# Master of Science in Biomedical Engineering

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## Welcome



Please feel free to stop me and ask questions at any time

## Do you know the way to San Jose?



- Location: Heart of Silicon Valley
- Population: 1 million 10th largest city in the USA
- Climate: arguably the best in the world
- **Diversity**: outstanding
- Technologically: most vibrant place on earth
  - More than 1,100 biomedical companies in Bay Area large, medium & start-ups
  - More than 600 in manufacturing

#### Amenities

- Beach: 45 minutes
- Mountains: 30 minutes

## **Self-Introductions**



- Name
- Undergraduate degree: Major, University
- Country of origin
- Native language
- Full-time or part-time student
- Current job/internship (if any)

## **University Structure**



- 7 Colleges
  - Departments within each college
  - Degree programs in each department
- College of Engineering
  - 10 Departments
  - 13 Degree Programs
  - Department: administrative unit
  - · Program: academic discipline in which degree is awarded

## **BS Biomedical Engineering**



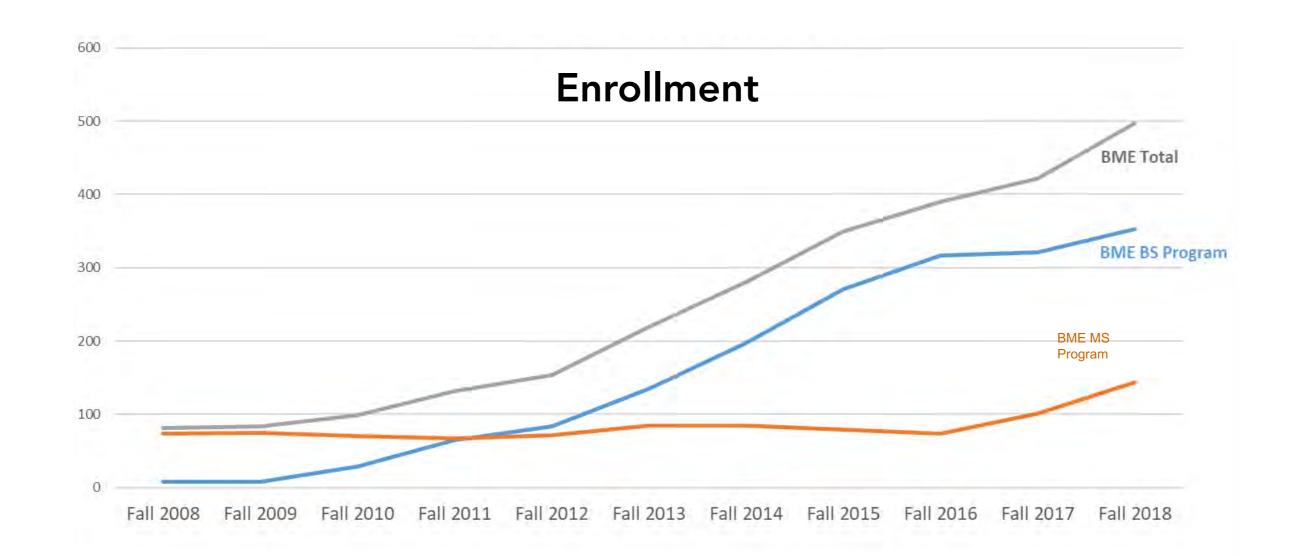
- Housed in the Biomedical Engineering Department
  - One degree program (undergraduate and graduate)

- BME Department Offices: Room 233
- BME Department Labs: Room 221, Room 233C

## **BS Biomedical Engineering**



- Initial efforts begun in 2005
- Approved by CSU Chancellor in October 2011
- ABET accredited October 2014
- Independent department, effective July 1st, 2018



## **Biomedical Engineering**



- Deployment of engineering knowledge in the biological and health sciences arena for the improvement of quality of human life
- Interdisciplinary
- Rapidly growing field
  - Opportunities for innovation, entrepreneurship, collaboration, and jobs
- Ability to communicate with life sciences professionals, physicians, regulatory affairs professionals, and others
- FDA-regulated industry







## **Biomedical Engineering**



#### Disciplines/areas within Biomedical Engineering

- Biomedical devices
- Biomechanics
- Prosthetics, orthopedics
- Bioinformatics
- Biopharma
- Imaging
- Tissue engineering

- Diagnostics
- Proteomics, genomics
- Biomaterials
- Microfluidics
- Signal processing
- Nanotechnology
- Quality
- Regulatory

And many others, including some that are evolving

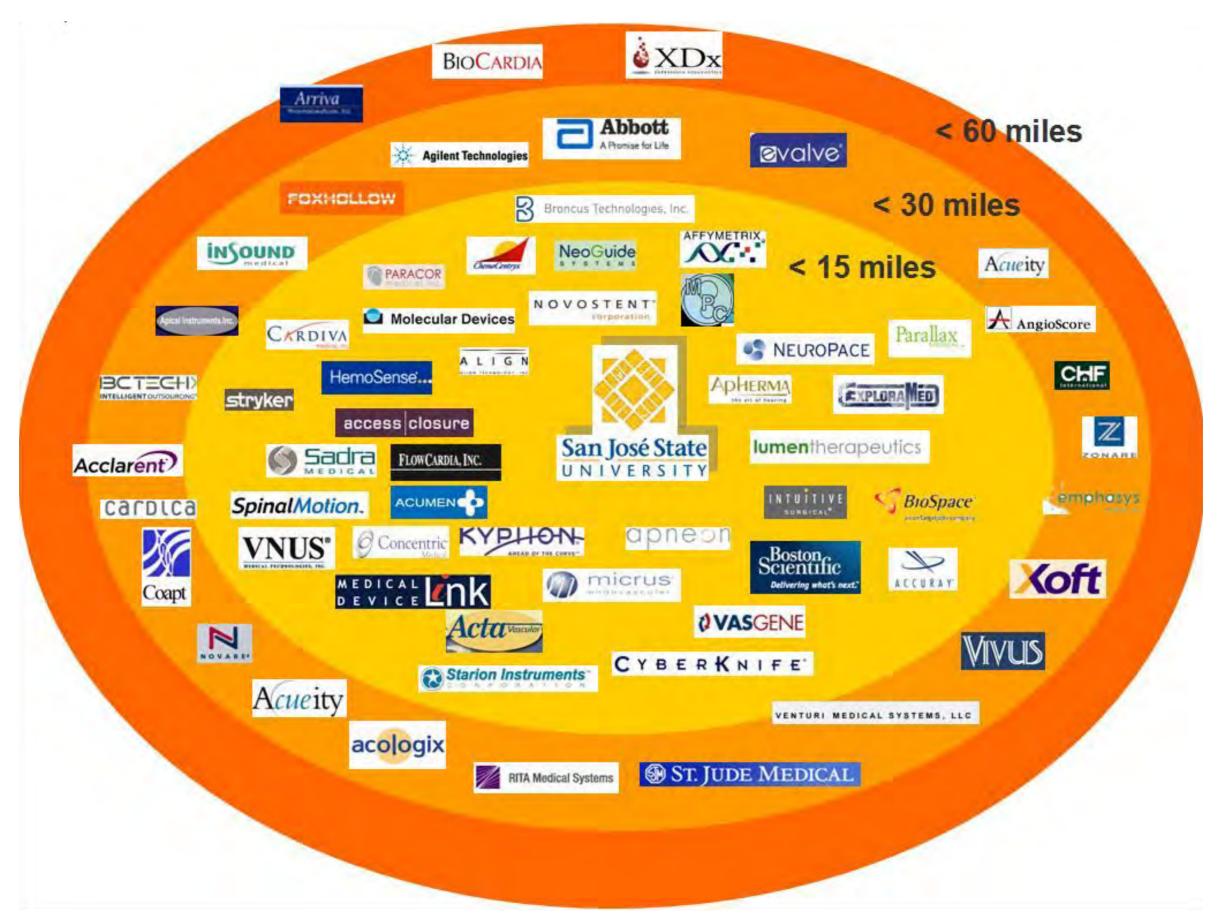


Figure compiled by Ganesh Iyer

## **Some California Statistics**



- Number of biomedical companies: 2,848
  - Device & Medical Equipment: 1,662
- Revenues: \$115.4 billion
- Venture capital investment: \$4.8 billion
- Employment: 281,198

### Some California Statistics



- Number of biomedical companies: 2,848 3,249
  - Device & Medical Equipment: 1,662 1,796
- Revenues: \$115.4 billion \$169b
- Venture capital investment: \$4.8 billion \$6.7b
- Employment: <del>281,198</del> **298,709**

## **Some California Statistics**



- Employment in Bay area: 72,663 (24%)
  - #1 in California
- Employment in Medical Devices, Instruments & Diagnostics: 77,278 (26%)
- Indirect/Induced employment: 621,000
- Employment growth rate (2012-2016): 7.7%

## **Driving Forces**



#### Societal

- Aging and more affluent population
- Greater demand for, and awareness of, better quality of life
- Preventive therapies
- Health care cost containment
- Improved accountability

#### **Technological**

- Improved technological capabilities
- Optics & fiber optics
- Miniaturization of electronics
- Micro-fabrication
- Imaging technologies
- IT Improvements
- Nano, nano, nano
- Many, many others

## Why BME @ SJSU?



- No. 3 among biomedical engineering schools in the U.S., based on average salary (December 2016)
- More than 1,100 biomedical companies in the Bay Area
- Curriculum developed with industry professionals and experts
- Diverse student population 46% female
- Inclusive, welcoming SJSU BMES Chapter

## Mission of the Biomedical Engineering Program

 To be a recognized leader in translational biomedical research; to provide hands-on education focused on solving real world biomedical problems; and to foster innovation and entrepreneurship in the service of human well being.

## Program Educational Objectives



 Program Educational Objectives are defined as career and professional accomplishments that are to be achieved within the first few years of graduation.

## Program Educational Objectives



- Our MS-BME Program is designed to produce graduates who are prepared to:
  - 1. Are able to solve complex engineering problems and tasks, and use engineering, science and statistics principles to justify recommendations.
  - 2. Are able to evaluate the impact of their work on society, including ethical, economic, global and environmental aspects.
  - 3. Can deliver effective presentations of engineering results in written and oral formats.
  - 4. Have life-long learning skills and are able to apply their engineering knowledge to critically evaluate relevant literature and new technologies or systems.
  - 5. Are effective leaders, capable of working in diverse environments.
  - 6. Are able to apply their engineering education to a variety of career paths.

## Succeeding in our Program



- Curriculum Requirements
- Explore new areas, innovate
- Participate in BMES initiatives
  - Annual Biomedical Device Conference
  - Peer mentoring
  - Industry field trip
  - Social events
  - Hiking, volleyball

## MS Program features



- Diverse
  - Full time students
  - Working professionals
- Interdisciplinary
- Integrates skill sets necessary for professional success into curriculum

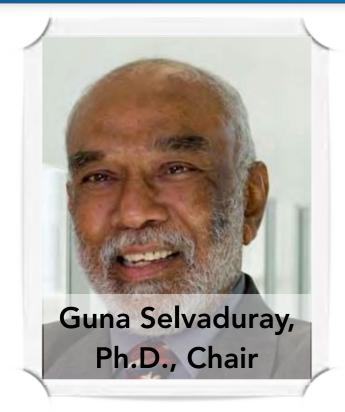
## People



- Faculty
- Industry Advisory Committee
- Students

## Faculty













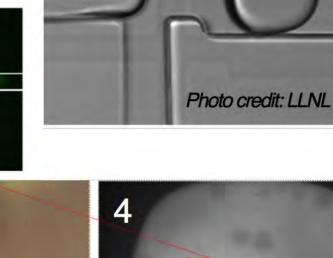


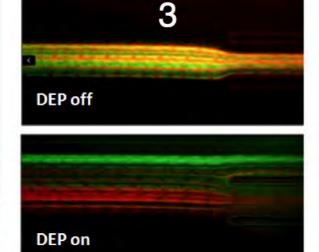
- Ph.D. Biomedical Engineering University of California, Irvine
- M.S. Biomedical Engineering University of California, Davis
- B.S. Chemical Engineering University of Cincinnati

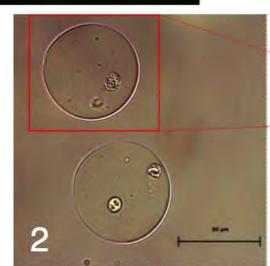
#### Lab expertise:

- Production of picoliter, nanoliter droplets
- 2. Cell encapsulation using microfluidics
- Cell sorting using dielectrophoresis (DEP)
- Droplet manipulation using EWOD
   (electrowetting-on-dielectric) technology





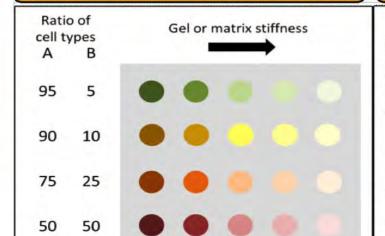






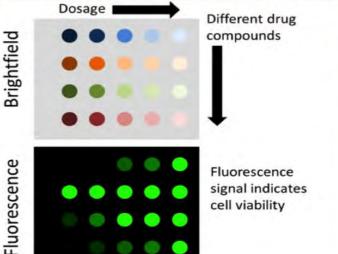
Cancer cells encapsulated in alginate beads. (right) Alginate beads inside a 0.3  $\mu$ L droplet on an EWOD device.

## Research interests

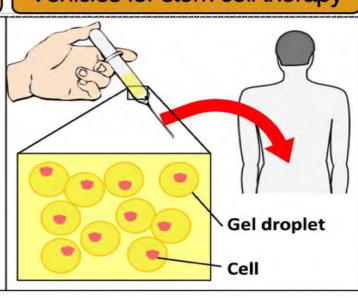


Tissue engineering screening

#### Drug dosing/toxicity studies

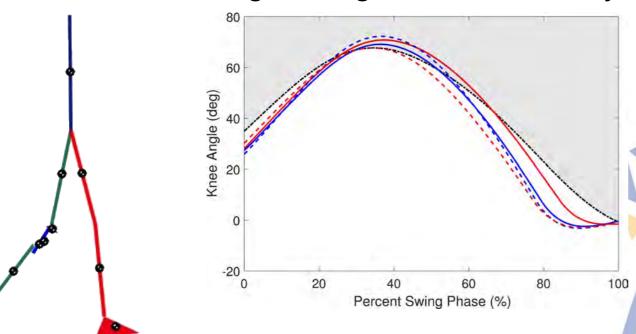


#### Vehicles for stem cell therapy



#### **Matt Leineweber**

Ph.D. Mechanical Engineering, Cornell University M.S. Mechanical Engineering, Cornell University



**Research Interests** 

- Research-driven design of mobility assistive devices in real-world environments
- Computer simulations of human gait with lowerlimb prostheses
- Use of additive manufacturing for flexible and low-cost prostheses
- Developing sensory biofeedback systems for lower-limb amputees

Sensory Information

Simulating gait with lower-limb prostheses to improve device design and promote healthy

movement

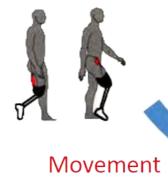




Vibratory Feedback









Incorporating biofeedback technology into lower-limb prostheses

3D printing with flexible materials for a lightweight and functional infant hand prosthesis

Ph. D. Biophotonics – University at Buffalo (SUNY) B.S. Chemical Engineering – University at Buffalo (SUNY)

#### Research Interest:

Elucidating the fundamental relationships between nanoparticle synthesis conditions and desirable nanoparticle properties for biomedical applications.

#### **Recent Publications:**

Erogbogbo et al., Theranostics 3 (9), 719, 2013

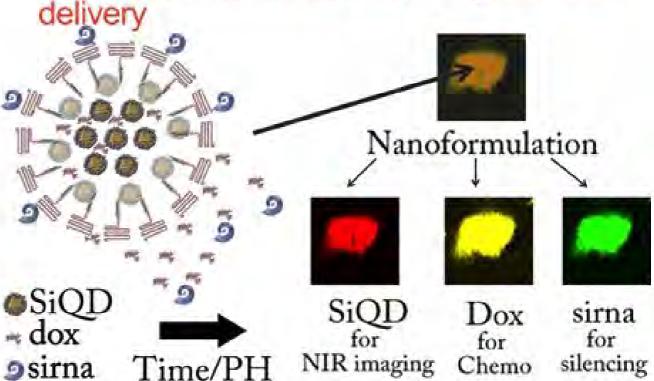
Erogbogbo et al., ACS Nano 7 (8), 7303-7310, 2013

#### Lab Expertise:

Gas phase synthesis of nanoparticles

Engineering silicon for biomedical applications

NIR Silicon QD for tracking Drug and RNA



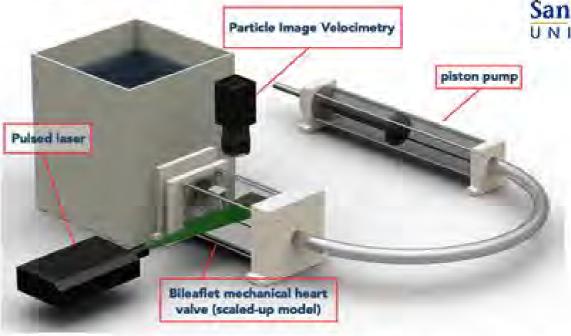
Ph. D. Chemical Engineering – Universitá Federico II, Napoli, Italy M.S. Chemical Engineering – Universitá Federico II, Napoli, Italy



San José State

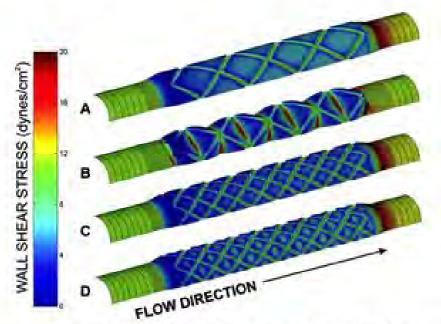
#### Research Interests

Fluid mechanics of biomedical devices, Hemodynamics, Cardiovascular mechanics, Particle Image Velocimetry



Scaled-up model of a mechanical heart valve. The experiment was designed to investigate the shear-induced blood damage due to the valve.

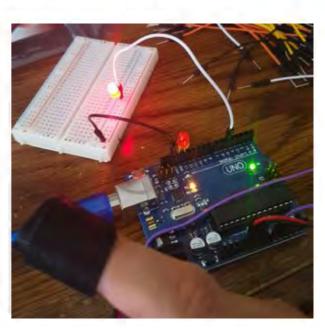
### Current Projects



Numerical investigation of the hemodynamic performance of drug-eluting stents (Image from LaDisa et al., 2005)



In Vitro Hemocompatibility Test Methods for Coronary Stents (www.chandler-loop-system.de)



Wearable devices for monitoring heart function

Ph. D. Extractive Metallurgy – Stanford University
M.S. Materials Sci & Engr – Stanford University
B. Engr. Mechanical Engr – Tokyo Institute of Technology



#### Research Interests

Surface modifications and biocompatibility of implantable materials
Solder joint reliability

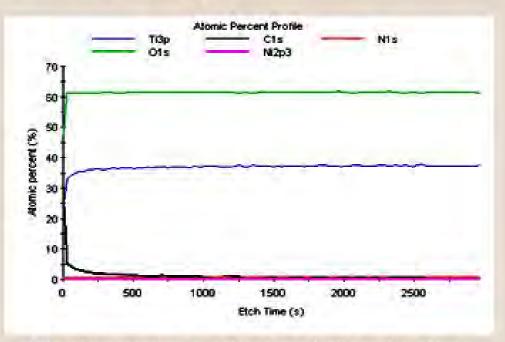
#### **Current Projects**

Dip-coating of hydroxyapatite on Ti substrates

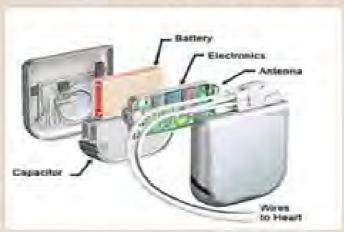
Development of Ni-free TiO<sub>2</sub> coating on Nitinol

Development of natural fiber reinforced composites for orthopedic applications

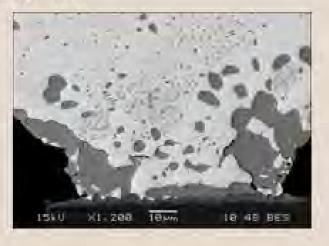
Creep of Pb-free solders for medical electronics Biomimetics



X-ray photoelectron spectroscopy depth profile of the specimen nitrided in 96% N<sub>2</sub> + 4% H<sub>2</sub> at 1000°C for 20 min and oxidized in air at 700°C for 60 min.



Electronic components of defibrillator; Source: http://www.heartonline.org/defibrillator.htm (Accessed Sept 5, 2012)



Solder joint creep failure

## Industry Advisory Council





Jennifer Matteus

Director, Stryker

Neurovascular



Ray Chia, Ph.D. Senior R&D Manager Am Med Systems



Maurino Flora

Managing Director

APOMed Consultants



Todd Thompson
Proteus Digital Health



Michael Reo Industry Veteran Consultant



Felix Vega, D. V. M. Preclinical Consultant



Michael Passaglia Cannon Quality Group

#### **Other Members**

Kamel Chair, M.D. Stryker Neurovascular

Greg Bennett

Abaxis

Celia Holmes Intuitive Surgical

Roger Guidi Healthcare Associates

Janie Mandrusov, Ph.D. Sinopsys

# BIOMEDICAL ENGINEERING SOCIETY

**Preview** 

## **BMES SJSU Student Chapter**





Hanna Vu President



Jessica Horton VP - Conference



Ben Phung • VP - Events



Suzanne Estella Secretary



Kevin Wiest Treasurer

BMES Clubroom: room E 182

Get involved!

## About us



#### Purpose

Promote the professions of BME through study, research, & discussion

#### Mission

Supplement academic knowledge gained in class with professional, community, and social activities.

#### Goal

Provide benefits and value to our members and the University as a whole

#### **Programs**

- Outreach
- Mentorship
- Health and Fitness
- BMEidea

#### **Events**

- National BMES Conference
- Bay Area Biomedical Device Conference
- General Meetings
- Company Tours
- Guest Speaker Events

#### How to join

- Obtain Membership from the National BMES
  - a. Bmes.org
  - b. \$30 for students
- 2. Forward your confirmation email attached with the contract to us <a href="mailto:sjsubmes@gmail.com">sjsubmes@gmail.com</a>
- 3. Fill out Membership Update form on our Website

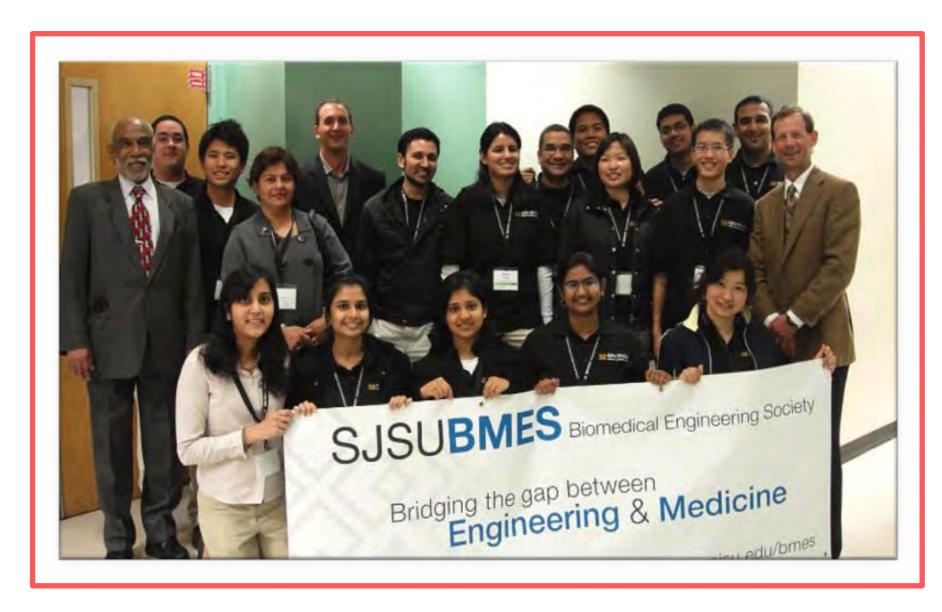
http://www.sjsubmes.org/ membership

# How to get your door code

- 1. Be a BMES Member
- 2. Fill out Clubroom Rules Contract
  - a. Complete electronically (recommended)
- 3. Email us the Contract: <a href="mailto:sjsubmes@gmail.com">sjsubmes@gmail.com</a>

## Chapter history





since 2008

Students, alumni, faculty, and industry professionals collaborating

## **Awards**



- 2010 BMES Student Chapter Honorable Mention Award, BMES National
- 2010 Outstanding New Program at San Jose State University, AS SJSU
- 2011 Student Chapter Meritorious Performance Award, BMES National
- 2012 Outstanding Student Chapter Award, BMES National
- 2012 Student Leadership Award, AS SJSU
- 2012 Advisor of the Year, AS SJSU
- 2014 Outstanding Student Chapter Award, BMES National
- 2015 Most Creative Design, UC Davis
- 2016 Student Chapter Meritorious Performance Award, BMES National
- 2018 Commendable Achievement Award, BME National

## 10th Annual Bay Area Biomedical Device Conference



### Annual Meeting of the BMES (National)





# MS program Curriculum Requirements

### Entry requirements



• B.S. in engineering, physics, chemistry, biology

 If undergrad GPA > 3.00 then GRE not required

else GRE: > 315 (Sections 1, 2) + 3.5 (Section 3)

#### **Curriculum Overview**



Transition courses



Engineering, math, science, biology fundamentals

BME Core



BME breadth

BME electives





BME depth

#### Transition courses: lower division classes



- BME 65\*# Biomedical Applications of Statics
- BME 68\*# Biomedical Applications of Metals and Ceramics
- EE 98\*# Introduction to Circuit Analysis
- Chem 1A\* General Chemistry
- Chem 1B\* General Chemistry
- Phy 50\* General Physics
- Phy 51\* General Physics

1 year of Chemistry

1 year of Physics

<sup>\*</sup> Lower Division classes can be taken at community colleges

<sup>#</sup> Needs special permission: email me with your name, student ID and Course Section number

### Transition courses: upper division classes



- CE 112# Mechanics of Materials
- Math 123 (or 133A) Ordinary Differential Equations
- BME 147 Quantitative and Statistical Methods in BME
- BME 115 Foundations of Biomedical Engineering

#### Enrolling in Transition Courses

- Enroll as soon as possible to make sure you have a space
- Follow directions sent out by BME Advisor
  - Mechanism to enroll in each class is slightly different
- Not taking Transition Courses in a timely manner will delay your progress towards your degree

<sup>#</sup> Needs special permission: email me with your name, student ID and Course Section number

### Change of classification



- As long as you still have transition courses to complete, you will have a conditionally classified standing.
- Once you complete all your transition courses with B or better, you can change your classification to **classified standing**.
  - You initiate the process by submitting a **Change of Classification form** to the Graduate Advisor.
- **Note**: having a classified standing (without condition) is a prerequisite to start your MS project/thesis.

#### BME core



- BME 207: Experimental Methods in BME
- BME 210: Mathematical Methods in BME
- BME 272: Medical Device Design & Principles
- BME 274: Regulatory, Clinical and Manufacturing Aspects of Medical Devices
- BME 177: Physiology for Engineers
- BME 291: Project/Thesis Preparation Seminar

#### **BME** electives



- BME 117: Biotransport Phenomena
- BME 165: Applied Engineering Biomechanics
- BME 168: Medical and Biological Polymers
- BME 182: Prosthetics and Orthotics
- BME 188: Biomedical Manufacturing Methods
- BME 254: Microscale Biomedical Systems
- BME 256: Biomedical Applications of Nanoplatforms
- BME 258: Biomedical Imaging
- ME 267: Engineering Biomechanics
- BME 272: Biomedical Device Design and Principles
- BME 288: Tissue Engineering

### MS Thesis/Project Options



#### Project option:

BME Core: 15 units +
BME Electives: 12 units (4 classes) +
BME 291: 1 unit MS Thesis/Project Preparation Seminar +
BME 298: 2 units MS Project =

#### 30 units

#### • Thesis option:

<ul><li>BME Core:</li></ul>	15 units		+
<ul><li>BME Electives:</li></ul>	9 units	(3 classes)	+
• BME 291:	1 unit	MS Thesis/Project Preparation Seminar	+
• BME 298:	2 units	MS Project	+
• BME 299:	3 units	MS Thesis	_

#### Recommended Class Sequence



- Transition Courses
- Engr 200W, BME Core
- BME 291 + Electives
- Project/Thesis (BME 298/299)

#### Prerequisites for BME 291



- All Transition Courses completed
- Engr 200W with B or better
- Minimum 9 units towards MS degree
- Change of Classification form filed
- Candidacy form filed
- Good academic standing GPA > 3.0
- Thesis/Project topic and advisor identified



- Before you begin BME 291
  - identify technical advisor, topic and team members
  - complete short reading/writing assignments (lit review, specific aims...)
  - obtain access to the lab (requires completing online training and test)
  - identify required training (instrumentation, software...), budget and funding opportunities, dissemination plan.
- A word of advice: get started at least one semester before you enroll in BME 291.



- During the BME 291 semester
  - Write your project proposal
  - Defend your proposal
  - Complete all the required training (instrumentation, software)
  - Obtain necessary clearance for your research: IRB, IACUC



- During the BME 298/299 semester
  - Perform your experiments
  - Write your final report
  - Disseminate your results
  - Defend your project

- The time to complete your MS project/thesis is not fixed.
  - It depends on a number of more or less predictable variables, including but not limited to the time and effort you put into it.
  - If you need to extend your project into one or more semesters where you don't have any other classes to complete, you will be required to **enroll in UNVS 1290R**, to maintain continuous enrollment.



- After you successfully defend your project/thesis
  - Finalize and submit your final report
  - Collect and submit all the required paperwork
  - Complete your project close-out and handover
  - You graduate!

#### Program requirements



- Maintain GPA > 3.0 in all coursework
  - Lower division courses do not count towards GPA
- Courses for MS degree must be C or better
- 30 semester units of approved courses
- Meet university's English proficiency requirement
  - Does not count towards 30 units for M.S. degree
- Complete Thesis/Project Proposal Examination (BME 291)
- Complete Thesis/Project Defense
- Submit written Thesis or Project Report
- Note: there is a 7-year limit on course validity.

### **English Competency Requirement**



- University requirement: all graduate students must demonstrate competency in written English.
- Four pathways to meeting this requirement
  - Have documented proof of having completed an upper division technical writing class with B or better; this class needs to be acceptable at SJSU
  - Submit proof of competency in written English, e.g., paper published in peer reviewed journal with student as sole or principal author
  - Take the university's Writing Skills Test (WST)
    - you may earn a "waiver" for Engr 200W
  - Take Engr 200W with B or better



- Advising is mandatory every semester.
  - Advising Hold will be removed only after Advising form is submitted and approved
  - Please: follow directions!
- Transfer from Conditionally Classified standing to Classified standing, when Transition Courses have been completed
  - Fill out and submit Change of Classification form
  - Fill in all of your information AND each Transition Course, when taken, where taken, grade obtained.



- Candidacy form
  - aka Petition for Advancement to Graduate Candidacy
- Before you can submit your candidacy form, you must have:
  - Completed all Transition Courses
  - Changed your Classification to Classified standing
  - Completed a minimum 9 of graduate units
  - No more than 9 units of 100-level classes
  - Completed the University's English proficiency requirement



- Candidacy form
  - aka Petition for Advancement to Graduate Candidacy
- The form must be filed at least one year before graduation and before beginning BME 291.
- List only courses to be counted towards MS degree
  - Do not include Transition Courses or Engr 200W
  - Enter classes in appropriate categories
- The total number of units must add up to 30, with GPA > 3.0
- Your grade in each course must be C or better



#### Course Substitution Form

- This form must be submitted **only if** you are changing any of the elective courses listed in the Candidacy form.
  - List course(s) to be dropped and course(s) to be added.



Application for Graduation

- Must be submitted at least two semesters ahead
  - submit directly to GAPE



- Verification of Culminating Experience
- To be filled out and filed after
  - thesis/project defense completed, AND
  - written report/thesis submitted and approved, AND
  - all other requirements for the MS degree have been met.
- The Graduate Coordinator submits this form upon verification from project/thesis advisor that all requirements have been completed.
- You will not graduate until this form is submitted.



- Clear grades for BME 298/299
  - Make sure that the instructor for BME 298/299 submits a grade for you
  - BME 298/299 will carry a "RP" grade until everything is completed, including submission of thesis
- All forms issued by Graduate Studies Office can be found at:
  - http://www.sjsu.edu/gape/forms
- All forms must be submitted electronically.
- Please submit all forms to Graduate Advisor, for review, approval and forwarding to GAPE.

#### Other relevant information



- All forms electronically available at:
  - http://www.sjsu.edu/gape/forms
  - Electronic submission is a requirement
  - Keep copies of all paperwork submitted

### Student Rights & Responsibilities



- Rights
  - Fair grading demand it!
  - Access to records (only your own)
  - Office hours use it!
- Responsibilities
  - Academic honesty
    - no cheating, no plagiarism
    - do not give or receive unauthorized assistance

### Important dates: Fall 2019



#### SJSU ACADEMIC YEAR CALENDAR 2019/20\*

#### **FALL 2019**

Thursday	July 4	Independence Day - Campus Closed (I)
		Academic Year Begins - Fall Semester Begins
		Pre-Instruction Activities: Faculty Orientation, Advisement, Faculty Meetings and Conferences (P)
Wednesday	August 21	First Day of Instruction – Classes Begin
		Labor Day - Campus Closed (L)
		Last Day to Drop Courses Without an Entry on Student's Permanent Record (D)
Tuesday	September 10	Last Day to Add Courses & Register Late (A)
		Enrollment Census Date (CD)
		Veteran's Day (Observed) - Campus Closed (V)
		Non-Instructional Day – (NI)
		Thanksgiving Holiday - Campus Closed (T)
The state of the s		Rescheduled Holiday - Campus Closed (RH)
		Last Day of Instruction - Last Day of Classes
: : : [1] [1] [1] [1] [2] [2] [2] [2] [2] [3] [4] [4] [4] [4] [4] [4] [4] [4] [4] [4		Study/Conference Day (no classes or exams) (SC)
		Final Examinations (exams)
나를 하는 것도 하는 이렇게 하면 어떻게 다른 그렇게 들어가 되었다. 이렇게 되어 하게 하라고 했다.		Final Examinations (exams)
그래요 그렇게 그렇게 그렇게 그렇게 하는 것 같아. 회원에 나가 없었다면 그 것이다면 그는 경기를 하는 것이다. 그렇게 되었다는 것 같아.		Final Examinations Make-Up Day (MU)
		Grade Evaluation Day (E)
		Grades Due From Faculty - End of Fall Semester (G)
보이보는 것은 점점 이 없었다면 하는 사람이 되었다는 그 회사에 되었다면 하는 것을 때문에 모르겠다면 그렇게 되었다.	December 18-19	(1)에 되면 : 말았습니다. 1 x 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
		Christmas Holiday - Campus Closed (CH)
The second secon	December 25	

#### Fall 2019 BME courses



- BME 115: Foundations of BME
- BME 117: Biotransport Phenomena
- BME 130: Numerical Methods in BME
- BME 147: Quantitative and Statistical Methods in BME
- BME 168: Medical and Biological Polymers
- BME 177: Physiology for Engineers
- BME 188: Medical Device Manufacturing Methods
- BME 198A: Senior Design Project I
- BME 256: Biomedical Applications of Nanoplatforms
- BME 274: Regulatory, Clinical and Manufacturing Aspects of Medical Devices
- BME 291: MS Thesis/Project Preparation Seminar
- BME 298/299: MS Project/Thesis

# Conditions for probation and disqualification

#### Probation

- Based on overall GPA
- IF overall GPA falls below 3.0

#### Continued Probation

- IF overall GPA < 3.0, BUT
- your last completed semester GPA > 3.0

#### Disqualification

- IF 2 consecutive semesters with an overall GPA < 3.0, AND</li>
- a semester GPA ≤ 3.0

#### Reinstatement



- When and why:
  - You have been disqualified and want to get back in
- Reinstatement Procedure:
  - Must obtain, complete, and submit Reinstatement Petition
    - from Registrars Office to MSE Office (E 491)
  - Select Program of Study option on petition
  - Program Director will identify two 100-level technical courses to take
    - you must get a grade of B+ or better in both to be reinstated
    - you cannot take graduate-level courses
  - Must apply for readmission

#### More about SJSU



- Classes harder to enroll, especially UG classes
  - Enroll as early as you can!
- Parking bad
- International Student Services
  - (Clark Hall Room 543)
- MLK Jr Library
  - Online Search & Interlibrary Loan Services
  - Largest public library west of the Mississippi
- Event Center & Exercise Facilities
- Spartan Bookstore
- Good restaurants within walking distance



I remember meeting with you for the first time. I was just beginning my career as an engineer and a graduate student, and I wasn't quite sure what to expect from the program. However, I leave the program with a vast array of new knowledge and skills that will be useful in my career for many years to come. I am proud to have been part of such a distinguished program and I look forward to hearing about more of the great things to come from SJSU and SJSU's BME program.

Alexis Dong - MS BME 2016

## Thank you very much for your attention!



Questions
Comments
Ideas
Anything else???

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### Welcome to SJSU