Mechanical and Aerospace Engineering Graduate Students Orientation

Prof. Jerry Shan & Ms. Cindy Cartgena

July 28, 2021
Welcome

Chair
Prof. Alberto Cuitino

Departmental Administrator
Carmen Elsabee
Shefali Patel, Sania Sadhvani

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

American Revolutionary War

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. Lee

Prof. Bottega

Second Edition
Engineering Vibrations

Prof. Baruh

APPLIED DYNAMICS

Cover Small,
Semih Cetindag & Prof. Shan

Cover JCP,
Profs. Zadeh & Drazer
World-Class Faculty & Students

Selected recent student awards

• Peter Balogh
  – 2019 Andreas Acrivos Doctoral Dissertation Award in Fluid Dynamics from the American Physical Society.
  – "For the development of a high-fidelity, versatile numerical methodology to simulate flow of deformable blood cells in dense suspension through highly complex geometries, and for providing insights to the physics of blood flow in physiologically realistic microvascular capillary networks."

• Semih Cetindag
  – 2019 Best Presentation Award, Materials Research Society Fall Meeting
  – Small cover article

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)
Today, we will discuss:

1. Rutgers 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)
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>Semester</th>
<th>Courses</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>1st Semester (10cr)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Required</td>
<td>642:527 Math</td>
<td>3cr</td>
</tr>
<tr>
<td>Required</td>
<td>650:530 Fluid Mechanics 1</td>
<td>3cr</td>
</tr>
<tr>
<td>Required</td>
<td>650:570 Conduction Heat Transfer</td>
<td>3cr</td>
</tr>
<tr>
<td>Required</td>
<td>Seminar</td>
<td>1cr</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Semester</th>
<th>Courses</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>2nd Semester (10cr)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Required</td>
<td>Mech. of Advanced Manufacturing</td>
<td>3cr</td>
</tr>
<tr>
<td>Required</td>
<td>Seminar</td>
<td>1cr</td>
</tr>
<tr>
<td>Manufacturing Elective</td>
<td>(Choose one from the list below)</td>
<td>3cr</td>
</tr>
<tr>
<td>Technical Elective</td>
<td>See below</td>
<td>3cr</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Semester</th>
<th>Courses</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>3rd Semester (10cr)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Required</td>
<td>650:550/4 Mechanics of Materials/Continua</td>
<td>3cr</td>
</tr>
<tr>
<td>Required</td>
<td>Seminar</td>
<td>1cr</td>
</tr>
<tr>
<td>Manufacturing Elective</td>
<td>(Choose one from the list below)</td>
<td>3cr</td>
</tr>
<tr>
<td>Manufacturing Elective</td>
<td>(Choose one from the list below)</td>
<td>3cr</td>
</tr>
</tbody>
</table>
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
Today, we will discuss:

1. Rutgers 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)
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 2021

- Courses will be in-person for Fall
  - Some online sections
  - Synchronous - Please contact instructor to make arrangements if asynchronous instruction is needed

- Mode of instruction for Spring 2022 to be determined
### Classes Offered in Fall 2021

- **650:504** Advanced Control I
- **650:512** Robotics & Mechatronics
- **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
- **650:570** Conduction Heat Transfer
- **650:562/563** CTEC 1 Discovery to Business Model
- **650:634** Compressible Flow
- **650:606** ST: Drone Fundamentals
- **650:670** Combustion
- **650:567** Spacecraft Dynamics & Control
- **642:527** Math I
- **650:608** Seminar

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

Take 2 or 3 of these plus Math & Seminar.

Add/drop deadline is Tuesday September 7, 2021 (tentative).
Graduate Course Schedule 1/2

Tentative course schedule at https://mae.rutgers.edu/graduate-program-overview
Typically will offer ~2 summer classes as well

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>F21</th>
<th>S22</th>
<th>F22</th>
<th>S23</th>
<th>F23</th>
</tr>
</thead>
<tbody>
<tr>
<td>650:504</td>
<td>Adv. Control I</td>
<td>X</td>
<td></td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>650:505</td>
<td>Adv. Control II</td>
<td></td>
<td></td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>650:514</td>
<td>Design Mechanism/Mechanisms of Robotics</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>650:524</td>
<td>Optimal Design</td>
<td></td>
<td></td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>650:522</td>
<td>Analytical Dynamics</td>
<td></td>
<td></td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>650:550</td>
<td>Mechanics of Materials</td>
<td></td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>650:554</td>
<td>Continua (SM I)</td>
<td></td>
<td></td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>650:556</td>
<td>Elasticity (SM II)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>650:512</td>
<td>Robotics &amp; Mechatronics</td>
<td></td>
<td></td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>650:651</td>
<td>Viscoelasticity &amp; Plasticity (SM III)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>650:652</td>
<td>Composites (SM IV)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>650:653</td>
<td>Structural Mech (SM V)</td>
<td></td>
<td></td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>650:654</td>
<td>Dyn.Solid Struct. (SM VI)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>650:664</td>
<td>Fracture (SM VII)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>650:660</td>
<td>Comp. Solid (SM VIII)</td>
<td></td>
<td></td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>650:567</td>
<td>Spacecraft Dynamics &amp; Control</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>650:569</td>
<td>Mechanics of Advanced Manufacturing</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>650:531</td>
<td>Additive Manufacturing</td>
<td></td>
<td></td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>650:606</td>
<td>Special Topics: Drones I: Fundamentals</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>650:606</td>
<td>Special Topics: Drones II: Control &amp; Coordination</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>650:607</td>
<td>Special Topics: Habitats on Moon &amp; Mars</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
</tr>
</tbody>
</table>
### Graduate Course Schedule 2/2

Tentative course schedule at https://mae.rutgers.edu/graduate-program-overview

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

<table>
<thead>
<tr>
<th>Category</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adv. Control I</td>
</tr>
<tr>
<td>Optimal Design</td>
</tr>
<tr>
<td>Analytical Dynamics</td>
</tr>
<tr>
<td>Mechanics of Materials</td>
</tr>
<tr>
<td>Continua (SM I)</td>
</tr>
<tr>
<td>Elasticity (SM II)</td>
</tr>
<tr>
<td>Fluids I</td>
</tr>
<tr>
<td>Conduction</td>
</tr>
<tr>
<td>Thermodynamics</td>
</tr>
<tr>
<td>Fluids II</td>
</tr>
<tr>
<td>Convection</td>
</tr>
</tbody>
</table>
• 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
Today, we will discuss:

1. Rutgers 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)
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)
Today, we will discuss:

1. Rutgers 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)
• **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
    emranlallow13@gmail.com
  – Hongxiang Cao
    hc536@scarletmail.rutgers.edu
  – Mohit Agarwal
    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!
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 1\textsuperscript{st}, 2\textsuperscript{nd}, and 3\textsuperscript{rd} place contestants
Recent MEGA Activities

• Movie watch party

• Online chess tournament

• PhD Qualifying Exam review sessions

• Always looks for other ideas!
  – Emran Lallow – President
    emranlallow13@gmail.com

  – Hongxiang Cao
    hc536@scarletmail.rutgers.edu

  – Mohit Agarwal
    ma1633@scarletmail.rutgers.edu
Expectations

• Treat all members of Rutgers community with respect

• Academic integrity
  – Cheating/Copying/plagiarism are grounds for dismissal
  – In research & reports, 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!
Have a great (and healthy) Fall semester!

Remember:
1. Office hours
   - Cynthia Cartegna drop-in office hours: Wed 3:30-4:30 pm
     [https://rutgers.webex.com/meet/ccartegn](https://rutgers.webex.com/meet/ccartegn)
   - Professor Shan drop-in office hours: Mon & Wed 4:30-5:30 pm
     [https://rutgers.webex.com/meet/jshan](https://rutgers.webex.com/meet/jshan)

2. Deadlines & requirements for graduation

3. Check MAE & Graduate School websites for key information

4. Participate in Mechanical Engineering Graduate Students Association (MEGA)