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
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)
Chartered as **Queen’s College** in New Brunswick, New Jersey.

**1776**

American Revolutionary War

**1766**

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

**1825**

Renamed as **Rutgers College** in honor of trustee and Revolutionary War veteran Colonel **Henry Rutgers**.
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.
Rutgers joins the Big Ten.

A BIG MOMENT IN THE BIG TEN

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

• Recent books/covers

  - Prof. Norris
  - Prof. Diez
  - Prof. Norris
  - Prof. Lee

  Prof. Bottega
  Prof. Baruh
  Cover JCP, Profs. Zadeh & Drazer
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
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1. Rutgers Highlights

2. **Department Organization**

3. Degrees Offered and Requirements

4. Courses Offered

5. Choosing a Project/Thesis & Advisor

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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

<table>
<thead>
<tr>
<th>1st Semester (10cr)</th>
<th>2nd Semester (10cr)</th>
<th>3rd Semester (10cr)</th>
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<tbody>
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<tr>
<td>650:530 Fluid</td>
<td>Required</td>
<td>Required</td>
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<tr>
<td>Mechanics 1</td>
<td>3cr</td>
<td>Seminar</td>
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<tr>
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<td>1cr</td>
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<tr>
<td>Required</td>
<td>Required</td>
<td>Required</td>
</tr>
<tr>
<td>650:570 Conduction</td>
<td>Manufacturing</td>
<td>Manufacturing</td>
</tr>
<tr>
<td>Heat Transfer</td>
<td>Elective</td>
<td>Elective</td>
</tr>
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<td>3cr</td>
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<td>(Choose one from</td>
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<tr>
<td>Required</td>
<td>Technical</td>
<td>Manufacturing</td>
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<td>Seminar</td>
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<td>Elective</td>
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<td>the list below)</td>
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<tr>
<td></td>
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<td>3cr</td>
</tr>
</tbody>
</table>
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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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

- Attendance will be taken
- Please behave professionally

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

Take 2 or 3 of these plus Math and Seminar

Add deadline is September 11th
Drop deadline is September 18th
## 2-year Course Offering Plan

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

- **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

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>F17</th>
<th>S18</th>
<th>F18</th>
<th>S19</th>
<th>F19</th>
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<tbody>
<tr>
<td>650:530</td>
<td>Fluids I</td>
<td>X</td>
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<tr>
<td>650:570</td>
<td>Conduction</td>
<td></td>
<td>X</td>
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<tr>
<td>650:574</td>
<td>Thermodynamics</td>
<td></td>
<td></td>
<td>X</td>
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<tr>
<td>650:630</td>
<td>Fluids II</td>
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<td></td>
<td></td>
<td>X</td>
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<tr>
<td>650:578</td>
<td>Convection</td>
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<td>X</td>
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<tr>
<td>650:670</td>
<td>Combustion</td>
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<td></td>
<td>X</td>
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<tr>
<td>650:674</td>
<td>Radiation Heat Transfer</td>
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<td>X</td>
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<tr>
<td>650:532</td>
<td>Exptl. Fluid Mechanics</td>
<td></td>
<td></td>
<td>X</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>650:634</td>
<td>Compressible Flow</td>
<td></td>
<td></td>
<td>X</td>
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</tbody>
</table>

**Course Requirements:**
- **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 1\textsuperscript{st} or 2\textsuperscript{nd} 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.

<table>
<thead>
<tr>
<th>Advisor Name</th>
<th>Office</th>
<th>Email</th>
<th>Title of Project</th>
<th>Optional Brief statements, description or Link to website</th>
<th>Name of selected student</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prof. R. Baugh</td>
<td>SB44</td>
<td><a href="mailto:rbaugh@pvic.vt.edu">rbaugh@pvic.vt.edu</a></td>
<td>Computational Fluid Dynamic Modeling of Blood Flow at Microscale</td>
<td>Fullibranch: research encompassing CFD, fluid-structure interaction, fluid flow, microrheology, large-scale simulation.</td>
<td></td>
</tr>
<tr>
<td>Prof. X. Bai</td>
<td>SB44</td>
<td><a href="mailto:xbai@pvic.vt.edu">xbai@pvic.vt.edu</a></td>
<td>Multiphysics modeling of fluid flow, solid body interaction, and heat transfer.</td>
<td>Multiscale modeling of complex systems and devices.</td>
<td></td>
</tr>
<tr>
<td>Prof. B. Chen</td>
<td>SB310</td>
<td><a href="mailto:bchen@pvic.vt.edu">bchen@pvic.vt.edu</a></td>
<td>Numerical simulation of differential equations with constraints.</td>
<td>To apply to graduate program in chemical engineering.</td>
<td></td>
</tr>
<tr>
<td>Prof. W. J. Beers</td>
<td></td>
<td></td>
<td>Theoretical Quantum Mechanics: Mechanics of Retinal Detachment.</td>
<td>Mathematical and computational techniques.</td>
<td></td>
</tr>
<tr>
<td>Prof. K. G. Okrun</td>
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<td>avery                                                                -------------------------------------------------------------------------------------------------</td>
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<tr>
<td>Prof. A. Guilled</td>
<td>SB35</td>
<td><a href="mailto:aguilled@pvic.vt.edu">aguilled@pvic.vt.edu</a></td>
<td>Interface topology and stress concentration in bilayer and multilayer tablets.</td>
<td>Multiscale modeling of complex systems and devices.</td>
<td></td>
</tr>
<tr>
<td>Prof. A. Guilled</td>
<td>SB35</td>
<td><a href="mailto:aguilled@pvic.vt.edu">aguilled@pvic.vt.edu</a></td>
<td>Mechanical characterization of multicomponent tablets.</td>
<td>Multiscale modeling of complex systems and devices.</td>
<td></td>
</tr>
<tr>
<td>Prof. A. Guilled</td>
<td>SB35</td>
<td><a href="mailto:aguilled@pvic.vt.edu">aguilled@pvic.vt.edu</a></td>
<td>Heat transfer and flow properties of granular materials in rotary conveyors.</td>
<td>Multiscale modeling of complex systems and devices.</td>
<td></td>
</tr>
<tr>
<td>Prof. A. Guilled</td>
<td>SB35</td>
<td><a href="mailto:aguilled@pvic.vt.edu">aguilled@pvic.vt.edu</a></td>
<td>Device for in vivo ultrasound assessment of continuous manufacturing.</td>
<td>Multiscale modeling of complex systems and devices.</td>
<td></td>
</tr>
<tr>
<td>Prof. M. Devine</td>
<td>SB35</td>
<td><a href="mailto:mdevine@pvic.vt.edu">mdevine@pvic.vt.edu</a></td>
<td>Mathematical and computational techniques.                                                                ---------------------------------------------------------------------------------------------------------</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Prof. A. Devine</td>
<td>SB35</td>
<td><a href="mailto:adevine@pvic.vt.edu">adevine@pvic.vt.edu</a></td>
<td>3D Mapping from a drone using LiDAR/Seven Sensors.</td>
<td>Multiscale modeling of complex systems and devices.</td>
<td></td>
</tr>
<tr>
<td>Prof. G. Uppal</td>
<td>CB18</td>
<td><a href="mailto:guppal@pvic.vt.edu">guppal@pvic.vt.edu</a></td>
<td>Deep learning methods in chemical engineering applications.</td>
<td>Multiscale modeling of complex systems and devices.</td>
<td></td>
</tr>
<tr>
<td>Prof. Z. Zhang</td>
<td>SB44</td>
<td><a href="mailto:zzhang@pvic.vt.edu">zzhang@pvic.vt.edu</a></td>
<td>Study the behavior of complex systems and devices.</td>
<td>Multiscale modeling of complex systems and devices.</td>
<td></td>
</tr>
<tr>
<td>Prof. Z. Zhao</td>
<td>SB310</td>
<td><a href="mailto:zzhao@pvic.vt.edu">zzhao@pvic.vt.edu</a></td>
<td>Analysis of mechanical and computational techniques.</td>
<td>Multiscale modeling of complex systems and devices.</td>
<td></td>
</tr>
<tr>
<td>Prof. D. Knight</td>
<td>SB145</td>
<td><a href="mailto:ddknight@pvic.vt.edu">ddknight@pvic.vt.edu</a></td>
<td>Numerical simulation of shock wave boundary layer interaction.</td>
<td>Requires prior experience in C, C++, or Python programming.</td>
<td></td>
</tr>
</tbody>
</table>
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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!
• **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