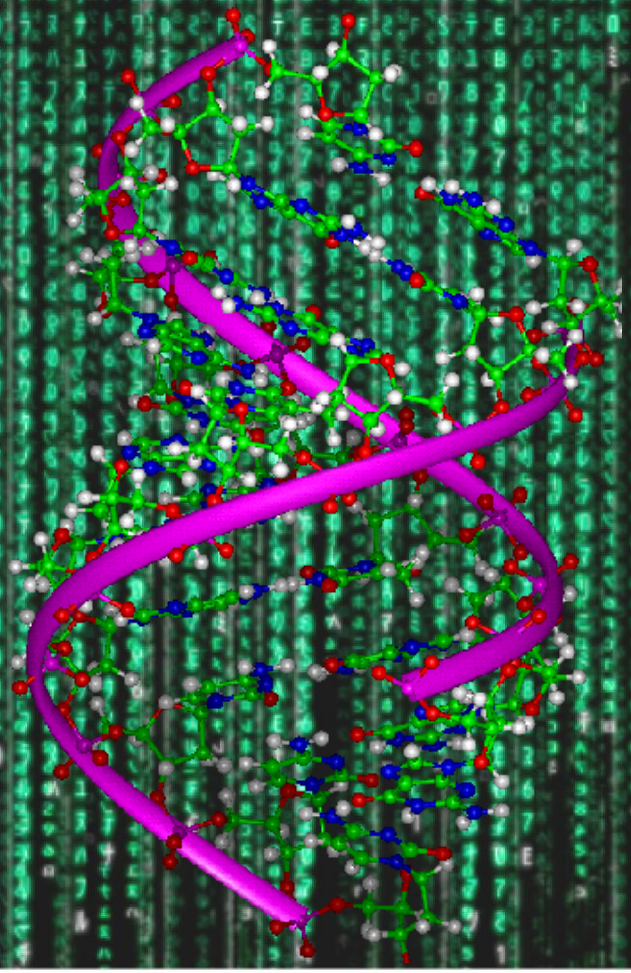
# Related Minors

- MSE Minor
  - Must take MSE 2101 and 2002
  - Must take 9 credits from MSE 3000's, 4000's, BME 3700, or CHEG 3156
  - Can be fulfilled just by taking MSE 2101, BME 3700 and 3 MSE courses (which you have to do anyway!)
- Nanomaterials Minor
  - MSE 2101 and 2002
  - 9 credits from MSE 4001, 4240, 4241, or 4095 (if related)
  - Cannot get both minors, must pick one

# Current UConn Labs studying Biomaterials

- Dr. Mei Wei
  - Fabrication of tissue engineering scaffolds for bone and osteochondral repair
  - Biomimetic apatite/collagen coatings for bone repair and drug delivery
  - Apatite-polymer fiber absorbable composites
- Dr. Yong Wang (Chemical Engineering)
  - Antibody-like nanomaterials
  - Bioinspired Protein Delivery Systems
  - Tissue-Like Nano-Structured Biomaterials
  - Health Center Staff
- Health Center's Center for Biomaterials has many faculty members currently researching biomaterials as well

# Bioinformatics



# Classes

- CSE 1102, 2100, 2300W, 2500, 3300 (Computer Networks and Data Communication)….(you are not limited to classes online)
- If you really like CSE 1100 or 1102 and BME 1401 you should consider this track
- Applications Medical informatics, Biology computation, systems biology

# Biomechanics

JORDAN R. SMITH

# What is Biomechanics?

- Application of mechanical principles to biological systems
- This includes the study of motion, material deformation, and fluid flow.
- Biosolid vs. Biofluid

# What's the Difference?

Biosolid

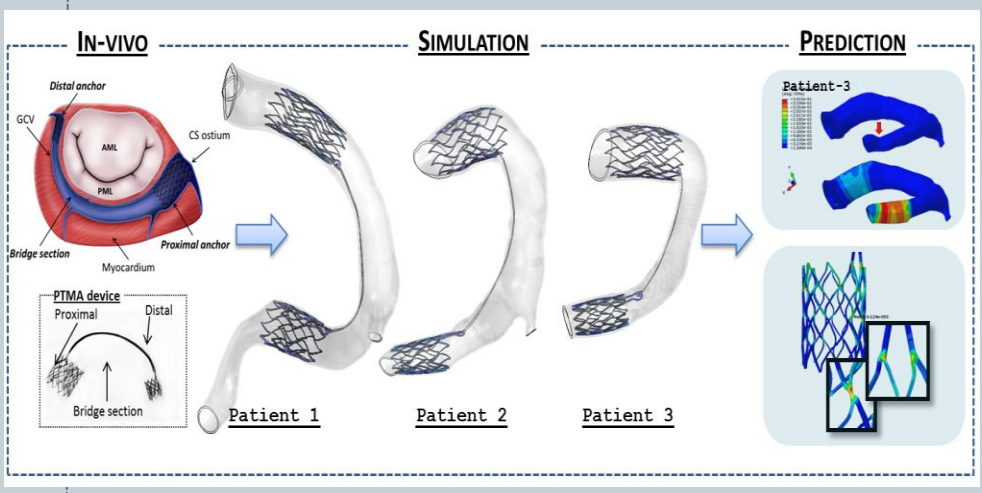
- Study of motion of particles and rigid bodies
- Focus on Skeletal System
- design of prosthetic limbs
- Modification of wheelchairs (proper posture and support)

Biofluid

- Movement of fluids in body under force, transfer of chemical substances across membranes
- Focus on Cardiovascular System
- development of artificial hearts and heart valves

# Research: Prof. Wei Sun

- Experimental study and modeling of cardiovascular biomaterials
- Studies tissue and organ function
- Designing and surgical reconstruction of new heart valves
- Works closely with American Heart Association
- These techniques may one day improve device design and use, and ultimately benefit patients suffering from cardiovascular disease.



# Course Selection

## Biosolid

- ME 3214 - Dynamics of Particles and Rigid Bodies
- ME 3225 - Computer-Aided Design, Modeling, and Graphics
- ME 3227 - Design of Machine Elements
- ME 3229 - Machine Design
- ME 3253 Linear Systems Theory
- ME 3255 - Computational Mechanics
- ME 3260 - Measurement Techniques

## Biofluid

- ME 2233 Thermodynamic Principles
- ME 2234 Applied Thermodynamics
- ME 3242 Heat Transfer
- ME 3250 Fluid Dynamics I
- ME 3251 Fluid Dynamics II
- ME 3275 Introduction to Computational Fluid Dynamics

# If you liked…


- BME 3600W- Biomechanics
- CE 2110- Applied Mechanics I
- BME 3150- Statics and Dynamics for BMEs
- PHYS 1501Q- Physics for Engineers I

…then Biomechanics might be for you!

# Questions?