Mechanical and Aerospace Engineering
Graduate Students Orientation

Prof. Jerry Shan
Graduate Program Director
August 5, 2020
Welcome

Chair
Prof. Alberto Cuitino

Departmental Administrator
Carmen Elsabee
Shefali Patel, Sania Sadhvani

Outreach Director
Prof. Stephen Tse

Laboratory Director
Prof. Qingze Zou

Undergraduate Program
Prof. Mina Pelegri

Graduate Program
Prof. Jerry Shan
Cynthia Cartegna
MEGA (Mechanical Engineering Graduate Student Association)

Office Hours: M/W 4:30 – 5:30 PM; Other times by appointment

https://rutgers.webex.com/meet/jshan
Today, we will discuss:

1. Rutgers History & Highlights
2. Degrees Offered and Requirements
3. Courses Offered
4. Choosing a Project/Thesis & Advisor
5. Mechanical Engineering Graduate Students Association (MEGA)
6. Expectations, Funding, To-dos (Today)
1766  Chartered as **Queen’s College** in New Brunswick, New Jersey.

1776  American Revolutionary War

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
  - Cover JCP, Profs. Zadeh & Drazer
  - Cover Small, Semih Cetindag & Prof. Shan
  - Applied Dynamics, Haim Baruh
  - Engineering Vibrations, William J. Bottega

- Prof. Norris
- Prof. Diez
- Prof. Lee
- Prof. Bottega
- Prof. Baruh
World-Class Faculty & Students

Selected recent faculty awards

- **Xiaoli Bai**
  - 2019 NASA Young Investigator Award
  - 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

- **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

Selected recent student awards

- **Peter Balogh**
  - 2019 Andreas Acrivos Doctoral Dissertation Award in Fluid Dynamics from the American Physical Society.

- **Semih Cetindag**
  - 2019 Best Presentation Award, Materials Research Society Fall Meeting
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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 and Defense

Master of Engineering (MEng)
- 30 course credits
- Report & Presentation

Doctor of Philosophy (Ph.D.)
- 42 course credits + 24 research credits + 6 credits of research and/or courses
- Qualifying exam and PhD proposal
- Dissertation and Defense
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
- Can take 2 courses from other departments
- 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>
</tr>
</thead>
<tbody>
<tr>
<td>Required 650:530 Fluid Mechanics 1</td>
<td>Required Seminar</td>
<td>Required Seminar</td>
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<tr>
<td>Required 650:570 Conduction Heat Transfer</td>
<td>Manufacturing Elective (Choose one from the list below)</td>
<td>Manufacturing Elective (Choose one from the list below)</td>
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<tr>
<td>Required Seminar</td>
<td>Technical Elective See below</td>
<td>Technical Elective See below</td>
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</tbody>
</table>

3 cr
Course Credits (Ph.D.)

Doctor of Philosophy

- 42 course credits + 24 research credits + 6 credits research and/or courses

- B and above average, max 2 C grades
- Max 2 independent study
- Can take 4 courses from other departments
  - 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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3. Courses Offered

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Five areas for PhD Qualifying Exam:

1. Design and Manufacturing \((M)\)
2. Dynamics and Control \((C)\)
3. Fluid Mechanics \((F)\)
4. Mechanics of Solids, Materials and Structures \((S)\)
5. Thermal Sciences \((T)\)
Classes Offered in Fall 2020

• Courses will be online for Fall
  – Synchronously if possible
  – Please contact instructor to make arrangements if asynchronous instruction is needed

• Mode of instruction for Spring 2021 to be determined

• In-person research for graduate students is available
  – Testing & approval process involving advisor
Classes Offered in Fall 2020

- 650:504 Advanced Control I
- 650:550 Mechanics of Materials
- 650:554 Continua (SM I)
- 650:651 Viscoelasticity & Plasticity (SM III)
- 650:531 Additive Manufacturing
- 650:530 Fluid Mechanics I
- 650:582 Computational Heat Transfer
- 650:562/563 CTEC 1 Discovery to Business Model
- 650:634 Compressible Flow
- 650:605 ST: Smart Manufacturing & Cybersecurity
- 650:606 ST: Drone Fundamentals
- 650:607 ST: Aerospace Accident Investigation

Take 2 or 3 of these plus Math & Seminar

Add/drop deadline is Tuesday September 8, 2020 (tentative)

- 642:527 Math I
- 650:608 Seminar

Attendance will be taken

Selected senior-level undergraduate courses can also be taken with permission
## Graduate Course Schedule 1/2

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>F20</th>
<th>S21</th>
<th>F21</th>
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</thead>
<tbody>
<tr>
<td>650:504</td>
<td>Adv. Control I</td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>650:505</td>
<td>Adv. Control II</td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>650:514</td>
<td>Design Mechanism/Mechanisms of Robotics</td>
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<td>X</td>
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<tr>
<td>650:524</td>
<td>Optimal Design</td>
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<td>X</td>
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<tr>
<td>650:522</td>
<td>Analytical Dynamics</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></td>
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<tr>
<td>650:554</td>
<td>Continua (SM I)</td>
<td>X</td>
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<td></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>
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<td>X</td>
</tr>
<tr>
<td>650:651</td>
<td>Viscoelasticity &amp; Plasticity (SM III)</td>
<td>X</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>X</td>
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<tr>
<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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<td>X</td>
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<tr>
<td>650:660</td>
<td>Comp. Solid (SM VIII)</td>
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<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>
</tr>
<tr>
<td>650:531</td>
<td>Additive Manufacturing</td>
<td>X</td>
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<tr>
<td>650:606</td>
<td>Special Topics: Drone Fundamentals</td>
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<td>X</td>
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</tbody>
</table>

Typically will offer ~2 summer classes as well
Graduate Course Schedule 2/2

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>F20</th>
<th>S21</th>
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</thead>
<tbody>
<tr>
<td>650:530</td>
<td>Fluids I</td>
<td>X</td>
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<tr>
<td>650:570</td>
<td>Conduction Heat Transfer</td>
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<td>X</td>
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<tr>
<td>650:574</td>
<td>Thermodynamics</td>
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<td>X</td>
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<tr>
<td>650:630</td>
<td>Fluids II</td>
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<td>X</td>
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<tr>
<td>650:578</td>
<td>Convection Heat Transfer</td>
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<td>X</td>
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<tr>
<td>650:670</td>
<td>Combustion</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>
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<tr>
<td>650:534</td>
<td>Comput. Fluid Mechanics</td>
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<tr>
<td>650:634</td>
<td>Compressible Flow</td>
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<td>X</td>
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<tr>
<td>650:562/563</td>
<td>CTEC 1: Discovery to Business Model</td>
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<td>X</td>
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<tr>
<td>650:564/565</td>
<td>CTEC 2: Business Model to Launch</td>
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<td>X</td>
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<tr>
<td>650:608</td>
<td>Seminar</td>
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<tr>
<td>650:606</td>
<td>Special Topics: Autonomous Navigation</td>
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<td>650:607</td>
<td>Special Topics: Aerospace Accident Investigation</td>
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<td>X</td>
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<td>Special Topics: Smart Manufacturing &amp; Cybersecurity</td>
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<td>X</td>
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<tr>
<td>642:527</td>
<td>Methods of Applied Mathematics I</td>
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<td>642:528</td>
<td>Methods of Applied Mathematics II</td>
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<tr>
<td>650:606</td>
<td>Special Topics: Renewable Energy</td>
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Typically will offer ~2 summer classes as well
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 10 (9+1) credits
- Research Credits: 650:701
Topics for PhD Qualifying Exam

- Five areas: Design & Manufacturing, Dynamics & Control, Fluids, Solids, Thermal Science
  - All students will take one 3-hour Mathematics exam, and four 90-minute subject exams
- Offered in early September
  - Taken either at end of 1st or 2nd years
- Tests fundamental knowledge as preparation for research
  - Not necessarily tied directly to particular courses
  - Holistic review of material is good preparation for research

All subject exams

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<td>Thermodynamics</td>
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<td>Fluids II</td>
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<td>Convection</td>
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PhD Qualifying Exam by Area (1/2)

• Design & Manufacturing
  – Elective: Any other two qualifying exam subjects (including those listed above)

• Dynamics & Control
  – Required: Advanced Control I, Analytical Dynamics
  – Elective: Any other two qualifying exam subjects
PhD Qualifying Exam by Area (2/2)

• Fluids
  – Required: Fluid Mechanics, Advanced Fluid Mechanics
  – Electives: Chose two from Thermodynamics, Conduction, Convection, Control, and Continuum Mechanics

• Solids
  – Required: Two chosen from Continuum Mechanics, Mechanics of Materials, Analytical Dynamics, and Elasticity
  – Electives: Any other two qualifying exam subjects

• Thermal Science
  – Required: Two chosen from Thermodynamics, Conduction, Convection
  – Electives: Any other two qualifying exam subjects
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Choosing Project & Advisor

• Consider:
  – Interests?
  – Future goals?
  – Personality/fit in group?
  – Funding?

• Make appointments to talk to faculty
• For MEng projects, co-advised industry projects are also suitable
• Talk to senior students
• Choose by end of Fall Semester
  – Return Advisor-Advisee agreement to Ms. Cindy Cartegna (B226)
Mechanical and Aerospace Engineering

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• **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.

• **Recent Actions**
  – We completed a survey to get the graduate students’ opinions on the qualifying exam and the diversity requirements for PhD students
    • And will help students with their studies on the qualifying exam
  – Connected students with recent graduates for job opportunities

• **Department Stats**
  – International students (~65%)
  – Domestic students (~35%)
Our Organization

• Who We Are
  – Emran Lallow – President
    rick.castellano@rutgers.edu

  – Hongxiang Cao – Vice President
    hc536@scarletmail.rutgers.edu

  – Mohit Agarwal – First Year Representative
    ma1633@scarletmail.rutgers.edu

• Your voice matters
  http://mega.rutgers.edu
BBQ

- We host summer BBQs for the graduate students
  - The BBQ is a great way to socialize with your fellow students and professors during the summer
  - We cook chicken wings, burgers, hot dogs, and vegetarian burgers for everyone in the department to enjoy!
Social Events

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

**Our bowling event**

Over 40 students were in attendance!
Ping Pong Tournament

- Ping Pong Tournament September – November 2018
  - Over $300 awarded in prizes to the 1st, 2nd, and 3rd place contestants

3rd Place: Hang
1st Place: JP
2nd Place: Wuhan
Organizer: Rick
Spring/Summer 2020 MEGA Activities

- Movie watch party
- Online chess tournament
- PhD Qualifying Exam review sessions
- Always looks for other ideas!
  - Emran Lallow – President
    rick.castellano@rutgers.edu
  - Hongxiang Cao – Vice President
    hc536@scarletmail.rutgers.edu
  - Mohit Agarwal – First Year Representative
    ma1633@scarletmail.rutgers.edu
Expectations

• Treat all members of Rutgers community with respect

• Academic integrity
  – Cheating/Copying/plagiarism are grounds for dismissal
  – In research, give references and do not cherry-pick data!

• Contribute to the Department & to the Engineering profession!
  – Research
  – Teaching
  – Personally & Socially
Opportunities for funding

• **Hourly employment**
  – Graders
  – Proctors
  – Occasionally opportunities for paid 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 (Will send out – return as soon as possible)

• 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/W 4:30 – 5:30 PM at https://rutgers.webex.com/meet/jshan
  – Other times by appointment