Mechanical and Aerospace Engineering Graduate Students Orientation

Prof. Jerry Shan

Graduate Program Director

September 1, 2017

Welcome

Chair of

Mechanical and
Aerospace Engineering

Professor

Alberto Cuitino

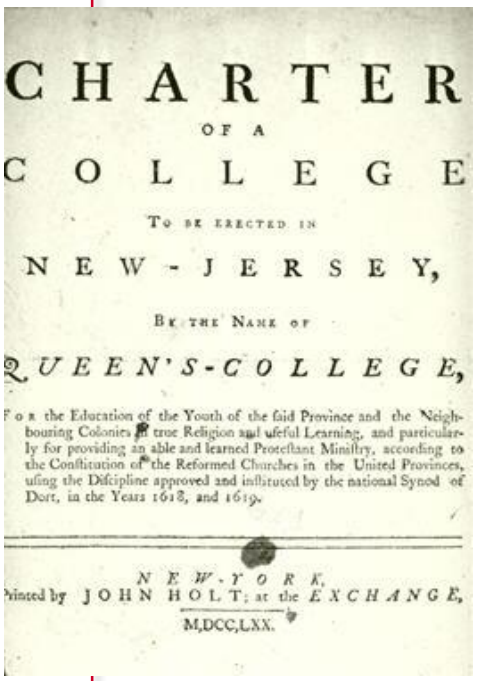
Mechanical and Aerospace Engineering

Today, we will discuss:

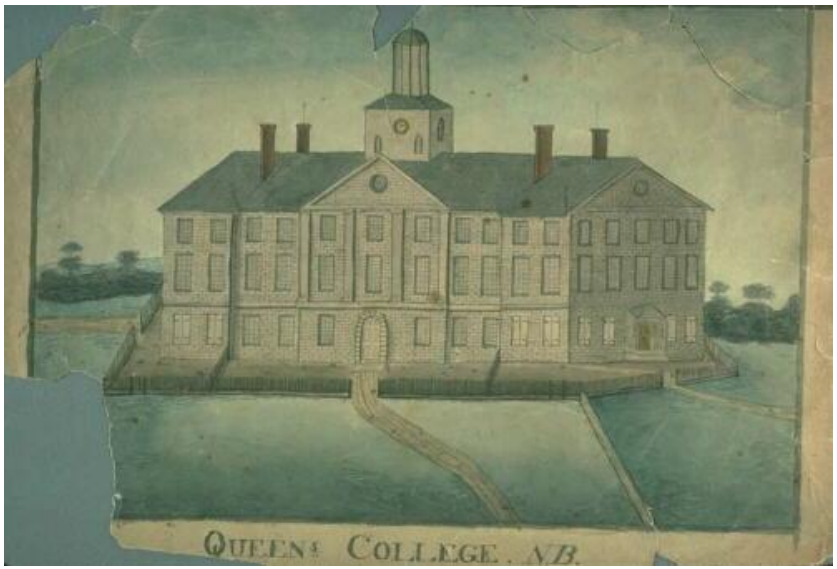
1. **Rutgers History & Highlights**
2. Department Organization
3. Degrees Offered and Requirements
4. Courses Offered
5. Choosing a Project/Thesis & Advisor
6. Mechanical Engineering Graduate Students Association (MEGA)
7. Expectations, Funding, To-dos (Today)
8. Research Highlights (by Faculty)

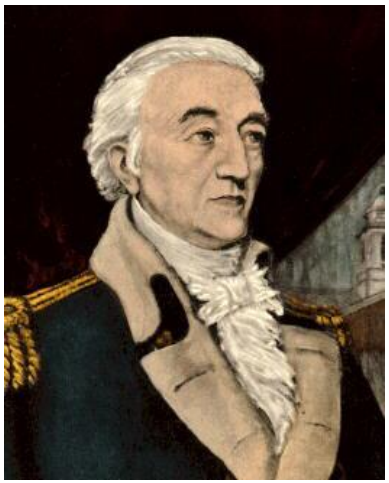
Rutgers History

1766 Chartered as **Queen's College** in New Brunswick, New Jersey.



CHARTER
OF A
COLLEGE
TO BE ERECTED IN
NEW-JERSEY,
BY THE NAME OF
QUEEN'S-COLLEGE,
For the Education of the Youth of the said Province and the Neighbouring Colonies in true Religion and useful Learning, and particularly for providing an able and learned Protestant Ministry, according to the Constitution of the Reformed Churches in the United Provinces, using the Discipline approved and instituted by the national Synod of Dort, in the Years 1618, and 1619.
NEW-YORK,
Printed by JOHN HOLT; at the EXCHANGE,
M,DCC,LXX.



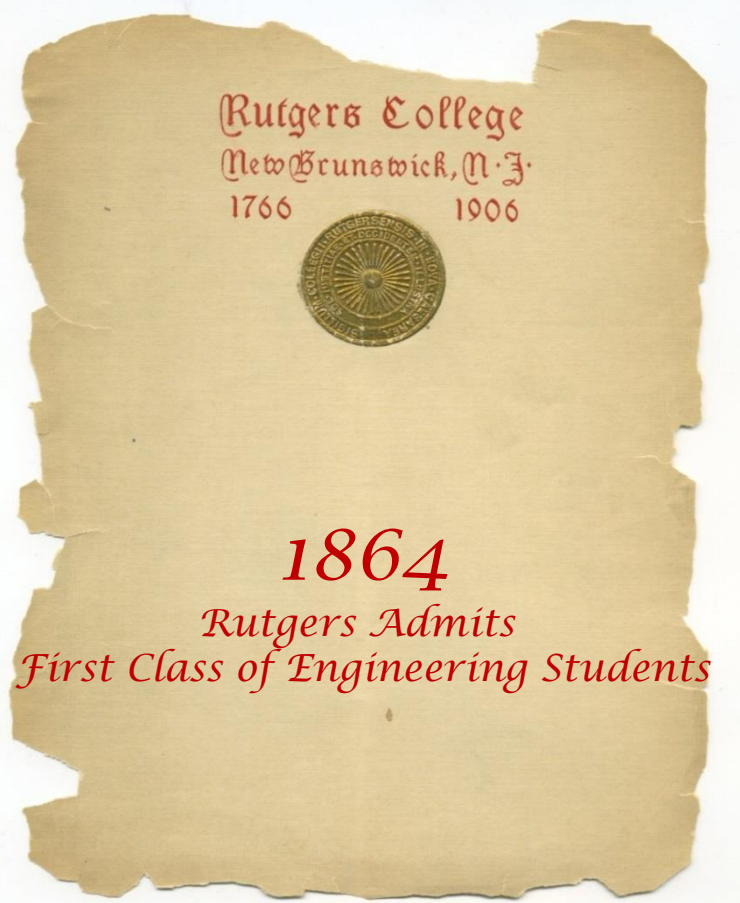


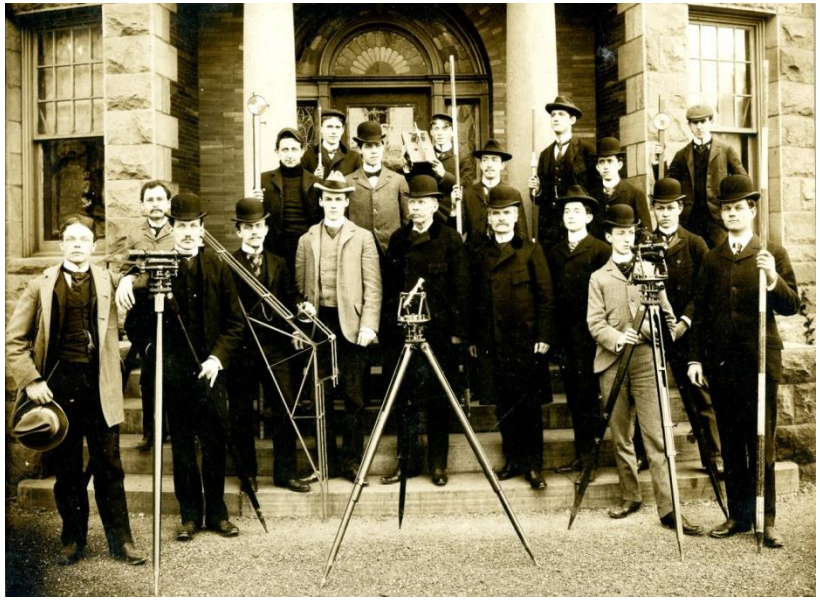
1776 American Revolutionary War

1825 Renamed as **Rutgers College** in honor of trustee and Revolutionary War veteran Colonel **Henry Rutgers**.

Engineering Begins

1864 The state legislature picks the **Rutgers Scientific School** over Princeton University to be the state land-grant college, which marks the beginning of the **Engineering** programs at Rutgers.





Joining the Big Ten

2012 **Rutgers** joins the **Big Ten**.

2014 **Rutgers University-New Brunswick** ranks **33rd** among world's top universities and **24th** among the US universities according to **Center for World University rankings.**

250th Anniversary

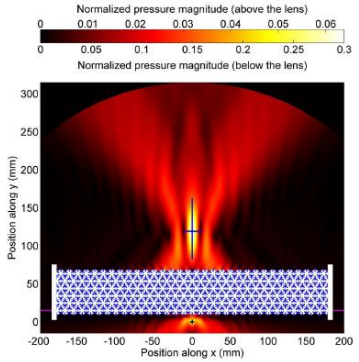
2016

Rutgers celebrates its **250th Anniversary**.

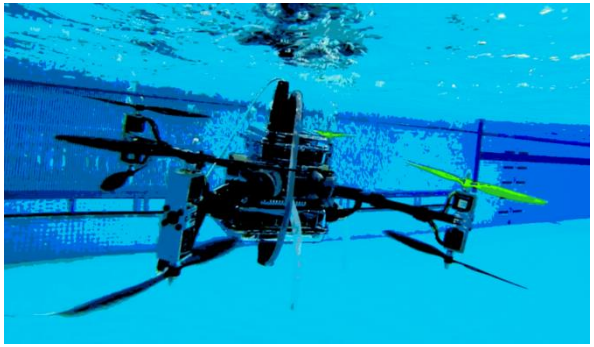
President Barack Obama speaks at Rutgers Commencement

Research Leadership

- MAE Department is among the top 20% in the nation based on faculty reputation and productivity (Academic Analytics)



Prof. Norris



Prof. Diez

NEWS

Braille Maps for Blind and Visually Impaired Created with 3-D Printing Technology at Rutgers

An engineering student and professor help the blind and visually impaired in the Joseph Kohn Training Center in New Brunswick to navigate their surroundings

Monday, February 22, 2016

By Todd B. Bates

Using a high-tech 3-D printer, a Rutgers undergraduate and his professor created sophisticated braille maps to help blind and visually impaired people navigate a local training center.

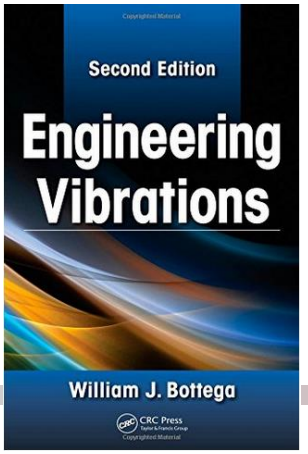
The three plastic tactile maps are for each floor at the Joseph Kohn Training Center, a state-funded facility for the blind and visually impaired in New Brunswick. And the goal is to print maps for all of the center's students.

"It was a very fulfilling experience," said Jason Kim, 25, a senior mechanical engineering student in the Department of Mechanical and Aerospace Engineering in Rutgers' School of Engineering. "I learned a lot. The most difficult part was trying to imagine what it would be like to

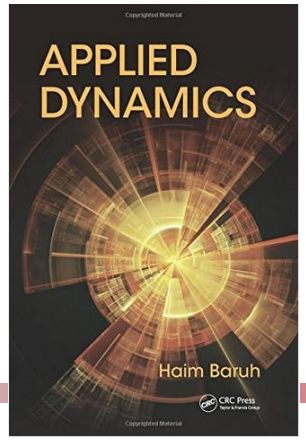
Photo: Cameron Bowman
Engineering student Jason Kim and Howon Lee, assistant professor in

Prof. Lee

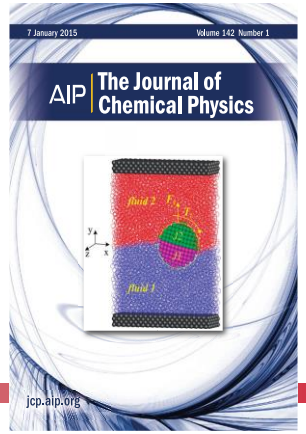
- Recent books/covers



Prof. Bottega



Prof. Baruh



Cover *JCP*, Profs. Zadeh & Drazer

World-Class Faculty

Selected recent faculty awards

- Xiaoli Bai
  - 2016 Air Force Young Investigator Award
- Liping Liu
  - 2015 American Society of Mechanical Engineers Best Paper Melville Medal
  - 2015 Society of Engineering Sciences Young Investigator Medal
  - 2014 American Society of Mechanical Engineers Young Faculty Eshelby Mechanics Award
  - 2014 National Science Foundation CAREER Award
- Aaron Mazzeo
  - 2016 NSF CAREER award
  - 2014 A. Walter Tyson Young Investigator Award (SoE)
- Andy Norris
  - 2014 SoE Faculty of the Year Award
  - 2014 American Society of Mechanical Engineers Per Bruel Gold Medal
- George Weng
  - 2014 Society of Engineering Sciences William Prager Medal

Mechanical and Aerospace Engineering

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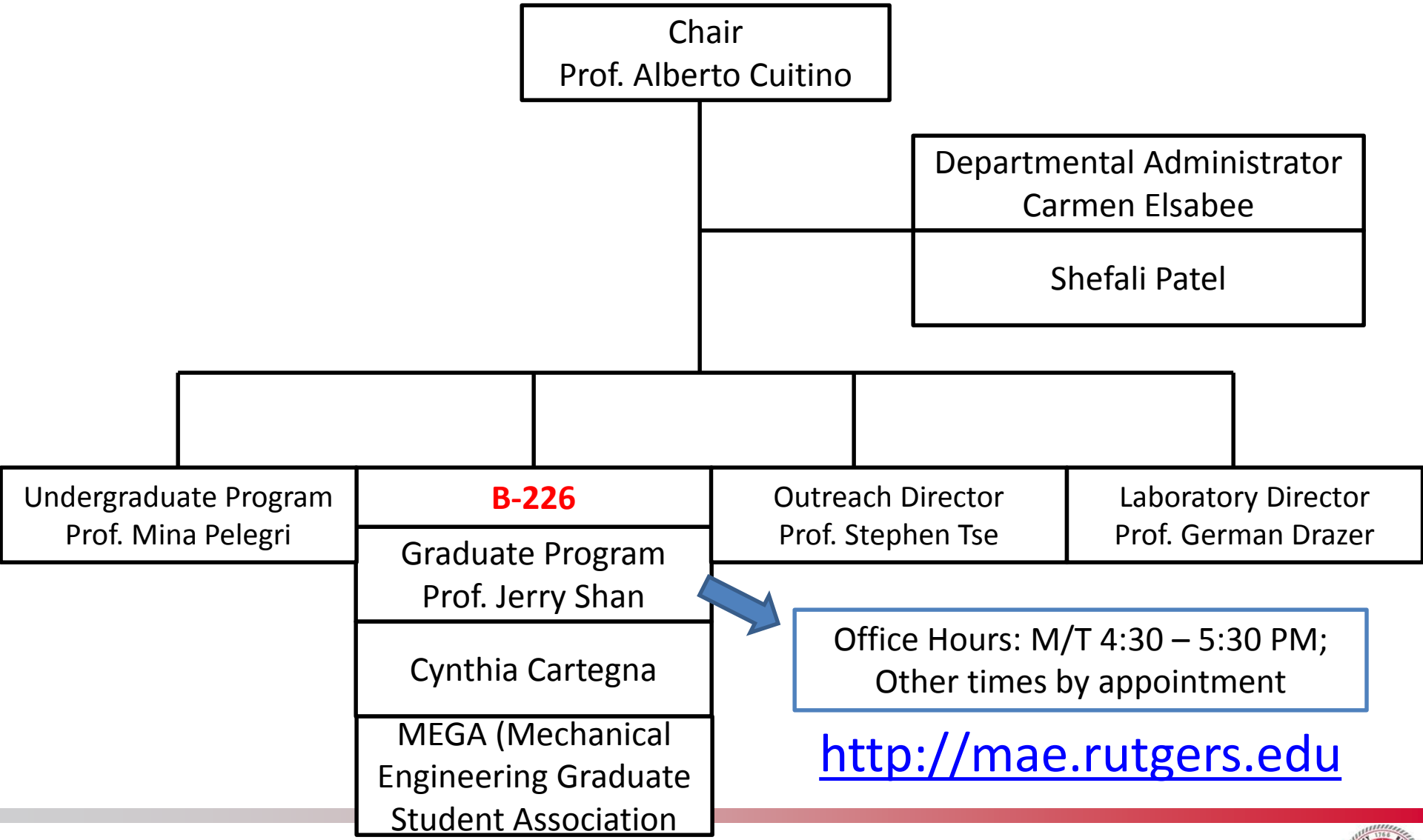
Mechanical and Aerospace Engineering



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Graduate Degrees Offered

Master of Science

Master of Engineering

Doctor of Philosophy

Graduate Degrees Offered

Master of Science (MS)

- 24 course credits + 6 research credits
- Thesis

Master of Engineering (MEng)

- 30 course credits
- Report & Presentation

Doctor of Philosophy (Ph.D.)

- 48 course credits + 24 research credits
- Qualifying and candidacy exams
- Dissertation

Course Credits (MS, MEng)

Master of Science (MS)

- 24 course credits + 6 research credits

Master of Engineering (MEng)

- 30 course credits

For both:

- B and above average, max 1 C grade
- Max 1 independent study
- Min 5 MAE courses (MS), 7 MAE courses (MEng)
- 1 Math 642: 527
- Seminar (1 course credit, minimum 2 semesters, max 3 semesters)

Specialized Certificates (MS, MEng)

Three specializations with guided sequence of courses (additional information online)

- Advanced Manufacturing (example below)
- Robotics
- Space Systems

1st Semester (10cr)

Required	642:527 Math	3cr
Required	650:530 Fluid Mechanics 1	3cr
Required	650:570 Conduction Heat Transfer	3cr
Required	Seminar	1cr

2nd Semester (10cr)

Required	Mech. of Advanced Manufacturing	3cr
Required	Seminar	1cr
Manufacturing Elective	(Choose one from the list below)	3cr
Technical Elective	See below	3cr

3rd Semester[3] (10cr)

Required	650:550/4 Mechanics of Materials/Continua	3cr
Required	Seminar	1cr
Manufacturing Elective	(Choose one from the list below)	3cr
Manufacturing Elective	(Choose one from the list below)	3cr

Course Credits (Ph.D.)

Doctor of Philosophy

- 48 course credits + 24 research credits
  - B and above average, max 2 C grades
  - Max 2 independent study
  - Min 10 MAE courses
  - 2 Math 642: 527, 642:528
  - Seminar (1 course credit, 6 semesters required)
  - One graduate level course from each area within MAE

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Mechanical and Aerospace Engineering

Four areas of specialization:

1. Design and Control (D)
2. Fluid Mechanics (F)
3. Mechanics of Solids, Materials and Structures (S)
4. Thermal Sciences (T)

Classes Offered in Fall 2017

- 650:504 Adv. Control I
- 650:512 Robotics
- 650:530 Fluid Mechanics I
- 650:550 Mech. of Materials
- 650:554 Mech. of Continuum
- 650:570 Conduction Heat Trans
- 650:562/563 CTEC Discovery to BUS 1
- 650:651 Plasticity
- 650:664 Fracture

⋮

- 642:527 Math
- 650:608 Seminar

Take 2 or 3 of these plus Math and Seminar

Add deadline is September 11th
Drop deadline is September 18th

- Attendance will be taken
- Please behave professionally

Selected senior-level undergraduate courses can also be taken with permission

2-year Course Offering Plan

				F17	S18	F18	S19	F19	S20
		650:504	Adv. Control I	X		X		X	
		650:505	Adv. Control II				X		
		650:514	Design Mechanism/Mechanisms of Robotics		X			X	
		650:524	Optimal Design		X		X		X
		650:522	Analytical Dynamics		X		X		X
		650:550	Mechanics of Materials	X		X		X	
		650:554	Continua (SM I)	X		X		X	
		650:556	Elasticity (SM II)		X		X		X
		650:512	Robotics	X		X			X
		650:651	Plasticity (SM III)	X				X	
		650:652	Composites (SM IV)				X		
		650:653	Structural Mech (SM V)			X			
		650:654	Dyn.Solid Struct. (SM VI)		X				X
		650:664	Fracture (SM VII)	X				X	
		650:660	Comp. Solid (SM VIII)		X		X		X
		650:567	Spacecraft Dynamics & Control			X			X
		650:569	Mechanics of Advanced Manufacturing		X			X	

Design & Control (required topic for PhD qualifying exam)

Design & Control (elective topic for PhD qualifying exam)

Solid Mechanics (elective topic for PhD qualifying exam)

2-year Course Offering Plan

				F17	S18	F18	S19	F19	S20
		650:530	Fluids I	X		X		X	
		650:570	Conduction	X		X		X	
		650:574	Thermodynamics		X		X		X
		650:630	Fluids II		X		X		X
		650:578	Convection		X		X		X
		650:582	Comput. Heat Transfer			X			
		650:670	Combustion	X				X	
		650:674	Radiation HeatTransfer		X				X
		650:532	Exptl. Fluid Mechanics				X		
		650:534	Comput. Fluid Mechanics		X				X
		650:634	Compressible Flow			X			
		650:631	Micro/Nano Fluids Mech.					X	

Fluid Mechanics (required topic for PhD qualifying exam)

Thermal Sciences (required topic for PhD qualifying exam)

Design & Control (elective topic for PhD qualifying exam)

Credit Requirements

- Full-time: 9 credits (Maximum 16 credits)

- GA: 6E credits(650:866) + max 10 (9+1) credits
- TA: 6E credits(650:877) + max 10 (9+1) credits
- Fellowship : 0E credits(650:811) + max 16 (15+1) credits

- Research Credits: 650:701

Topics for PhD Qualifying Exam

- Four subject-area tests plus Math:
  - Fluids Mechanics
    - Fluids, Advanced Fluids, Thermodynamics, Conduction
  - Mechanics of Solids, Materials & Structures
    - Dynamics, Mechanics of Materials, Continua, Elasticity
  - Thermal Sciences
    - Fluids, Conduction, Thermodynamics, Convection
  - Design & Control
    - Analytical Dynamics, plus three other subjects and math
- Offered in May
  - Taken either at end of 1st or 2nd years

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Choosing Project & Advisor

- Consider:
  - Interests?
  - Future goals?
  - Personality/fit in group?
  - Funding?
- Make appointments to talk to faculty
- Talk to senior students
- Choose by end of Fall Semester
  - Return Advisor-Advisee agreement to Ms. Cindy Cartegna (B226)

List of Topics

- Link to google sheet will be emailed to you.

Advisor Name	Office	Email	Title of Project	(Optional) Brief comments, description or link to website	Name of selected student
Prof. P. Bagchi	B244	pbagchi@jove.rutgers.edu	Computational Fluid Dynamic Modeling of Blood Flow at Microscale	MS: Multidisciplinary research encompassing CFD, fluid structure interaction, blood flow, microfluidics, large-scale computation. Potential application is in the area of cardiovascular disease, and drug design.	
			Computational Fluid Dynamic Modeling of Bacterial Swimming	MS: Multidisciplinary research encompassing CFD, fluid structure interaction, microfluidics, large-scale computation. Application area is cancer cell migration and metastasis.	
Prof. X. Bai			UAV Formation Flight	1 MS: Require background in dynamics, control, and electronics	
Prof. H. Baruh	B-242	baruh@rutgers.edu	UAV Formation Flightedfed	Paper, when folded into a chevron-type shape, exhibits strong resistance to deformation. There are plans to use folded paper as stiffening devices. We have done some experimental work with folded paper and would like to do some numerical modeling, using finite element methods. -> Master of Science Thesis	
			Numerical Integration of Differential Equations Subject to Constraints	In several applications, modeling spacecraft dynamics with quaternions being one example, it is convenient to deal with differential equations subject to constraints. While there is specialized software that deals with such differential-algebraic equations, it is also desirable to analyze the effectiveness of simpler approximate techniques. -> Master of Engineering Project	
Prof. W. J. Bottega			Theoretical Ocular Mechanics: Mechanics of Retinal Detachment	grad students with a mathematical bent: Ph.D. students and M.S. students (interested in progressing to Ph.D. study). Theoretical work (theory, mathematics and computation) pertaining to mechanics of the eye and associated corrective surgery. (see description of "Ocular Mechanics" on MAE website under http://mech.rutgers.edu/laboratories-and-facilities	
Prof. K. Cook-Chennault					
Prof. A. Cuitiño	B235	alberto.cuitino@rutgers.edu	Interfacial topography and cross contamination in bilayer and multilayer tablets	Interfacial topography has a strong influence on the tensile strength of bilayer tablets. The topography and the strength of the layer interface are related to the applied compaction forces and the property of the materials. We will use the Raman spectrometry analysis to identify the materials in each layer of a bilayer tablet and investigate the shape (topography) of the layer interface. We will investigate the topography of the interface at different compaction levels and for different materials. In addition, we will use the data from the Raman spectrometry to compute the extent of cross-layer contamination. Companies: pharmaceutical companies	
Prof. A. Cuitiño	B235	alberto.cuitino@rutgers.edu	Mechanistic characterization of multicomponent tablets	Previous mechanistic analyses of powder compaction are mostly limited to single component tablets. In this project we will investigate the mechanical properties (such as the compactibility and tensile strength) of tablets consisting of two or more excipients and active ingredients. We will do this by varying the contents of the excipients systematically. The project will be experimental measurements coupled with computational simulations, and the outcomes of the project will be integrated into a larger database of material properties. Companies: pharmaceutical and chemical manufacturing companies	
Prof. A. Cuitiño	B235	alberto.cuitino@rutgers.edu	Heat transfer and flow property of granular materials in rotary calciners	Rotary calciners are frequently used for thermal treatment of powders and granular materials in several industrial processes. There is a lack of clear understanding about the heat transfer process, especially when it comes to scale up during transfer of technology from lab scale experiments to large manufacturing scale productions. In this project, we will use the discrete element method (DEM) to model granular flow and heat transfer in lolig calciners. Our goal is to model heat transfer through conduction (heat transfer through contact between calciner and particles, and inter-particle contacts). We might also attempt to add radiation and convection heat transfer mechanisms to our existing models. This project will be part of a bigger catalyst manufacturing consortium of about 10 large chemical companies. Companies: chemical manufacturing companies.	
Prof. A. Cuitiño	B235	alberto.cuitino@rutgers.edu	Device for inline ultrasonic assessment of continuous manufacturing	Design and construct semi-automatic setup to measure material properties of powders and consolidated materials used in the pharmaceutical industry. The setup consists of controllable moving parts and sensors interconnected to perform certain measurements including position, force, gas pressure, etc. to be interfaced to a computer where data are recorded in a single file. Tasks: 1)Design semi-automatic setup to be used for material characterization and draw blueprints in Auto-CAD or similar. 2) Search for and buy parts and pieces needed for the construction. 3)Be in charge of the construction of the setups. This means sending the parts and blueprint to a workshop when tasks are complex or make small tasks in the workshop. 4)Machining knowledge is necessary. 4)Wire, connect and interface setups with computer. Be able to program is a plus. 5) Verify setup and write protocol/manual on how to operate it.	
Prof. M. Denda					
Prof. J. Diez	B238	diez@rutgers.edu	3D Mapping from a drone using Lidar/Stereo Vision	MS student	
Prof. G. Drazer	D158	german.drazer@rutgers.edu	Drop penetration method to characterize pharmaceutical powders	MS student; Experimental work in the NSF Engineering Research Center;	
			Controlled inhibition experiments in porous media and granular systems	MS student; Experimental work in the NSF Engineering Research Center;	
			Molecular dynamics simulations of the motion of colloidal particles in multiphase flows	MS student; Numerical Work;	
			Subsurface transport in fractured rocks to model proppant behavior	MS student; Experimental Work in collaboration with Prof. Zadeh	
			Novel microfluidic separation systems using liquid membranes	MS student; Experimental work	
Prof. H. G. Gea					
Prof. Z. Guo					
Prof. Y. Jaluria					
Prof. D. Knight	B244B	doyleknight@gmx.com	Numerical Simulation of Shock Wave Boundary Layer Interaction	Requires prior experience in C, C++ or Fortran programming.	

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Mechanical Engineering Graduate Students Association (MEGA)

- Representative body for graduate students
- Works with faculty & staff to represent the interests of the department, and improve the educational experience for students
  - Plan activities (Trips, BBQs, potluck dinners)
  - Improve office space
  - Survey students about concerns/needs
  - Organize workshops on job search, internships, etc.

MEGA – Student Organization

- **Mission Statement:**
  - To improve the lives of the graduate students of the mechanical engineering department by organizing events, career development advice and acting as a point of contact for the students.

- Who We Are
  - **Rick Castellano** – President
  - **Wuhan Yuan** – Vice President
  - **Jubilee Prasad** – Secretary / Treasurer
  - **Yasir Demiryurek** – Social Chair

Image from our bowling event

Over 40 students were in attendance!

Social Events

- **Trip to NYC**
  - MEGA hosted the trip to NYC, to sightsee and visit the Intrepid Museum
  - Costing only $25 per person

- **Paintball Event**
  - We brought together grad students who wanted to have a great time playing paintball

We are here for you

- We host meetings each semesters to field questions from the graduate students
- Email mega@soe.rutgers.edu with any comments or concerns (we are students just like you)
- http://mega.rutgers.edu is our website

MEGA

Fall Semester Kickoff BBQ!

MAE Courtyard

Noon, Friday September 1st

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Expectations

- Treat all members of Rutgers community with respect
- Academic integrity
  - Copying/plagiarism are grounds for dismissal
  - Give references!
- Contribute to the Department & to the engineering profession!
  - Research
  - Teaching
  - Personally & Socially

Opportunities for funding

- Hourly employment
  - Graders
  - Proctors
  - Occasionally paid for research assistance.
- Internships
  - Must be approved by advisor & Graduate Program Director
  - Register for course and provide reports to faculty advisor
- PhD students
  - Teaching assistantships
  - Research assistantships
  - Fellowships

To Dos & Additional Forms

- Student Information Form (Now)
- Graduate Advisor-Advisee Agreement (End of Fall semester or ASAP)
- Begin researching projects and advisors
- Participate in MEGA!

Questions?

- Now?
- Later:
  - Prof. Shan's office hours: M/T 4:30 – 5:30 PM; Other times by appointment

Faculty research

- Highlights from some faculty in each of the areas
  - Design & Control
  - Fluid Mechanics
  - Mechanics of Solids, Materials and Structures
  - Thermal Sciences

- Please check project list and MAE department website for other faculty