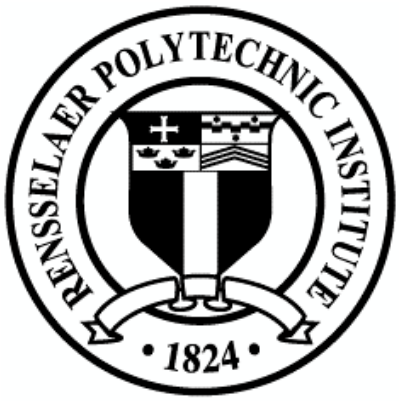

School of Engineering

Mechanical, Aerospace, and Nuclear Engineering

Undergraduate Handbook

MANE

Class of 2023

Advising Handbook

Rev. 2019 June 11

Table of Contents

DEPARTMENT OF MECHANICAL, AEROSPACE, AND NUCLEAR ENGINEERING (MANE)

The Department of Mechanical, Aerospace, and Nuclear Engineering (MANE) is part of Rensselaer's School of Engineering (SoE). MANE offers three collaborative but distinct undergraduate programs leading to a Bachelor of Science degree:

- Mechanical Engineering (ME),
- Aerospace Engineering (AE), and
- Nuclear Engineering (NE).

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Comparing Majors

Data on the career opportunities associated with each field of engineering can be obtained from the U.S. Department of Labor's Bureau of Labor Statistics web site: www.bls.gov/ooh/Architecture-and-Engineering. The site provides information on the various fields of engineering, including statistics concerning salary and an estimate of future job growth. Each field includes details on the work that each type of engineer does, the work environment, educational preparation, salary range, similar occupations, key characteristics of workers and occupations, and contacts for more information.

Careers in Aeronautical/Aerospace Engineering

Today's aerospace engineers not only develop airplanes and rockets, they design high-speed trains, submarines, hydrofoils, wind turbines, and cars. Rensselaer graduates have helped to develop the engines that propel jumbo jets, the lunar lander for the Apollo spacecraft, and the Rover for the Mars Exploration Mission.

At Rensselaer you will begin with core engineering, basic science, computing, and the fundamentals of flight. These will prepare you for further studies of fixed-wing and rotary-wing aircraft, lightweight structures, propulsion, and space vehicle design. Our programs place emphasis on research, design, development, and operation of flight vehicles for aeronautical and space applications. In the senior year undergraduates may focus on fixed-wing aircraft, rotary-wing aircraft, or spacecraft design, though none of these choices precludes employment or graduate work in any other focus area. Our graduates choose careers in industry or government laboratories, doing research in anything from high-speed aerodynamics or high-temperature strength of jet engine blades, to the sale of aircraft and aircraft components. (And head coach of an NFL football team.)

Aeronautical/Aerospace Engineering at a Glance

Aeronautical engineers work on things like:

- Airplanes and helicopters
- Submarines and hydrofoils
- Rockets, lunar landers, Mars rovers, satellites
- Engines, high-speed trains, and wind turbines

Aeronautical/Aerospace engineering disciplines include:

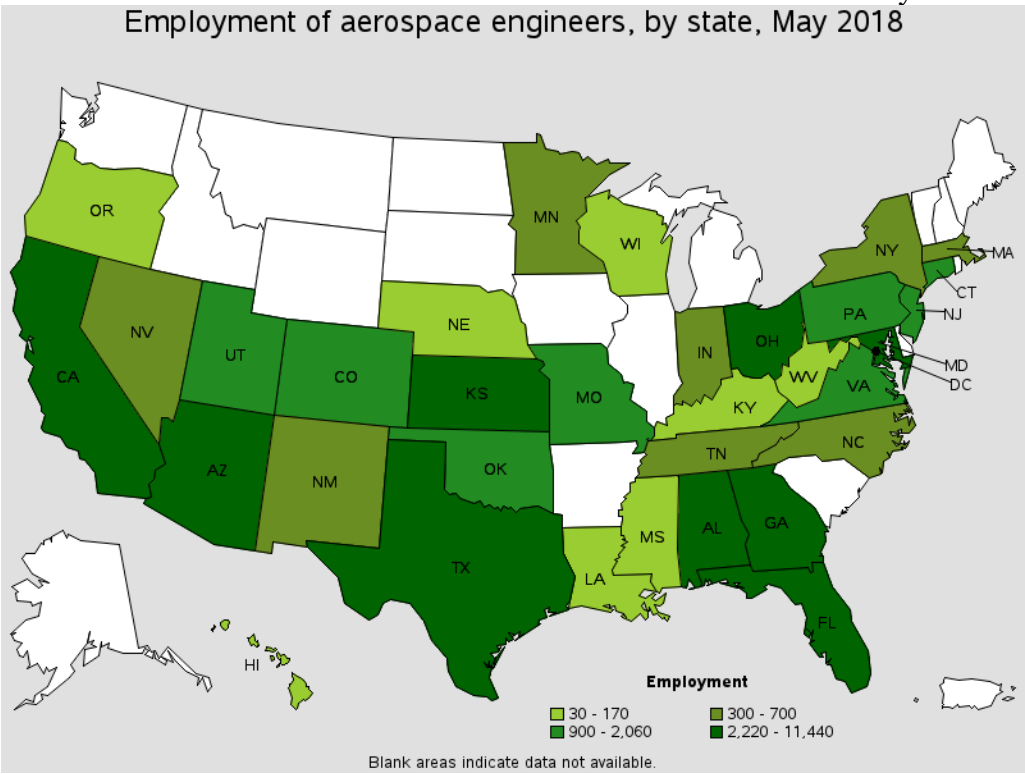
- Fixed-wing aircraft, rotary-wing aircraft
- Propulsion, spacecraft structures
- Light-weight structures and adaptive/smart structures
- Flight control systems and avionics
- Fluid mechanics and heat transfer
- High-performance computing

Graduates typically choose industry or government laboratory careers doing things like:

- High-speed aerodynamics
- High-temperature strength of jet engine blades
- Sale of aircraft and aircraft components

Graduates typically work for employers like:

American Airlines	General Electric	Northrop-Grumman
Bell Helicopter	Gulfstream	Orbital Sciences
Boeing	Honeywell	Pratt and Whitney
Bombardier	JPL	Raytheon
B. F. Goodrich	Lockheed-Martin	Rolls-Royce
Cessna	NASA	Sikorsky



(Observe the note: "blank areas indicate data not available"; there are aerospace engineers in all 50 states.)

Bureau of Labor Statistics: https://www.bls.gov/oes/current/oes172011.htm#st

Careers in Mechanical Engineering

Mechanical engineers design, develop, manufacture, sell, and maintain machinery. Air conditioning and heating systems, automobiles, jets, power plants, spacecraft, and oil drilling equipment all bear the imprint of the mechanical engineer.

As an undergraduate you'll follow the core engineering curriculum in your first two years, gaining a solid grounding in mathematics, physics, and chemistry, as well as taking introductory courses in computing and mechanical engineering. You can then opt for technical electives in aeronautics, applied mechanics/mechanics of materials, control systems, energy systems, manufacturing and design, or space technology. Many mechanical engineering graduates assume positions of management, while others prefer a career along technical lines.

Mechanical Engineering at a Glance

Mechanical engineers work on things like:

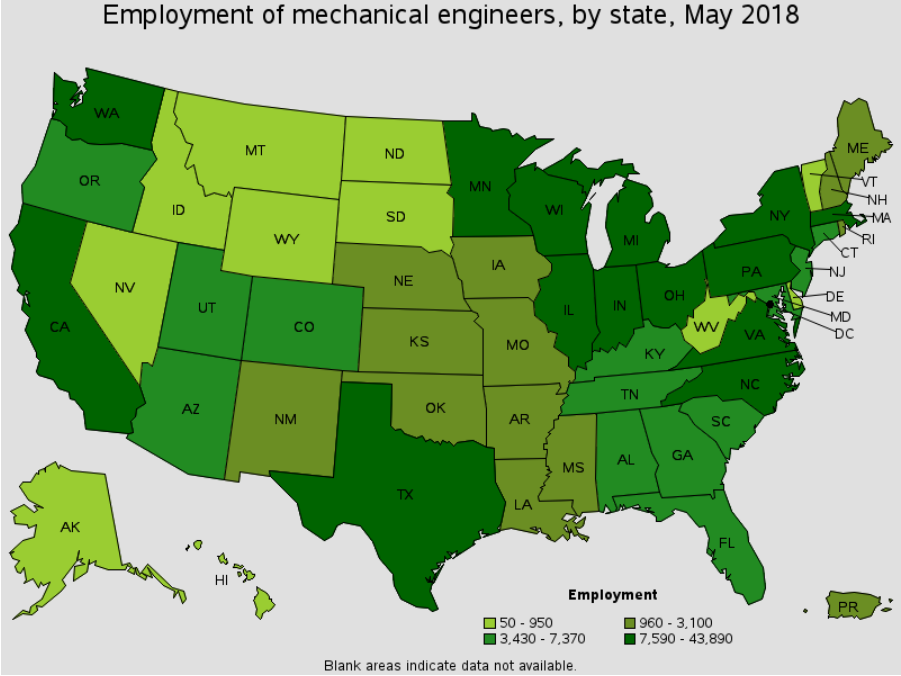
- Automobiles, airplanes, and spacecraft
- Power plants and oil rigs
- Air conditioning and heating systems

- Designing mechanisms and analyzing machine dynamics
- Forensic engineering of failed systems
- Manufacturing plants

Mechanical Engineering disciplines include:

- Applied mechanics, including dynamics, mechanics of materials, computational mechanics
- Control systems and mechatronics
- Energy systems, such as thermodynamics, fluid mechanics, and heat transfer
- Manufacturing and design processes and systems

Mechanical Engineering graduates work throughout the spectrum of technology, as mechanical engineering is the most widely applicable field of engineering. Career paths range from small startups to the largest multinationals, from household solar-powered devices to artificial body parts to space stations. Almost all companies involved in technology can benefit from a mechanical engineer. For example, the most common undergraduate major of U.S. Nuclear Regulatory Commission employees is mechanical engineering.



(Observe the note: "blank areas indicate data not available"; there are aerospace engineers in all 50 states.)

Bureau of Labor Statistics: https://www.bls.gov/oes/current/oes172141.htm#st

Careers in Nuclear Engineering

Nuclear engineering focuses on methods, devices, and systems to get benefits from the peaceful use of nuclear energy and radiation. At Rensselaer, you'll begin with fundamentals in chemistry, physics, mathematics, core engineering, computing, and Nuclear Phenomena for Engineering Applications. These will prepare you for further studies in nuclear energy production, energy systems, health physics, and radiation technology.

Areas of research pursued at Rensselaer include reactor engineering, thermal-hydraulics, health and medical physics, dosimetry, radiation transport, neutron scattering, and x-ray production. Careers in nuclear engineering include electricity production, food safety, medical diagnostics and treatment, space and underwater propulsion applications, and non-destructive testing for industry.

Nuclear Engineering at a Glance

Nuclear engineers work on things like:

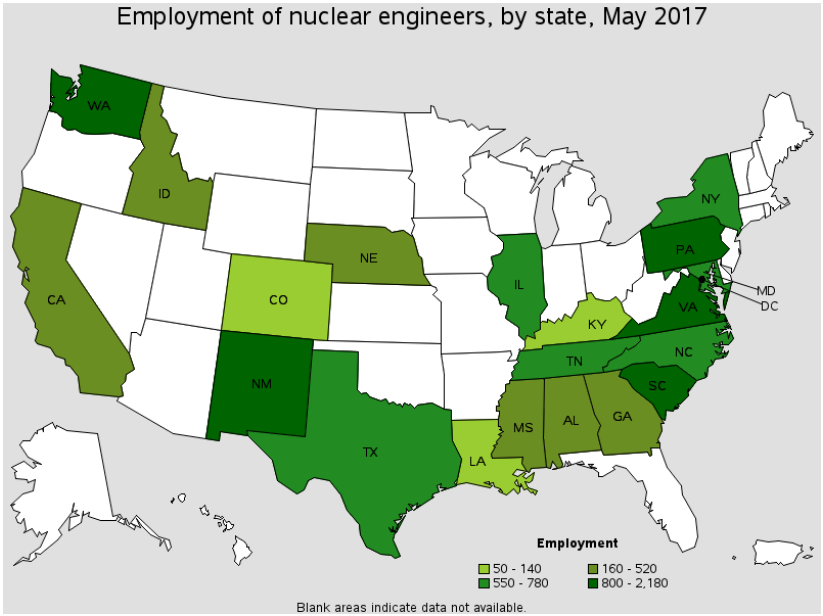
- Nuclear reactor engineering
- Health and medical physics
- Thermal-hydraulics
- Dosimetry
- Radiation transport
- X-ray production
- Neutron scattering

Nuclear engineering disciplines include:

- Nuclear energy production
- Health and medical physics
- Nuclear systems engineering
- Radiation technology

Graduates choose careers in:

- Electricity production
- Medical diagnostics and treatment
- Space and underwater propulsion
- Food safety
- Non-destructive testing for industry
- Mineral resource and geological exploration
- Carbon dating
- Art authentication



(Observe the note: "blank areas indicate data not available"; there are nuclear engineers in all 50 states.)

Bureau of Labor Statistics: https://www.bls.gov/oes/current/oes172161.htm#st

ARCH AT RENSSELAER

https://info.rpi.edu/the-arch

The Arch at Rensselaer is a unique approach for student development and growth that prepares students to meet the multifaceted challenges of the 21st century. The Arch will augment academic and experiential programs, and provide an even more robust – and transformative – educational experience for undergraduate students.

Students in the Class of 2023 will generally be required to be on campus in the Summer 2021 term. Early Arch is available for students who are accelerated. There is an exception process for some athletes, ROTC students, and a few other select cases.

The Arch is a restructuring of the Rensselaer academic calendar. It creates additional opportunities for experiential learning that complement curricular and co-curricular offerings at Rensselaer.

Rising juniors will attend a full summer semester between their sophomore and junior years. Juniors then spend a semester away during either the fall or spring semester of their junior year, still only taking eight semesters to graduate.

This will allow students to take advantage of the numerous experiential learning activities available off campus, including international travel, internships, co-ops, research opportunities, and engagement in community service projects.

Academic Semester Experience

YEAR	FALL	SPRING	SUMMER
First Year	Expected	Expected	Optional
Sophomore	Expected	Expected	**Required**
Junior	*	*	Optional
Senior	Expected	Expected	

* one of these semesters is expected to be resident (on campus), and one will be a required "away" semester

"Expected" only indicates that students are assumed to be resident (on campus) those semesters. With planning a student may be able to take additional internship, co-op, or other opportunities in these semesters.

Accelerated Students

Students who plan to graduate in less than eight total semesters must plan their Arch summer and away semester carefully to assure a timely graduation. It may be necessary to be resident for the required Arch summer after the First Year to attempt to graduate in less than eight semesters.

BACHELOR OF SCIENCE IN AERONAUTICAL ENGINEERING

Minimum credit hour requirements for the Bachelor's Degree in Aeronautical Engineering: 130

FIRST YEAR					
	FALL SEMESTER (17 CREDITS)	**Credits**		**SPRING SEMESTER (17 CREDITS)**	**Credits**
ENGR-1100	Introduction to Engineering Analysis [1]	4	CHEM-1100	Chemistry I [1]	4
ENGR-1200	Engineering Graphics and CAD [1,2]	1	MANE-1060	Fundamentals of Flight [4]	1
MATH-1010	Calculus I	4	MATH-1020	Calculus II	4
PHYS-1100	Physics I	4	PHYS-1200	Physics II	4
IHSS-….	HASS Core Elective [3]	4	HASS	HASS Core Elective [3]	4
SECOND YEAR					
	FALL SEMESTER (16 CREDITS)	**Credits**		**SPRING SEMESTER (17 CREDITS)**	**Credits**
ENGR-1200	Engineering Processes [6]	1	ENGR-2600	Modeling and Analysis of Uncertainty [1,6]	3
SoE-2….	Engineering Design Elective [1,5,6]	4	MANE-2110	Numerical Methods and Programming [1]	3
ENGR-2530	Strength of Materials [1]	4	MANE-2720	Fluid Mechanics [1]	3
MANE-2710	Thermodynamics [1]	3	MATH-2010	Multivariable Calculus and Matrix Algebra [1]	4
MATH-2400	Introduction to Differential Equations [1]	4	HASS	HASS Core Elective [3]	4
THIRD YEAR [8]					
	SUMMER ARCH SEMESTER (16 CREDITS)	**Credits**		**FALL OR SPRING (16 CREDITS)**	**Credits**
ENGR-2090	Engineering Dynamics	4	MANE-4500	Modeling & Control of Dynamic Systems [6]	3
MANE-4060	Aerospace Structures and Materials	4	MANE-4900	Aeroelasticity and Structural Vibrations	3
MANE-4070	Aerodynamics I	4	MANE-4910	Fluid Dynamics Laboratory [8]	2
HASS	HASS Core Elective [3]	4	MANE-4920	Aerospace Structures and Controls Lab [8]	2
			STSS-4100	Professional Development II [1,6,7]	2
				Free Elective [6,9]	4
FOURTH YEAR					
	FALL SEMESTER (16 CREDITS)	**Credits**		**SPRING SEMESTER (15 CREDITS)**	**Credits**
MANE-4080	Propulsion Systems [1]	3	ENGR-4010	Professional Development III [1,6]	1
MANE-4510	Control Systems Laboratory [1,8]	2	MANE-4….	Capstone Design Elective [9,12]	3
MANE-4….	Computation Elective [1,6,10]	3	MANE-4….	Aerospace Technical Elective [1, 13]	3
MANE-4….	Flight Mechanics Elective [9,11]	4	HASS	HASS Core Elective [3]	4
	Free Elective	4		Free Elective	4

[1] These required courses may be taken in any order in the academic year shown (or in a previous year) given the pre-requisites are met.

[2] Choice of ENGR-1200 Engineering Graphics & CAD, ENGR-1400 Engineering Communication, or CIVL-1200 Engineering Graphics for Civil Engineers; Engineering Graphics & CAD is preferred for Aerospace Engineers.

[3] The five HASS Electives may be taken in any semester; it is recommended to schedule one in each of the first two semesters and one in the Arch Summer. Students should take a HASS Inquiry course during their first year; for a listing of HASS Inquiry courses go to https://info.rpi.edu/hass-inquiry. Students should take a HASS Communications Intensive course during their first three semesters; refer to the link "Communications Intensive (CI) Requirement" on the Registrar's "Academic Planning" web page.

[4] Any 1 credit engineering exploration elective ("Introduction to [major]") may be substituted.

[5] Choice of ENGR-2050 Introduction to Engineering Design or MANE-2220 Inventor's Studio 1; both have ENGR-1010 Professional Development I embedded in them.

[6] These courses may be taken in the Arch Summer semester (if the summer schedule permits).

[7] For a list of courses that satisfy the PD II requirement refer to the link "Professional Development II Courses" on the Registrar's "Academic Planning" web page. It should be completed before the capstone design course.

[8] These three laboratory courses may be taken any semester in the junior or senior year, provided all prerequisites have been completed.

[9] Aeronautical Engineering students should start planning for their Flight Mechanics/Capstone Design track prior to the Arch summer.

- Space Flight track. Plan to take MANE 4100 Spaceflight Mechanics during junior year fall or spring semester (in place of the free elective). Plan to take MANE 4250 Space Vehicle Design senior year fall semester, though a limited number of seats will be available in the spring semester of senior year. Spaceflight Mechanics is not a prerequisite for Space Vehicle Design but it is strongly recommended.
- Fixed-Wing track. Plan to take MANE 4090 Flight Mechanics junior or senior year fall semester. Plan to take MANE 4230 Air Vehicle Design senior year spring semester. Flight Mechanics is a prerequisite for Air Vehicle Design, though in select cases this may be waived with the instructor's permission.
- Rotorcraft track. In the junior or senior year plan to take either MANE 4120 Helicopter Aerodynamics and Performance in fall of an even-year or MANE 4130 Multirotor Aerial Vehicles in fall of an odd year. (Interested students may choose to take both, applying the second to the Aerospace Technical Elective and/or Free Elective credits.) Plan to take MANE 4210 VTOL Aircraft Design senior year spring semester. One of either Helicopter Aerodynamics and Performance or Multirotor Aerial Vehicles must be taken as a prerequisite to VTOL Aircraft Design, though in select cases this may be waived with the instructor's permission.

[10] Choice of MANE-4140 Intro to Computational Fluid Dynamics (spring only), MANE-4240 Introduction to Finite Elements (fall, spring, and summer), or MANE-4280 Numerical Design Optimization (fall only).

[11] Choice of MANE 4090 Flight Mechanics, MANE 4100 Spaceflight Mechanics, MANE 4120 Helicopter Aerodynamics and Performance, or MANE 4130 Multirotor Aerial Vehicles.

[12] Choice of MANE 4210 VTOL Aircraft Design, MANE 4230 Air Vehicle Design, or MANE 4250 Space Vehicle Design.

[13] Aerospace Technical Elective

- The Aerospace Technical Elective is a MANE 4000-level or higher course or research related to Aerospace Engineering that is taken for 3 credits or more.
- Aerospace Technical Electives may not be taken on a Pass/No Credit basis.

Aeronautical Engineering Course Prerequisite Chart

First Year Fall semester

ENGR-1100 Introduction to Engineering Analysis
No prerequisites

ENGR-1200 Engineering Graphics & CAD / ENGR-1400 Eng. Comm. / CIVL-1200 EG for CIVL
No prerequisites

MATH-1010 Calculus I
No prerequisites

PHYS-1100 Physics I
No prerequisites

First Year Spring semester

CHEM-1100 Chemistry I
No prerequisites

MANE-1060 Fundamentals of Flight
No prerequisites

MATH-1020 Calculus II
MATH-1010 Calculus I

PHYS-1200 Physics II
PHYS-1100/-1150 Physics I

Second Year Fall semester

ENGR-1300 Engineering Processes
No prerequisite

ENGR-2050 Introduction to Engineering Design / MANE-2220 Inventor's Studio 1
ENGR-1100 Introduction to Engineering Analysis
ENGR-1200 EG&CAD, or ENGR-1400 Eng. Comm., or CIVL-1200 EG for CIVL
(PHYS-1200 Physics II* is a co-requisite)

ENGR-2530 Strength of Materials
ENGR-1100 Introduction to Engineering Analysis

MANE-2710 Thermodynamics
CHEM-1100 Chemistry I
ENGR-1100 Introduction to Engineering Analysis
MATH-1200 Calculus II*
PHYS-1100/-1150 Physics I

MATH-2400 Introduction to Differential Equations
MATH-1020 Calculus II*

Second Year Spring semester

ENGR-2600 Modeling and Analysis of Uncertainty
MATH-1010 Calculus I

MANE-2110 Numerical Methods and Programming
ENGR-1100 Introduction to Engineering Analysis
(MATH-2400 Introduction to Differential Equations*, PHYS-1200/-1250 Physics II* are co-requisites).

MANE-2720 Fluid Mechanics
ENGR-1100 Introduction to Engineering Analysis
PHYS-1100/-1150 Physics I
(MATH-2010 Multivariable Calculus and Matrix Algebra* and MATH-2400 Introduction to Differential Equations* are co-requisites)

MATH-2010 Multivariable Calculus and Matrix Algebra
MATH-1020 Calculus II*

ARCH Summer semester

ENGR-2090 Engineering Dynamics
ENGR-1100 Introduction to Engineering Analysis
PHYS-1100/-1150 Physics I
(MATH-2400 Introduction to Differential Equations* is a co-requisite)
MANE-4060 Aerospace Structures and Materials
ENGR-2530 Strength of Materials*
MANE-4070 Aerodynamics I
MANE-2720 Fluid Mechanics*

Third Year resident semester (Fall or Spring)

MANE-4500 Modeling and Control of Dynamic Systems
MATH-2400 Introduction to Differential Equations*
PHYS-1200\-1250 Physics II*
[ENGR-2090 Engineering Dynamics* is a recommended pre-requisite]
MANE-4900 Aeroelasticity and Structural Vibrations
MANE-4060 Aerospace Structures and Materials*
MATH-2400 Introduction to Differential Equations*
MANE-4910 Fluid Dynamics Laboratory
MANE-4070 Aerodynamics I*
MANE-4920 Aerospace Structures and Controls Laboratory
MANE-4060 Aerospace Structures and Materials*
STSS-4100 Professional Development II
No prerequisites
[For a list of courses that satisfy the PD II requirement refer to the link "Professional Development II Courses" on the Registrar's "Academic Planning" web page. It should be completed before the capstone design course.]

Fourth Year Fall semester

MANE-4080 Propulsion Systems
MANE-4710 Thermodynamics*
MANE-4720 Fluid Mechanics*
MANE-4510 Control Systems Laboratory
MANE-4500 Modeling and Control of Dynamic Systems*

Fourth Year Spring semester

ENGR-4010 Professional Development III
ENGR-2050 Introduction to Engineering Design*, MANE-2220 Inventor's Studio 1*, or ENGR-1010 Professional Development I

Computation Electives

MANE-4140 Introduction to Computational Fluid Dynamics
MANE-2110 Numerical Methods and Programming*
MANE-2720 Fluid Mechanics*

MANE-4240 Introduction to Finite Elements
MANE 2110 Numerical Methods and Programming*
ENGR-2530 Strength of Materials* or MANE-2720 Fluid Mechanics*

MANE-4280 Numerical Design Optimization
MANE 2110 Numerical Methods and Programming*
MATH 2010 Multivariable Calculus and Matrix Algebra*

Flight Mechanics Electives

MANE-4090 Flight Mechanics
MANE-4500 Modeling and Control of Dynamic Systems*
MANE-4070 Aerodynamics I*

MANE-4100 Spaceflight Mechanics
ENGR-2090 Engineering Dynamics*
MATH-2400 Introduction to Differential Equations*

MANE-4110 Helicopter Aerodynamics and Performance
MANE-4070 Aerodynamics I*

MANE-4120 Multirotor Areal Vehicles
MANE-4070 Aerodynamics I*

Capstone Design Electives

MANE-4210 VTOL Aircraft Design
MANE-4110 Helicopter Aerodynamics and Performance* or MANE-4120 Multirotor Areal Vehicles*

MANE-4230 Air Vehicle Design
MANE-4090 Flight Mechanics*

MANE-4250 Space Vehicle Design
Any Flight Mechanics Elective*
[MANE-4100 Spaceflight Mechanics* is a recommended prerequisite]

*This course also has prerequisite requirements.

Courses in (parenthesis) are co-requisites that must be taken during or before the course being considered. Courses in [brackets] are suggestions but not requirements.

The 4000-level MANE Aerospace Technical Electives may have prerequisites; check the course catalog.

HASS courses and free electives may have prerequisites; check the course catalog.

Additional Guidance for Building an Aeronautical Engineering Curriculum

- MANE's industrial advisors recommend students acquire more than the minimum communication skills required at Rensselaer. Thus, a *technical communication* course is recommended as a HASS elective. Examples include:

  COMM-4180 Studio Design in Human-Computer Interaction
  COMM-4420 Foundations of HCI Usability
  COMM-4470 Information Design
  COMM-4880 Interactive Data Visualization
  WRIT-1110 Writing in Context
  WRIT-4410 Research Writing

  Courses with related technical communication content include:

  COMM-4460 Visual Design: Theory and Application
  WRIT-2110 Strategic Writing
  WRIT-2340 Speech Communication
  WRIT-4550 Proposing and Persuading

  Please note that these courses are not offered every semester and there are not enough seats to accommodate all of the students who may wish to take them. Please do not stress out if you are unable to register for one of these courses: this recommendation is a suggestion, not a requirement. If you do take additional Communication Intensive courses, we recommend you include those skills on your resume.

- Aerospace Engineers are more likely to use CAD skills in industry, so ENGR-1200 EG&CAD is recommended over ENGR-1400 Engineering Communication or CIVL-1200 Engineering Graphics for Civil Engineers, though any one of these is acceptable.
- Select a Computation Intensive Elective based on your interests and strengths. Finite Element methods (FEM) are primarily for structural analysis, though they are applied to fluid problems as well. Computational Fluid Dynamics (CFD) is focused on fluid systems analysis. Numerical Design Optimization methods are mathematical techniques used extensively in industry, and especially in the aerospace industry.
- Most aerospace companies are not concerned with which mechanics/capstone sequence you take as an undergraduate. It is for you to choose what path you are most passionate about and where your strengths are. Plan carefully, as the fixed-wing and rotorcraft paths are fall-spring, while the space path is generally spring-fall (though fall-spring sections may be offered on occasion).

Eligible students who intend to become co-terminal students should begin to identify a graduate co-terminal advisor in the Junior year resident semester, and begin the application process at the beginning of their senior year.

- To reduce the course load in your graduate year, try to front-load at least one course applicable to your master's degree in your senior year. Many graduate courses are offered only every other year, so plan ahead for what courses to take in your senior and co-terminal years.
- Prior to registering for senior year courses, consult with your co-terminal master's advisor on the best use of the Aerospace Technical Elective in preparing for your graduate studies.
- Consider being resident for a summer to make progress on your master's thesis/project (though not taking any credits).

BACHELOR OF SCIENCE IN MECHANICAL ENGINEERING

Minimum credit hour requirements for the Bachelor's Degree in Mechanical Engineering: 129

FIRST YEAR					
	FALL SEMESTER (17 CREDITS)	**Credits**		**SPRING SEMESTER (17 CREDITS)**	**Credits**
CHEM-1100	Chemistry I	4	ENGR-1200	Engineering Processes [1]	1
ENGR-1100	Introduction to Engineering Analysis [1]	4	ENGR-1600	Materials Science for Engineers	4
ENGR-1200	Engineering Graphics and CAD [1,2]	1	MATH-1020	Calculus II	4
MATH-1010	Calculus I	4	PHYS-1100	Physics I [1]	4
IHSS-….	HASS Core Elective [3]	4	HASS	HASS Core Elective [3]	4
SECOND YEAR					
	FALL SEMESTER (17 CREDITS)	**Credits**		**SPRING SEMESTER (15 CREDITS)**	**Credits**
ENGR-2530	Strength of Materials [1]	4	MANE-2110	Numerical Methods & Programming [1]	3
MANE-2710	Thermodynamics [1]	3	SoE-2….	Engineering Design Elective [1,5,6]	4
MATH-2400	Introduction to Differential Equations [1]	4	ENGR-2300	Electronic Instrumentation [6]	4
PHYS-1200	Physics II	4	MATH-2010	Multivariable Calc. & Matrix Algebra [1,6]	4
STSS-4100	Professional Development II [1,4]	2			
THIRD YEAR					
	ARCH SUMMER SEMESTER (15 CREDITS)	**Credits**		**FALL OR SPRING (17 CREDITS)**	**Credits**
ENGR-2090	Engineering Dynamics	4	ENGR-2600	Modeling & Analysis of Uncertainty [6]	3
MANE-2720	Fluid Mechanics	3	MANE-4040	Mechanical Systems Laboratory [7]	2
MANE-4030	Elements of Mechanical Design	4	MANE-4500	Modeling & Control of Dynamic Sys. [6]	3
HASS	HASS Core Elective [3]	4	MANE-4730	Heat Transfer	3
			MANE-4740	Thermal & Fluids Eng. Laboratory [7]	2
				Free Elective [5,6]	4
FOURTH YEAR					
	FALL SEMESTER (16 CREDITS)	**Credits**		**SPRING SEMESTER (15 CREDITS)**	**Credits**
ENGR-4010	Professional Development III [1]	1	SoE/S-4….	Technical Elective II [1,9]	3
MANE-4260	Multidisciplinary Capstone Design [1,8]	3	HASS	HASS Core Elective [3]	4
MANE-4510	Control Systems Laboratory [1,7]	2		Free Elective	4
MANE-4….	Computation Elective [1,6,9]	3		Free Elective	4
MANE-4….	Technical Elective I [1,9]	3			
HASS	HASS Core Elective [3]	4			

[1] These required courses may be taken in any order in the academic year shown (or in a previous year) given the pre-requisites are met.

[2] Choice of ENGR-1200 Engineering Graphics & CAD, ENGR-1400 Engineering Communication, or CIVL-1200 Engineering Graphics for Civil Engineers; ENGR-1200 Engineering Graphics & CAD is preferred for Mechanical Engineers.

[3] The five HASS Electives may be taken in any semester; it is recommended to schedule one in each of the first two semesters and one in the Arch Summer. Students should take a HASS Inquiry course during their first year; for a listing of HASS Inquiry courses go to https://info.rpi.edu/hass-inquiry. Students should take a HASS Communications Intensive course during their first three semesters; refer to the link "Communications Intensive (CI) Requirement" on the Registrar's "Academic Planning" web page.

[4] For a list of courses that satisfy the PD II requirement refer to the link "Professional Development II Courses" on the Registrar's "Academic Planning" web page. It should be completed before the capstone design course.

[5] Choose from ENGR-2050 Introduction to Engineering Design and MANE-2220 Inventor's Studio 1; both have ENGR-1010 Professional Development I embedded in them.

[6] These courses may be taken in the Arch Summer semester (if the summer schedule permits).

[7] These laboratory courses may be taken any semester in the junior or senior year, provided all prerequisites have been completed.

[8] Mechanical Engineering students may alternatively take MANE-4220 Inventor's Studio 2, MANE-4210 VTOL Aircraft Design, MANE-4230 Air Vehicle Design, or MANE-4850 Space Vehicle Design as alternative capstone design experiences, provided all prerequisites have been completed or given permission by the instructor.

[9] **Computation and Technical Electives**

- The Computation Elective must be chosen from the following list of courses: MANE-4240 Introduction to Finite Elements (fall, spring, and summer), MANE-4140 Introduction to Computational Fluid Dynamics (spring only), MANE-4280 Numerical Design Optimization (fall only), or MTLE-4500 Computational Methods for Materials Design (spring only).
- The first Technical Elective must be selected from any upper-level (4000 or above) MANE course.
- The second Technical Elective may be selected from any upper-level (4000 or above) course in the School of Engineering or the School of Science. An independent study course, such as a design project or an undergraduate research project in the School of Engineering or the School of Science may also be used to satisfy this requirement.
- Computational and Technical Electives may not be taken on a Pass/No Credit basis.

Mechanical Engineering Course Prerequisite Chart

First Year Fall semester

CHEM-1100 Chemistry I
No prerequisite
ENGR-1100 Intro to Engineering Analysis
No prerequisite
ENGR-1200 Engineering Graphics & CAD / ENGR-1400 Eng. Comm. / CIVL-1200 EG for CIVL
No prerequisites
MATH-1010 Calculus I
No prerequisite

First Year Spring semester

ENGR-1300 Engineering Processes
No prerequisite
ENGR-1600 Materials Science
CHEM-1100 Chemistry I
MATH-1020 Calculus II
MATH-1010 Calculus I
PHYS-1100 Physics I
No prerequisite

Second Year Fall semester

ENGR-2530 Strength of Materials
ENGR-1100 Introduction to Engineering Analysis
MANE-2710 Thermodynamics
CHEM-1100 Chemistry I
ENGR-1100 Introduction to Engineering Analysis
MATH-1200 Calculus II*
PHYS-1100/-1150 Physics I
MATH-2400 Introduction to Differential Equations
MATH-1020 Calculus II*
PHYS-1200 Physics II
PHYS-1100/-1150 Physics I
STSS-4100 Professional Development II
No prerequisites
[For a list of courses that satisfy the PD II requirement refer to the link "Professional Development II Courses" on the Registrar's "Academic Planning" web page. It should be completed before the capstone design course.]

Second Year Spring semester

MANE-2110 Numerical Methods and Programming
ENGR-1100 Introduction to Engineering Analysis
(MATH 2400 Introduction to Differential Equations, PHYS-1200/-1250 Physics II are co-requisites).
ENGR-2050 Introduction to Engineering Design / MANE-2220 Inventor's Studio 1
ENGR-1100 Introduction to Engineering Analysis
ENGR-1200 EG&CAD, or ENGR-1400 Eng. Comm., or CIVL-1200 EG for CIVL
(PHYS-1200 Physics II* is a co-requisite)
ENGR-2300 Electronic Instrumentation
PHYS-1200/-1250 Physics II*
MATH-2010 Multivariable Calculus and Matrix Algebra
MATH-1020 Calculus II*

ARCH Summer semester

ENGR-2090 Engineering Dynamics
ENGR-1100 Introduction to Engineering Analysis
PHYS-1100/-1150 Physics I
(MATH-2400 Introduction to Differential Equations* is a co-requisite)

MANE-2720 Fluid Mechanics
ENGR-1100 Introduction to Engineering Analysis
PHYS-1100/-1150 Physics I
(MATH-2010 Multivariable Calculus and Matrix Algebra* and MATH-2400 Introduction to Differential Equations* are co-requisites)

MANE-4030 Elements of Mechanical Design
ENGR-2530 Strength of Materials*
MATH-2400 Introduction to Differential Equations*

Third Year resident semester (Fall or Spring)

ENGR-2600 Modeling and Analysis of Uncertainty
MATH-1010 Calculus I

MANE-4030 Mechanical Systems Lab
(MANE-4040 Elements of Mechanical Design* is a co-requisite)

MANE-4500 Modeling and Control of Dynamic Systems
MATH-2400 Introduction to Differential Equations*
PHYS-1200/-1250 Physics II*
[ENGR-2090 Engineering Dynamics* is a recommended pre-requisite]

MANE-4730 Heat Transfer
MANE-4710 Thermodynamics*
(MANE-4720 Fluid Mechanics* is a co-requisite)

MANE-4740 Thermal and Fluids Engineering Laboratory
MANE-4710 Thermodynamics*
MANE-4720 Fluid Mechanics*
(MANE-4730 Heat Transfer* is a co-requisite)

Fourth Year Fall semester

ENGR-4010 Professional Development III
ENGR-2050 Introduction to Engineering Design*, MANE-2220 Inventor's Studio 1*, or ENGR-1010 Professional Development I

MANE-4510 Control Systems Laboratory
MANE-4500 Modeling and Control of Dynamic Systems*

Fourth Year Spring semester

See electives below

Computation Electives

MANE-4140 Introduction to Computational Fluid Dynamics
MANE-2110 Numerical Methods and Programming*
MANE-2720 Fluid Mechanics*

MANE-4240 Introduction to Finite Elements
MANE 2110 Numerical Methods and Programming*
ENGR-2530 Strength of Materials* or MANE-2720 Fluid Mechanics*

MANE-4280 Numerical Design Optimization
MANE 2110 Numerical Methods and Programming*
MATH 2010 Multivariable Calculus and Matrix Algebra*

MTLE-4500 Computational Methods for Materials Design
MANE 2110 Numerical Methods and Programming*
Junior Standing

Capstone Design Electives

MANE-4210	VTOL Aircraft Design MANE-4110 Helicopter Aerodynamics and Performance* or MANE-4120 Multirotor Areal Vehicles*
MANE-4220	Inventor's Studio 2 ENGR-2050 Introduction to Engineering Design* or MANE-2220 Inventor's Studio 1*
MANE-4230	Air Vehicle Design MANE-4090 Flight Mechanics*
MANE-4250	Space Vehicle Design Any Flight Mechanics Elective* [MANE-4100 Spaceflight Mechanics* is a recommended prerequisite]
MANE-4260	Multidisciplinary Capstone Design ENGR-2050 Introduction to Engineering Design* or MANE-2220 Inventor's Studio 1* Senior Standing

*This course also has prerequisite requirements.

Courses in (parenthesis) are co-requisites that must be taken during or before the course being considered. Courses in [brackets] are suggestions but not requirements.

The Technical Electives may have prerequisites; check the course catalog.

HASS courses and free electives may have prerequisites; check the course catalog.

Additional Guidance for Building a Mechanical Engineering Curriculum

- MANE's industrial advisors recommend students acquire more than the minimum communication skills required at Rensselaer. Thus, a *technical communication* course is recommended as a HASS elective. Examples include:

  COMM-4180 Studio Design in Human-Computer Interaction
  COMM-4420 Foundations of HCI Usability
  COMM-4470 Information Design
  COMM-4880 Interactive Data Visualization
  WRIT-1110 Writing in Context
  WRIT-4410 Research Writing

  Courses with related technical communication content include:

  COMM-4460 Visual Design: Theory and Application
  WRIT-2110 Strategic Writing
  WRIT-2340 Speech Communication
  WRIT-4550 Proposing and Persuading

  Please note that these courses are not offered every semester and there are not enough seats to accommodate all of the students who may wish to take them. Please do not stress out if you are unable to register for one of these courses: this recommendation is a suggestion, not a requirement. If you do take additional Communication Intensive courses, we recommend you include those skills on your resume.

- Mechanical Engineers are more likely to use CAD skills in industry, so ENGR-1200 EG&CAD is recommended over ENGR-1400 Engineering Communication or CIVL-1200 Engineering Graphics for Civil Engineers, though any one of these is acceptable.
- Select a Computation Intensive Elective based on your interests and strengths. Finite Element methods (FEM) are primarily for structural analysis, though they are applied to fluid problems as well. Computational Fluid Dynamics (CFD) is focused on fluid systems analysis. Numerical Design Optimization methods are mathematical techniques used extensively in industry, and especially in the aerospace industry.
- Most companies are not concerned with which Capstone Design experience you take as an undergraduate. It is for you to choose what path you are most passionate about and where your strengths are.

Eligible students who intend to become co-terminal students should begin to identify a graduate co-terminal advisor in the Junior year resident semester, and begin the application process at the beginning of their senior year.

- To reduce the course load in your graduate year, try to front-load at least one course applicable to your master's degree in your senior year. Many graduate courses are offered only every other year, so plan ahead for what courses to take in your senior and co-terminal years.
- Prior to registering for senior year courses, consult with your co-terminal master's advisor on the best use of the Technical Electives in preparing for your graduate studies.
- Consider being resident for a summer to make progress on your master's thesis/project (though not taking any credits)

BACHELOR OF SCIENCE IN NUCLEAR ENGINEERING

Minimum credit hour requirements for the Bachelor's Degree in Nuclear Engineering: 130

FIRST YEAR					
	FALL SEMESTER (17 CREDITS)	**Credits**		**SPRING SEMESTER (17 CREDITS)**	**Credit**
ENGR-1100	Introduction to Engineering Analysis [1]	4	CHEM-1100	Chemistry I [1]	4
ENGR-1200	Engineering Graphics & CAD [1,2]	1	MANE-1100	Introduction to Nuclear Engineering [4]	1
MATH-1010	Calculus I	4	MATH-1020	Calculus II	4
PHYS-1100	Physics I	4	PHYS-1200	Physics II	4
HASS	HASS Core Elective [3]	4	HASS	HASS Core Elective [3]	4
SECOND YEAR					
	FALL SEMESTER (17 CREDITS)	**Credits**		**SPRING SEMESTER (17 CREDITS)**	**Credit**
MANE-2710	Thermodynamics [1]	3	MANE-2110	Numerical Methods & Programming [1]	3
MANE-2830	Nuclear Phenom. for Eng. Applications	4	MANE-2710	Fluid Mechanics [1,5]	3
MATH-2010	Multivariable Calc. & Matrix Algebra [1,5]	4	MANE-2400	Fundamentals of Nuclear Engineering	4
MATH-2400	Introduction to Differential Equations [1]	4	MANE-4350	Nuclear Instrumentation & Measurement	3
STSS-4100	Professional Development II [1,5,6]	2	SoE	Materials Science Elective [1,5,7]	4
THIRD YEAR					
	ARCH SUMMER SEMESTER (14 CREDITS)	**Credits**		**FALL ONLY (16 CREDITS)**	**Credit**
SoE-2….	Engineering Design Elective [8]	4	ENGR-4010	Professional Development III [5,9]	1
ENGR-2600	Modeling & Analysis of Uncertainty	3	MANE-4400	Nuclear Power Systems Engineering	4
MANE-4500	Modeling & Control of Dynamic Sys.	3	MANE-4470	Radiological Engineering	3
HASS	HASS Core Elective [3]	4	MANE-4480	Physics of Nuclear Reactors	4
			HASS	HASS Core Elective [3]	4
FOURTH YEAR					
	FALL SEMESTER (16 CREDITS)	**Credits**		**SPRING SEMESTER (16 CREDITS)**	**Credit**
MANE-4380	NE Senior Design Project I	1	MANE-4390	NE Senior Design Project II	2
MANE-4370	Nuclear Engineering Laboratory	4	MANE-4….	Nuclear Engineering Laboratory II [10]	3
MANE-4….	NE Technical Elective I [1,11]	3	MANE-4….	NE Technical Elective II [1,11]	3
HASS	HASS Core Elective [3]	4		Free Elective [1]	4
	Free Elective [1]	4		Free Elective [1]	4

[1] These required courses may be taken in any order in the academic year shown (or in a previous year) given the pre-requisites are met.

[2] Choice of ENGR-1200 Engineering Graphics & CAD, ENGR-1400 Engineering Communication, or CIVL-1200 Engineering Graphics for Civil Engineers.

[3] The five HASS Electives may be taken in any semester; it is recommended to schedule one in each of the first two semesters and one in the Arch Summer. Students should take a HASS Inquiry course during their first year; for a listing of HASS Inquiry courses go to https://info.rpi.edu/hass-inquiry. Students should take a HASS Communications Intensive course during their first three semesters; refer to the link "Communications Intensive (CI) Requirement" on the Registrar's "Academic Planning" web page.

[4] Any 1 credit engineering exploration elective (e.g., "Introduction to [major]" or ENGR-1200 Engineering Processes) may be substituted.

[5] These courses are options that may be taken in the Arch Summer semester (if the summer schedule permits).

[6] For a list of courses that satisfy the PD II requirement refer to the link "Professional Development II Courses" on the Registrar's "Academic Planning" web page. It should be completed before the capstone design course.

[7] Choose from MANE-4460 Engineering Materials for Nuclear Applications or ENGR-1600 Materials Science.

[8] Choose from MANE-2220 Inventor's Studio 1 or ENGR-2050 Introduction to Engineering Design; both have ENGR-1010 Professional Development I embedded in them.

[9] Students restricted from Arch (e.g., ROTC, certain athletes) will delay PD III until senior year, after the Professional Development I content in the Engineering Design Elective.

[10] Choose from MANE-4440 Critical Reactor Lab or MANE-4961 LINAC Lab

[11] **NE Technical Electives**

- NE Technical Electives are MANE 4000-level or higher courses related to Nuclear Engineering that are taken for 3 credits or more.
- The NE Technical Electives allow you to focus on your technical interest or area of specialization within the Nuclear Engineering field.
- If you have questions regarding whether a specific course satisfies your NE Technical Elective requirements, please consult with your academic advisor.
- An independent study course, such as a design project or an undergraduate research project with a Nuclear Engineering instructor, may be used to satisfy one of the NE Technical Electives.
- NE Technical Electives may not be taken on a Pass/No Credit basis.

Nuclear Engineering Course Prerequisite Chart

First Year Fall semester

ENGR-1100 Intro to Engineering Analysis
No prerequisite

ENGR-1200 Engineering Graphics & CAD / ENGR-1400 Eng. Comm. / CIVL-1200 EG for CIVL
No prerequisites

MATH-1010 Calculus I
No prerequisite

PHYS-1100 Physics I
No prerequisite

First Year Spring semester

CHEM-1100 Chemistry I
No prerequisite

MANE-1100 Introduction to Nuclear Engineering
No prerequisite

MATH-1020 Calculus II
MATH-1010 Calculus I

PHYS-1200 Physics II
PHYS-1100/-1150 Physics I

Second Year Fall semester

MANE-2710 Thermodynamics
CHEM-1100 Chemistry I
ENGR-1100 Introduction to Engineering Analysis
MATH-1200 Calculus II*
PHYS-1100/-1150 Physics I

MANE-2830 Nuclear Phenomena for Engineering Applications
CHEM-1100 Chemistry I
PHYS-1100/-1150 Physics I
[PHYS-1200/-1250 Physics II* is a recommended pre-requisite]
[MATH-2400 Introduction to Differential Equations* is a recommended co-requisite]

MATH-2010 Multivariable Calculus and Matrix Algebra
MATH-1020 Calculus II*

MATH-2400 Introduction to Differential Equations
MATH-1020 Calculus II*

STSS-4100 Professional Development II
No prerequisites
[For a list of courses that satisfy the PD II requirement refer to the link "Professional Development II Courses" on the Registrar's "Academic Planning" web page. It should be completed before the capstone design course.]

Second Year Spring semester

MANE-2110 Numerical Methods and Programming
ENGR-1100 Introduction to Engineering Analysis
(MATH 2400 Introduction to Differential Equations, PHYS-1200/-1250 Physics II are co-requisites).

MANE-2400 Fundamentals of Nuclear Engineering
MANE-2830 Nuclear Phenomena for Engineering Applications*
MATH-2400 Introduction to Differential Equations*

MANE-2720 Fluid Mechanics
ENGR-1100 Introduction to Engineering Analysis
PHYS-1100/-1150 Physics I

(MATH-2010 Multivariable Calculus and Matrix Algebra* and MATH-2400 Introduction to Differential Equations* are co-requisites)

MANE-4350 Nuclear Instrumentation and Measurement
MANE-2830 Nuclear Phenomena for Engineering Applications*

ENGR-1600 Materials Science or MANE-4460 Engineering Materials for Nuclear Applications
CHEM-1100 Chemistry I

ARCH Summer semester

ENGR-2050 Introduction to Engineering Design / MANE-2220 Inventor's Studio 1
ENGR-1100 Introduction to Engineering Analysis
ENGR-1200 EG&CAD, or ENGR-1400 Eng. Comm., or CIVL-1200 EG for CIVL
(PHYS-1200 Physics II* is a co-requisite)

ENGR-2600 Modeling and Analysis of Uncertainty
MATH-1010 Calculus I

MANE-4500 Modeling and Control of Dynamic Systems
MATH-2400 Introduction to Differential Equations*
PHYS-1200/-1250 Physics II*
[ENGR-2090 Engineering Dynamics* is a recommended pre-requisite]

Third Year Fall semester (note that resident fall semester is required)

ENGR-4010 Professional Development III
ENGR-2050 Introduction to Engineering Design*, MANE-2220 Inventor's Studio 1*, or ENGR-1010 Professional Development I

MANE-4400 Nuclear Power Systems Engineering
ENGR-2250 Thermal and Fluids Engineering*

MANE-4470 Radiological Engineering
MANE-2830 Nuclear Phenomena for Engineering Applications*
(MANE-4350 Nuclear Instrumentation and Measurement* is a recommended pre-requisite)

MANE-4480 Physics of Nuclear Reactors
MANE-2400 Fundamentals of Nuclear Engineering*

Fourth Year Fall semester

MANE-4370 Nuclear Engineering Lab
ENGR-2600 Modeling and Analysis of Uncertainty*
MANE-2830 Nuclear Phenomena for Engineering Applications*

MANE-4380 NE Senior Design Project I
Prerequisite: senior standing or permission of instructor

Fourth Year Spring semester

MANE-4390 NE Senior Design Project II
MANE-4380 NE Senior Design Project I*

MANE-4440 Critical Reactor Laboratory / MANE-496x LINAC Lab
MANE-4480 Physics of Nuclear Reactors*

*This course also has prerequisite requirements.
Courses in (parenthesis) are co-requisites that must be taken during or before the course being considered. Courses in [brackets] are suggestions but not requirements.
The Technical Electives may have prerequisites; check the course catalog.
HASS courses and free electives may have prerequisites; check the course catalog.

Additional Guidance for Building a Nuclear Engineering Curriculum

- MANE's industrial advisors recommend students acquire more than the minimum communication skills required at Rensselaer. Thus, a *technical communication* course is recommended as a HASS elective. Examples include:

  COMM-4180 Studio Design in Human-Computer Interaction
  COMM-4420 Foundations of HCI Usability
  COMM-4470 Information Design
  COMM-4880 Interactive Data Visualization
  WRIT-1110 Writing in Context
  WRIT-4410 Research Writing

  Courses with related technical communication content include:

  COMM-4460 Visual Design: Theory and Application
  WRIT-2110 Strategic Writing
  WRIT-2340 Speech Communication
  WRIT-4550 Proposing and Persuading

  Please note that these courses are not offered every semester and there are not enough seats to accommodate all of the students who may wish to take them. Please do not stress out if you are unable to register for one of these courses: this recommendation is a suggestion, not a requirement. If you do take additional Communication Intensive courses, we recommend you include those skills on your resume.

- Nuclear engineering courses are only available in particular semesters. This means that the Arch away semester is specified as spring of the junior year, with fall of junior year on campus to take nuclear engineering courses of value to potential employers. Students planning additional co-op, internship, or other semester away experiences beyond the Arch away semester must plan very carefully. In particular, note that the NE Senior Design Project is a two semester fall-spring sequence that must be taken in consecutive fall-then-spring semesters.

Eligible students who intend to become co-terminal students should begin to identify a graduate co-terminal advisor in the Junior year resident semester, and begin the application process at the beginning of their senior year.

- To reduce the course load in your graduate year, try to front-load at least one course applicable to your master's degree in your senior year. Many graduate courses are offered only every other year, so plan ahead for what courses to take in your senior and co-terminal years.
- Prior to registering for senior year courses, consult with your co-terminal master's advisor on the best use of the Technical Electives in preparing for your graduate studies.
- Consider being resident for a summer to make progress on your master's thesis/project (though not taking any credits)

HASS AND PD II – POLICIES FOR ENGINEERING STUDENTS

Engineering students at Rensselaer are required to successfully complete:

- 20 credits of HASS (Humanities and Social Sciences)
- 2 credits of PD II (Professional Development II)

As well as:

- 1 credit of PD I (typically as part of ENGR-2050 *Introduction to Engineering Design* or MANE-2220 *Inventor's Studio 1*, or alternatively as ENGR-1010 *Professional Development I* if ENGR-2050 transferred in as less than a 4 credit course)
- 1 credit of ENGR-4010 *Professional Development III*

For a total of:

24 credits to fulfill the HASS Core requirement.

Engineering Students shall distribute the 20 credits of HASS as follows:

- 1 HASS Inquiry (IHSS) course in first 2 semesters
- 1 Communication Intensive (CI) course in first 3 semesters (see note below)
- A minimum of 1 Humanities Course (see table below)
- A minimum of 1 Social Science Course (see table below)
- At least 4 credits must be 4000+ level and may be included in the Integrative Pathway
- No more than 12 credits at the 1000 level
- No more than 4 credits can come from 1 credit courses (e.g. music ensemble)
- No more than 2 courses (8 credits total) can be from transfer courses (including AP classes)
- No more than 8 credits can be from Pass/No Credit courses, and P/NC courses may not apply to the Communication Intensive Requirement nor the Integrative Pathway requirement.

HUMANITIES:	SOCIAL SCIENCES:
ARTS (ARTS, MUSIC)	**COGS** (COGNITIVE SCIENCE)
COMM (COMMUNICATION & MEDIA)	**ECON** (ECONOMICS)
GSAS (GAMES & SIMULATION ARTS AND SCIENCES)	**GSAS** (GAMES & SIMULATION ARTS AND SCIENCES)
LANG (LANGUAGE)	**PSYC** (PSYCHOLOGY)
LITR (LITERATURE)	**STSS** (ANTHROPOLOGY)
PHIL (PHILOSOPHY)	**STSS** (SOCIOLOGY)
STSH (HISTORY)	**STSS** (SCIENCE & TECHNOLOGY)
STSH (SCIENCE & TECHNOLOGY)	
WRIT (WRITING)	
IHSS (INTERDISCIPLINARY HASS)	**IHSS** (INTERDISCIPLINARY HASS)

HASS Integrative Pathway

An Integrative Pathway (IP) is a themed set of courses that allows students to explore a designated topic area in greater breadth & depth. Students may choose from the list of over 40 topic areas to explore. Please visit this site for approved pathways (https://info.rpi.edu/pathways). This list also includes required courses for each pathway and other FAQs regarding the IP requirement. Many of the IPs can also lead to minors.

Students are required to take at least one HASS course that is "CI" (Communications Intensive). For a list of courses that satisfy the CI requirement refer to the link

"Communications Intensive (CI) Requirement" on the Registrar's "Academic Planning" web page. It should ideally be completed within the first three semesters at Rensselaer. This course may not be taken on a Pass/No Credit basis.

Enrolled Rensselaer students wishing to take a HASS course for credit at another institution must obtain prior approval for the course from the HASS Manager of Student Services or HASS Associate Dean. Applicants must furnish a syllabus for the proposed course (a catalog description is sometimes sufficient, but not always), and a completed copy of Rensselaer's Transfer Credit Approval form to apply for approval.

Cross-listed STSS/STSH courses can be switched (between H and SS) after the course is taken by making a request to the Registrar's Office.

The 2-credits of PD II shall be satisfied as follows:

STSS -4100 PD II Tech Issues and Solutions, a 2-credit course, will satisfy the PD II requirement.

A 4-credit PD II alternate course at the 2000- or 4000 level may be substituted for the 2-credit course. For a list of courses that satisfy the PD II requirement refer to the link "Professional Development II Courses" on the Registrar's "Academic Planning" web page. It should be completed before the capstone design course.

A course used to satisfy the PD II requirement may **not** be taken on a Pass/No Credit basis.

In general, the PD II alternate course will be split as follows:

- two credits allocated to satisfy PD II
- the remaining credits allocated to free elective (or "Not Applied" to the degree if free elective credits have been completed)

With restrictions, the credits of a PD II alternate that are not allocated to PD II may be used to fulfill the 20-credits of HASS. These credits:

- **cannot** count toward the 4000 requirement,
- **cannot** count toward the integrative pathways requirement,
- **cannot** increase the number of 1000 level credits past 12.

However,

- they can count toward the overall 20 credits of HASS,
- they can count toward the H and SS 4-credit minimums,
- they can count toward the HASS "CI" requirement.

If a student transfers in a course that is in name and course number equivalent to a PD II alternate it counts as that named HASS course, but it does **not** transfer in its status as a PD II alternate. The student would still be responsible for taking PD II or a PD II alternate at Rensselaer.

In the rare case that a student transfers in a course with Professional Development II content nearly identical to that in STSS -4100 PD II Tech Issues and Solutions, they may furnish a syllabus of the transfer course and a completed copy of Rensselaer's Transfer Credit Approval form to the Associate Dean of Engineering (JEC 3018) to apply for approval. Note that some courses in the Study Abroad program automatically satisfy the PD II requirement, as indicated in the transfer equivalency guide.

The School of Humanities, Arts, and Social Sciences (HASS) Associate Dean for Academic Affairs is:
Brett Fajen (fajenb@rpi.edu, Sage 4302)

Need an Extra Credit?

Q: What if I'm short 1-2 credits in HASS?
A: Use a 4-credit PD II alternate, with 2 credits to PD II, 1-2 credits to HASS as needed, and any remaining credits to free elective (or "Not Applied" if you have filled all of your free elective credits)

Q: What if I'm short 1-2 credits in Free Electives?
A: Use a 4-credit PD II alternate, with 2 credits to PD II and 2 credits to free elective

Q: Am I really free to choose my free electives?
A: Almost, but not quite – there are restrictions for "free" electives. To count as a free elective, one credit classes must be either
– from the School of Engineering, or
– graded classes (though you can take these on a Pass/No Credit basis),
– ROTC courses (USAF, USAR, USNA) must not total more than six credits
One credit classes that are graded Satisfactory / Unsatisfactory (S/U) that are not in the School of Engineering may **not** be used as free electives. For example, PHYS-1010 *A Passion for Physics* is a 1-credit S/U course that will not count as a free elective.

Options for 1 credit free electives
- independent study (1 credit ≈ 3 hours/week ⇒ ~ 45 hours of work in a semester)
- undergraduate research project (when taken for credit)
- School of Engineering courses, such as
  - CHME-1010 Introduction to Chemical Engineering
  - CIVL-1100 Introduction to Civil and Environmental Engineering
  - CIVL-1200 Engineering Graphics for Civil Engineers
  - ENGR-1300 Engineering Processes (if not required for your major)
  - ISYE-1100 Introduction to Industrial and Systems Engineering
  - MANE-1100 Introduction to Nuclear Engineering
  - MANE-1090 Introduction to Mechatronics Hardware and Software
  - MTLE-1200 Introduction to Materials Engineering
- School of Science courses
  - ISCI-4510 Origins of Life Seminar (requires Junior standing or higher)
- HASS courses
  - ARTS-2300 Rensselaer Orchestra
  - ARTS-2310 Rensselaer Concert Choir
  - ARTS-2320 Percussion Ensemble
  - ARTS-2330 Jazz Ensemble
  - ARTS-2360 Roots of Africa Music Ensemble
- ROTC courses (USAF, USAR, USNA, up to six credits maximum)
- most one-credit topics courses

FRIENDLY ADVICE

The courses at Rensselaer are generally more intense and faster paced and expect a much higher level of problem solving than some students have been prepared for. **The primary responsibility for learning has shifted to you.**

When we say "problem solving", we are in part referring to test questions. We refer to three types.

- The one you see coming: It's similar to homework problems you've been assigned, with a few minor changes. If the homework asked you 1+1=?, the test may ask 2+2=?.
- The one you still see coming, but from a different direction: If the homework asked you 2+2=?, the test may supply you with the definition of subtraction and ask 4-2=?.
- The one you'll never see coming: it is a question like nothing you've seen before, and that's the point. All that you've learned in the course has prepared you for the question, but the question itself is still completely new. What is being measured is: do you understand the material well enough that you understand how to apply it to completely new situations. That's one of the skills that differentiates an engineer from Rensselaer. And there are companies that rely on it when they hire. First year classes don't do this as much, but starting with sophomore classes like Thermodynamics and Fluid Mechanics may, and you must be prepared. **You must continuously learn how to learn.**

Try hard to not overload the number of credits needed in your last year: you will want time to look for a job that you will enjoy and that will value and reward you for your skills. Utilize your advisor; she or he is here to ensure that you have the best, well-rounded college experience possible.

And please take good care of yourself:

Eat right, get plenty of exercise, and get enough sleep.

EMAIL ETIQUETTE

In today's world, email plays a major role in communication with faculty and staff at RPI. Remember email is a reflection of who you are. If your email is disorganized and filled with mistakes, your recipient will likely think of you as disorganized and careless. Below are some tips to create effective emails:

- Be sure to begin all emails with a greeting like Dear Professor Smith, or Hello Ms. Jones.
- DO NOT WRITE YOUR EMAILS IN CAPITALS, they present an ANGRY tone.
- Introduce yourself. Don't assume that your recipient remembers meeting you; offer a reminder of who you are.
- Include the message thread so your recipient can read the history of the conversation without having to search their inbox.
- Keep your correspondence short. Clearly state the intentions of your email in a sentence or two.
- Avoid replying with a one word response. Be sure to reread the original email to make sure you have answered all questions.
- Avoid personal attacks in email.
- Reply in a reasonable amount of time. Responding within 24 hours is preferable considering students are expected to check their email daily.
- Always, always, always reread your email before clicking "send".

ENGINEERING PROGRAM REQUIREMENTS

Bachelor's Degree Requirements and Academic Policies

In addition to understanding the requirements of your academic major, you'll want to familiarize yourself with the Bachelor's degree requirements and the academic policies that apply to Rensselaer Undergraduates. That information can be found in the section of the online course catalog titled "Academic Information and Regulations" here: catalog.rpi.edu .

The Advising Process

The HUB

http://eng.rpi.edu/students/hub

The School of Engineering Advising Hub is the primary source of academic advising for all engineering students during their first three semesters at RPI. The Hub is located in the Ansell lounge on the third floor of the Jonsson Engineering Center (JEC) and is staffed by experienced advisors who will offer academic assistance for all engineering majors. Hub advisors assist students in establishing a foundation for academic success through student responsibility and planning. The Hub is a resource for all advising purposes including:

- Semester course planning
- Clear Student Advising Meeting (SAM) holds
- Major/minor declaration or changes
- Form approvals
- Registrar Protocol
- Summer Arch planning
- HASS and other course requirements

The Advising Hub will offer academic support to students through the end of the fall semester of their sophomore year. At that time, students will transition to a faculty advisor specific to the student's major. The faculty advisor will then contribute to the student's academic success by offering valuable perspective on internships, research and job prospects in addition to graduation requirements.

The Advising Hub hours are Monday, Tuesday, Thursday, and Friday 9am-4pm, by appointment.

Walk-in Wednesdays offer 20 minute meetings with no appointment necessary.

Academic Advisors

In addition to your School of Engineering HUB advisor, each undergraduate student in MANE is assigned an academic advisor who is a faculty member in the MANE department. When the HUB hands you off to your academic advisor for the remainder of your time here at Rensselaer, you should meet with your advisor at least once per semester to review and approve your course schedule before registration. But there are many more reasons to establish a good relationship with your academic advisor! Advisors can clarify degree requirements, help you develop an educational plan to serve your career goals, recommend specific courses, and refer you to sources of additional help on campus, such as career information, study skills, time management, and research opportunities.

Establishing an informal student-faculty contact can enhance the quality of your undergraduate experience, so it's very important that you get to know your advisor. Course offerings and

curriculum requirements sometimes change, so it's very important that you meet with your advisor on a regular basis to discuss any possible changes to your undergraduate plan of study and to stay on track for your degree. What's more, regular contact with your advisor can help provide a good source for recommendations later in your career.

MANE Office of Undergraduate Student Services

In addition to your academic advisor, the MANE Office of Undergraduate Student Services can assist you with many advisement and registration-related tasks. Our office provides all necessary Registrar forms and can help you complete them. We provide assistance with Registration issues; help with curriculum and course selection. If, after using this booklet, you still have questions or concerns or just want to know more about how we can help you, stop by JEC 2012 to say hello.

Student Advisor Meeting (SAM) Holds

Students are required to meet with their academic advisor at least once per year. If you do not meet with your advisor once per year, a Student Advisor Meeting (SAM) hold will be placed on your account and you will be prevented from registering. To resolve this situation, contact your academic advisor immediately. If your advisor is unavailable after repeated contact attempts, please contact MANE's Office of Undergraduate Student Services.

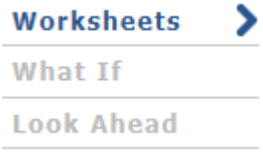
Registrar's Holds

Please contact MANE Student Services if you have a Registrar's hold, a financial hold, or some other hold and need to take certain MANE courses in order to graduate on time. We need to make sure we save you a slot in those classes. This is especially true for the laboratory courses, where enrollment is more limited.

Degree Works

Degree Works is a planning and advising tool – available only to undergraduate students – that allows you to track the progress you're making toward your Bachelor's Degree. You can access your Degree Works Audit via the main menu of the Student Information System (SIS).

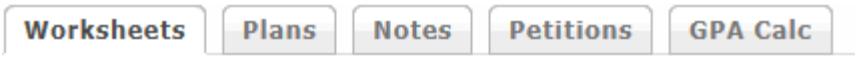
Once inside Degree Works, you will see three choices on the left side of the screen:



Worksheets – This is the opening page to Degree Works. On this page you will find demographic information, a degree progress chart, and your academic degree broken down by categories. Red boxes indicate courses (or a group of courses) not yet satisfied. A blue box indicates a requirement that you are currently enrolled in, or is in progress. A green box with a checkmark is a requirement that has been completed.

What If – If you are considering a change of major, adding a dual major or adding or changing your minor, the What If function is a helpful tool. This will take your completed credits and current registrations and show how they would potentially fit into a new major or minor. You should still need to meet with your advisor and complete a change of major form or minor approval form.

Look Ahead – The Look Ahead function is a great tool to make sure the courses you will be registering for will fulfill a requirement. Simply add the 4-digit department code (example – MANE or ENGR) and below that, enter the 4 digit course number (example – 1010 or 4941)



Please be aware that the Degree Works Audit is for guidance only, and is not necessarily an accurate portrayal of your graduation status. It is your responsibility to determine that you are on track to meet all of your graduation requirements. The four-year curriculum templates in this handbook can be helpful as a checklist to make sure you are progressing appropriately.

Additional Advising Resources

Advising and Learning Assistance Center: alac.rpi.edu
Center for Career and Professional Development: www.rpi.edu/dept/cdc
Course Catalog: www.rpi.edu/academics/catalog
International Programs: https://info.rpi.edu/international-programs
Registrar Forms: srfs.rpi.edu/update.do

COURSE REGISTRATION

When to Register

Registration for the spring semester generally occurs in early November. Registration for the fall semester occurs the preceding spring, usually in early April. Exact dates are included in the Academic Calendar. A few weeks before registration begins, you will receive an email with a "time ticket" that explains when you should register for your courses. Time tickets are explained in detail below.

How to Register

Use the Student Information System (SIS) to register for your courses. You can find details about each course in the online course catalog: catalog.rpi.edu.

Where to Register

There are no assigned rooms for registration. You can register for your classes using any computer with internet access.

Registration Time Tickets

Each semester you are issued a "time ticket," which designates a specific window of time during which you may register for the next semester. Your time ticket will be sent to your RPI email address a few weeks before registration. This e-mail message also notifies you of any issues, including a SAM hold, which may prevent you from registering. If there is any kind of registration hold on your account, you will need to resolve the issue before registering for courses.

Your registration time is assigned based on your class standing, which is determined by the number of credit hours you have earned (see below). Classes that are still in progress, courses that have been graded as "incomplete", and some transferred courses and Advanced Placement (AP) credits do not count toward earned credits.

School of Engineering Class Standing by Credit Hours Earned

First Year:	0 – 30 credits
Sophomore:	31 – 60 credits
Junior:	61 – 95 credits
Senior	96 – 128 credits

If a Course You Need is Full

The MANE department staff does its best to anticipate the number of seats needed for each course. However, high demand and classroom size restrictions sometimes result in a course being closed. Students are NOT prevented from graduating on time due to closed sections of courses! We use a wait list system to ensure fairness, and we prioritize those students who need a course to graduate on time. If you are unable to register for a course because it is full, please contact the appropriate staff member to be put on the waiting list. For CORE Engineering courses (course prefix ENGR), an online wait list is utilized. For MANE courses, stop by the Office of Undergraduate Student Services in JEC 2012. Please include your name, RIN, CRN, course number, section number, and course name for the courses you want to be put on the wait list for. For courses with multiple sections, list all of the sections that will fit in your schedule in descending order of preference. If you need to drop a course to make room for a course you hope to add, you must indicate that on your form.

ADDITIONAL DEGREE OPTIONS

Academic Minors

Minors are NOT available in either Mechanical Engineering or Aeronautical Engineering. Students interested in a minor in Nuclear Engineering may choose a minor focused on either Reactor Engineering or Medical Applications of Radiation Technology. For detailed information on Nuclear Engineering minors, please contact Professor Bimal Malaviya, Degree Clearance Officer for Nuclear Engineering.

Double Degrees

A student may become a candidate for a second baccalaureate degree when he or she has completed: (1) the equivalent of at least two terms (30 credit hours) of additional work beyond the requirements of a single degree, and (2) the courses in the department in which the student is registered and such other courses as are required for the second degree. From the MANE department's perspective, students considering a Double Degree may want to instead consider a co-terminal or regular master's degree. The ability to obtain a graduate level degree by taking 30 credits beyond the Bachelor's degree should be seriously considered rather than taking 30 additional credits and still ending up with a Bachelor's degree.

Dual Majors

Dual major programs lead to a single baccalaureate degree embracing two fields. There are several special programs that can be completed in eight semesters. Undergraduate students who fulfill all the degree requirements for two curricula and who have met the conditions below will receive one diploma noting both majors.

- The student must designate a first-named and second-named major in writing at least one semester prior to graduation, and have the Core Engineering Office (JEC 3018) approve this designation prior to submitting the dual major form with the registrar.
- Dual major students may be assigned an adviser in each department who will monitor progress towards degrees in that department. In some cases only one advisor is assigned (e.g., when both majors are within the same department, such as Mechanical and Aeronautical Engineering).
- The degree clearance officer in the department will certify that the student has met the degree requirements in that department.
- The 24-credit-hour mathematics/science requirement and the 24-credit-hour Humanities and Social Sciences (HASS) requirement will satisfy the Institute requirements for both majors.

The MANE Department currently has guidance for the following dual majors:

- Aeronautical Engineering and Mechanical Engineering
- Mechanical Engineering and Electrical Engineering
- Mechanical Engineering and Nuclear Engineering
- Mechanical Engineering and Design, Innovation, and Society
- Mechanical Engineering and Management
- Nuclear Engineering and Applied Physics
- Nuclear Engineering and Environmental Engineering

Please note that these are not the only possible dual degree combinations; these are simply the dual degrees for which we have already developed templates. If you wish to pursue a different dual major, you should first consult with your MANE academic advisor. If the second major is through another department, you will also need to consult an advisor in that department. Ideally, dual degree advisement should be completed during the first year to maximize the possibility of completing the dual degree in the minimum number of semesters.

MORE WAYS TO ENHANCE YOUR UNDERGRADUATE STUDIES

There are many ways to enhance your academic, career and social options during your four years on campus. Here are some of them.

International Programs: Study Abroad

The Study Abroad opportunity available at Rensselaer is an excellent experience for both professional and personal growth, and the department fully supports students wishing to take advantage of this wonderful opportunity. Information on the various Study Abroad programs, application materials, and Frequently Asked Questions are available through the Office for International Programs. More information can be found here: undergrad.rpi.edu. Professor Catalin Picu (picuc@rpi.edu) is the Study Abroad contact for the MANE Department.

When considering Study Abroad options, planning is required to minimize the impact on the graduation plans of the participant. In most situations, the time away does not delay graduation. Depending on your AP and transfer credit amounts, your choice of major, dual major or co-terminal plans, and in consultation with your academic advisor, you may choose to study abroad either in your sophomore year or junior year.

For MANE-specific course equivalents, please check the "Transfer Equivalency Catalog" listing, which can be found on the Login page of the Student Information System (SIS): sis.rpi.edu.

- Students are encouraged to choose from this list of pre-approved courses. If you are considering coursework that does not appear on the pre-approved list, please provide the course description from the university abroad and if possible a syllabus for that course. A prior approval form has to be completed and signed by the International Adviser of the Department. The forms are available on the Registrar's website or from the MANE Office of Undergraduate Student Services in JEC 2012.

- In addition, students may transfer courses that will be used as Free Electives or Humanities and Social Sciences courses. Students are encouraged to take abroad Humanities and Social Science (HASS) courses or free electives which are above the 1000 level here at RPI. Courses that the host university considers to be junior level or senior level courses can usually be transferred in to RPI.

Note: the system at RPI is based on 4 credit hour courses while many foreign universities rely on 3 credit courses so one can wind up one credit short per course. Therefore, you may wind up taking two courses to fill the credit hour requirement for one course at RPI with the extra credits going to Free Elective as a "split" course. Additional HASS credits may also come from 4-credit PD II alternate courses (two credits to PD II, one or two to HASS, and any remaining to free electives); however, these credits must satisfy the requirements for HASS courses (e.g., if a 1000-level PD II alternate is taken but you have already taken the maximum number of 1000-level courses/credits, then these credits cannot count toward HHSS requirements). In all cases, you should have prior approval of transfer credit: from a student perspective, this prior approval is the "guarantee" that coursework taken abroad will count towards your graduation requirements at RPI.

Undergraduate Research Project (URP)

Rensselaer's Undergraduate Research Program (URP) provides practical, hands-on research experience. Through this unique program, you have the opportunity to work directly with a faculty member on their research project. It's a great resume-builder! Here's how to find a URP opportunity:

1) Find a professor whose research interests you. You can start by checking out the faculty and research pages of the MANE department's website: mane.rpi.edu

   Some faculty members have their own homepages with more detail about their work. Do your homework and familiarize yourself with their research before you approach them.

2) Once you have picked someone you would like to work with, go to see them during their office hours or email them to make an appointment.

3) When you meet with the professor, think of it as a job interview! Bring your resume and your transcript and be prepared to talk about why you're interested in their research and how your interests and experience can contribute to the project.

4) Once a faculty member agrees to have you work with them, stop by the MANE Student Services Office in JEC 2012 to complete the URP paperwork.

URPs can be done for pay, for credit, or simply for the research experience. Additional information about the program and downloadable application forms may be found on the Office of Undergraduate Education web site: undergrad.rpi.edu

Research

MANE offers a wide range of disciplines that are flexible to accommodate individual interests. Research interests include the following.

Mechanics and Materials
Research areas: Acoustics, Multi-body dynamics; Fatigue and fracture processes; Friction and wear; Biomechanics; Plasticity; Composites; Microelectric materials; Materials under extreme loading conditions; Irradiation hardening; Nanomechanics of materials; Multiscale computational methods.
Participating faculty: Kurt Anderson, Terry Blanchet, Suvranu De, Nikhil Koratkar, Jie Lian, Emily Liu, Antoinette Maniatty, Catalin Picu, Henry Scarton, Mark Shepherd, John Tichy, Daniel Walczyk, and Lucy Zhang.

Thermal and Fluids Engineering
Research areas: Energy efficiency and sustainability; Advanced microfluidics for thermal management; System level thermal management, heat conduction and solid-state thermoelectric energy conversion in nanostructured materials; Nanoscale thermal metrology; Interfacial heat transfer; Convection and phase-change in microchannels; Structured surfaces for enhanced heat transfer; Nanostructured thermal interface materials; Thermal energy storage materials; Heat generation and dissipation in radio frequency heated magnetic nanoparticles; Microsystems for energy harvesting; Plasmonic nanoparticles spectrally coupled with luminescent solar concentrators; Loop heat pipes; and Combustion.
Participating faculty: Theo Borca-Tasciuc, Diana Andra Borca-Tasciuc, Amir Hirsa, Jie Lian, Matthew Oehlschlaeger, Zvi Rusak, Henry Scarton, Richard Smith, Lucy Zhang, and Wei Zhou.

Design and Manufacturing
Research areas: Design methodology in general and mechanical engineering design techniques in particular; Tribology; Metrology; Rapid prototyping; Flexible manufacturing; Micro/nano-scale manufacturing (subtractive and additive techniques); Process modeling; Material design for manufacturing; Sustainable manufacturing; Fiber-composite processing; Fuel-cell manufacturing; Bio-medical manufacturing; New manufacturing techniques; Operation of manufacturing facilities; CAD/CAM; Diagnostic and controls.
Participating faculty: Terry Blanchet, Antoinette Maniatty, Sandipan Mishra, Johnson Samuel, Daniel Walczyk, and John Wen.

Dynamics and Controls
Research areas: Adaptive and Smart Optics Systems; Intelligent Building Systems; Control of Micro/Nano-scale Manufacturing; Learning Control Systems; Nonlinear, Robust and Adaptive Control, Human-in-the-loop Control Design.
Participating faculty: Kurt Anderson, Mamadou Diagne, Fotis Kopsaftopoulos, Sandipan Mishra, and John Wen.

Fluid Dynamics/Aerodynamics
Research areas: Experimental, Numerical, and Theoretical fluid mechanics; Advanced Aerodynamic Flow Control techniques, Passive and Active; Aerodynamics of low, moderate, and high Reynolds number flows; Manned and unmanned aerial vehicle aerodynamics; Acoustics and vibrations; Compressible flows; Wind energy, Biofluids; Interfacial Hydrodynamics.
Participating faculty: Michael Amitay, Jason Hicken, Amir Hirsa, Zvi Rusak, Onkar Sahni, Henry Scarton, John Tichy, and Lucy Zhang.

Advanced Structures/Materials
Research areas: Active structures, morphing structures, cellular structures, structures with integrated damping capability, energy absorption capability; Advanced materials including piezoelectric materials, shape memory alloys and polymers, electrorheological and magnetrorheological fluids, nano-materials; Advanced composites, bio-composites; Advanced structural analysis methods, nonlinear aeroelasticity, nonlinear multi-body dynamics; and Computational structural dynamics.
Participating faculty: Farhan Gandhi, Prabhat Hajela, Jason Hicken, Fotis Kopsaftopoulos, Nikhil Koratkar, Emily Liu, and Daniel Walczyk.

Optimization
Research areas: Multidisciplinary design optimization; Aerodynamic shape optimization; Trajectory optimization; Optimization under uncertainty; Inverse problems and model reduction.
Participating faculty: Prabhat Hajela, Jason Hicken, and Onkar Sahni.

Space
Research areas: Spacecraft trajectory control optimization; Spacecraft relative motion optimization; Alternative ways to optimize propellant consumption relying on atmospheric differential drag; Large flexible spacecraft dynamics and control; Space vehicle control; Fluid dynamics in microgravity; Thermal management in microgravity.
Participating faculty: Kurt Anderson, John Christian, and Amir Hirsa.

Combustion/Propulsion
Research areas: Fuel chemistry; Optical diagnostics; Solid propellants; Spray combustion; Nano-energetics; Swirl-stabilized combustion; Transonic combustion.
Participating faculty: Matthew Oehlschlaeger and Zvi Rusak.

Nuclear Power Systems
Research areas: Novel reactor design concepts; Nuclear safety/risk analysis/emergency preparedness; Nuclear thermal hydraulics; Fuel cycle (spent fuel storage, geological repository, re-processing); Fuel design and performance; Nuclear data instrumentation and detector development; Computational methods (neutronics analysis, multi-physics, and multi-scale modeling); Nuclear fusion and energy policy.
Participating faculty: Yaron Danon, Wei Ji, Hyun Kang, Emily Liu, Jie Lian, Michael Podowski, Bimal Malaviya, and George Xu.

Applied Radiation Technologies
Research areas: Accelerator physics; Neutron, x-ray, and light scattering physics and experiments; Radiation detection and measurement; Novel radiation sources, Nuclear cross-section data measurement and analysis; Nuclear non-proliferation.
Participating faculty: Yaron Danon, Wei Ji, Emily Liu, and George Xu.

Radiation Protection, Medical and Industrial Uses of Radiation
Research areas: Radiation dosimetry; Imaging and radiotherapy of cancer; Medical isotope production; Non-destructive testing (civil engineering materials, oil exploration)
Participating faculty: Yaron Danon, Wei Ji, and George Xu.

Nuclear Materials
Research areas: Radiation interaction and radiation effects; Advanced nuclear fuels and structural materials; Aging management; Materials for nuclear waste management; Nanostructured materials for nuclear applications.
Participating faculty: Jie Lian and Emily Liu.

Cross-Cutting Research Areas

Energy Science and Engineering
Brief description: This cross-cutting research theme is centered around clear common interests in energy efficiency, energy storage, energy harvesting, and thermal controls. It builds on the strong expertise in fundamental thermal sciences and engineering across multiscales, thermal metrology, nanostructured materials, electrochemical energy storage, and microsystem fabrication technologies.
Participating faculty: Theo Borca-Tasciuc, Diana Andra Borca-Tasciuc, Jason Hicken, Wei Ji, Nikhil Koratkar, Jie Lian, Emily Liu, Matthew Oehlschlaeger, Michael Podowski, Zvi Rusak, Onkar Sahni, Mark Shepherd, Richard Smith, John Tichy, and Lucy Zhang.

Materials, Materials Processing and Controls
Brief description: MANE faculty are engaged in high impact interdisciplinary research in materials, manufacturing and controls as well as research that effectively links the three disciplines to come up with system level solutions to important technological problems. The research interests of the faculty include materials for energy, nano-materials, nano composites, nanoscale heat transfer, thermoelectrics, nano-mechanics, fiber-reinforced composites, additive manufacturing, non-linear controls, micro-machining, spaceflight control, tribology, non-linear dynamics, nuclear materials, bio-materials, smart materials, adaptive structures, and computational nano and bio mechanics.
Participating faculty: Kurt Anderson, Terry Blanchet, Diana Andra Borca-Tasciuc, Theo Borca-Tasciuc, Suvranu De, Farhan Gandhi, Jason Hicken, Amir Hirsa, Nikhil Koratkar, Jie Lian, Antoinette Maniatty, Sandipan Mishra, Catalin Picu, Johnson Samuel, Mark Shepherd, Daniel Walczyk, and John Wen.

Human Health and Safety
Brief description: This cross-cutting research theme is centered around common interests in biomechanics, virtual surgery, radiation dosimetry, medical robotics, biomechanical imaging, experimental nano-bio-science, and biotechnology.
Participating faculty: Diana Andra Borca-Tasciuc, Suvranu De, Amir Hirsa, Antoinette Maniatty, Sandipan Mishra, Emily Liu, John Tichy, George Xu, and Lucy Zhang.

Five Year Co-Terminal Degree Program

One of the best ways to increase the value of your undergraduate program study is through the MANE co-terminal degree program. Graduate degrees have become more essential in the workplace, and the five-year co-terminal program allows you to earn your Bachelor's degree *and* your Master's degree in only five years. Degrees can be earned in the same or in different academic disciplines, and financial assistance is available for all five years. And there's no GRE requirement!

In addition to offering increased academic and professional options when you graduate, a Master's program can serve as an introduction to the type of academic research undertaken by doctoral students. If you're not sure whether academic research is the right path for you, a Master's program is a great way to test the waters.

For more information about the MANE co-terminal program, contact Beth Ann Macey in the Graduate Student Services Office in JEC 2002. Beth Ann can be reached at 276-2031 or maceyb2@rpi.edu.

Center for Career and Professional Development

The Center for Career and Professional Development (CCPD) can assist with everything from creating a résumé and polishing job interview skills to researching career options and identifying potential employers. The CCPD offers a comprehensive program of career and professional development activities, co-op, internship, and full-time job search activities to both undergraduate and graduate students. Visit their web site for more information: www.rpi.edu/dept/cdc

Professional & Student Organizations

Alpha Nu Sigma

The objective of the Alpha Nu Sigma Society is to recognize high scholarship, integrity, and potential achievement in applied nuclear science and nuclear engineering among outstanding students by means of membership in the Society.

American Nuclear Society (ANS)

The American Nuclear Society is a not-for-profit, international organization dedicated to promoting the advancement of nuclear science, engineering, and technology. ANS serves its members in their efforts to develop and safely apply nuclear science and technology for public benefit through knowledge exchange, professional development, and enhanced public understanding. ANS consists of over 10,000 members worldwide, including more than 1,000 students. Our chapter consists of approximately 30 active members and is governed by a four-

member executive board. Our mission is to provide services to students that will foster personal and career development in a friendly environment.

American Institute of Aeronautics and Astronautics (AIAA)

AIAA currently has over 190 active student branches, including 12 foreign student branches, with a total active membership of over 5,000 students worldwide. Your student branch is your base of operations in AIAA during your college years, and it's an open door to professional activities, recognition, and contacts that would otherwise be unavailable to students.

American Society of Mechanical Engineers (ASME)

ASME is a society for all engineers that provides opportunities to grow as an engineer and as a professional. Through conferences, competitions and meetings/tours, ASME is a way to explore the many fields of engineering and stay up to date on what is happening across the world. ASME is not strictly for mechanical engineers, but for anyone majoring in any field of engineering.

Design Build Fly Team (DBF)

Design/Build/Fly (DBF) is an international aircraft design competition in which student teams from universities across the world design, build, and fly a remote controlled aircraft. Each year the American Institute for Aeronautics and Astronautics (AIAA) presents a new design challenge requiring a completely new aircraft to be created. The competition is sponsored by the AIAA, Cessna Aircraft and Raytheon Missile Systems and is focused on the development of unmanned aerial vehicles. RPI's team functions as an extra-curricular activity that typically meets twice per week in the design phase and as often as possible during the build and test phases. RPI DBF made its first appearance at the 2006-2007 competition and in the 2012-2013 competition they placed Third, beating out MIT by .53 points.

Engineers for a Sustainable World (ESW – RPI) (www.eswusa.org)

We are dedicated to combining the knowledge, skills, and experience of the RPI community to engineer solutions to social, environmental, and economic problems, both domestic and foreign, in the most sustainable way possible. We in Engineers for a Sustainable World endeavor to design solutions that will bring benefit over a great length of time, considering technological, social, and environmental limitations as they interrelate. We are not restricted to environmental projects, and we welcome all interested people, engineers or not.

Hybrid Car

An outgrowth of the Formula SAE Program, the Formula Hybrid Program emphasizes drive train innovation and fuel efficiency in a high performance green technology application.

MANE Student Advisory Council (SAC)

Established to pull student influence into the MANE Departments official business, the MANE Student Advisory Council betters the student experience by facilitating seminars, bringing in guest lecturers, and participating in various administrative tasks. In the past, public forum events, faculty hiring, and seminar series have been provided to the campus community by the Council. For more information on the MANE Student Advisory Council, visit https://sites.google.com/view/MANESAC

Pi Tau Sigma

Pi Tau Sigma, the international mechanical engineering honor society, was founded in March 1915 to recognize outstanding students who display both distinguished scholarship in technical fields and exemplary character. Pi Tau Sigma is highly regarded within industry and the academic world, and has grown to include 150 chapters in universities across the country. The Rensselaer Phi chapter was chartered in 1940, and is currently working towards hosting programs targeted towards freshmen and sophomores concerning research opportunities, as well as mentoring. Please visit our website at pts.union.rpi.edu for more information.

Rensselaer Aeronautical Federation (RAF)

The purpose of the RAF is to promote interest in aviation and aviation safety within the Rensselaer community, to encourage safe and economical flying, and to increase flight proficiency of the membership.

Sigma Gamma Tau

Sigma Gamma Tau is the honor society for Aerospace Engineering. It seeks to identify and recognize achievement and excellence in the Aerospace field. Sigma Gamma Tau's collegiate chapters elect annually to membership those students, alumni, and professionals who, by conscientious attention to their studies or professional duties, uphold this high standard for the betterment of their profession.

Society of Auto Engineers (SAE)

The Rensselaer Formula SAE Team is a dynamic group of individuals representing a broad array of academic disciplines who collaborate to conceive, design, and fabricate a high performance formula style racecar. The Team was formed in 1991 and participated in competition for the first time in1992. Since then, we have continued to place competitively, usually in the top third.

Society of Women Engineers (SWE)

The Society of Women Engineers is an international society designed to encourage and support women in the pursuit of professional career in the engineering and technologic fields, through corporate interaction, community outreach, and social events, both on the local and national levels.

Rensselaer Electric Vehicle (REV)

Rensselaer Electric Vehicle is a student organization for the design of electric vehicles at Rensselaer Polytechnic Institute. The team, formerly known as the RPI Solar Car Racing Team, has competed in the Shell Eco-marathon since 2011.

FREQUENTLY ASKED QUESTIONS

If I haven't declared a major already, is there help available to assist me in the process of choosing one?

The Advising & Learning Center (ALAC) has set up a one credit freshman seminar to help students make a decision about a major. During the seminar, students participate in interest tests, and results are reviewed with each student individually. Faculty from all of the schools offered at the Institute are available to meet with the seminar participants to answer any questions.

How do I change my major?

It is important to meet with a representative from your prospective department prior to making that decision. He or she will help you determine what requirements you will need to meet and whether they involve additional courses or credit hours. The Undergraduate Change of Major/Change of Status form must also be completed and signed by staff in the Core Engineering office (JEC 3018) – they sign as curriculum coordinators for the programs.

What classes should I take?

First year classes are generally determined by the curriculum you are enrolled in. For students enrolled in the School of Engineering, this includes completing core courses as well as the required courses determined by the Institute. Once you have declared a major your advisor will work with you on which courses to take. For those students who have not declared a major, several departments offer one credit introductory courses that provide students with the basics of that particular field.

Should I declare a minor?

Minors are NOT available in either Mechanical Engineering or Aeronautical Engineering. Students interested in a minor in Nuclear Engineering may choose a minor focused on either: Health and Medical Physics, Radiation Technology, Nuclear Systems Engineering, or Nuclear Energy Production. For detailed information on Nuclear Engineering minors, please contact Professor Bimal Malaviya, degree clearance officer for Nuclear Engineering. Minors range in their requirements from 15 to 24 credit hours, with most having 16 credit hours. The Minor Approval form must be completed and signed by your advisor and by the minor department.

Can I take a graduate level course?

Yes, you may take a graduate course as one of your free electives, or as a technical elective if it qualifies (consult with your academic advisor to determine this). An approval form must be completed and submitted to the Dean of Graduate Education before the second week of classes. Check with your advisor first about the appropriateness of the graduate level course.

Can I substitute a different class for a required course?

Substitutions for required courses are permitted only with the approval of the heads of the departments concerned and the dean of the school or designated representative. All approved substitutions must have written notice filed with the registrar.

Can a program requirement be modified?

Modifications must be approved by the program's Degree Clearance Officer. Your advisor may recommend that a requirement be modified, but this may not be possible if accreditation issues are involved.

How do undergraduates get involved in research? Can they? Do they?

The best way to get involved in a research project is to approach instructors of your classes. Visit their web sites and see what research they are working on to see if it interests you. Even if you

cannot find a project that interests you in your major field, you will find that faculty in all of the Institute's schools conduct research and may need undergraduate researchers to assist them.

How do I get an internship?

Internships and Cooperative Education (Co-op) are both managed by the Center for Career and Professional Development (CCPD). An important first step is to visit the CCPD and discuss your intentions with a counselor. CCPD can also give you access to JobLink, the on-line recruiting system where you can link to employers who are looking for co-op students.

Have more questions?

Contact your advisor or stop by JEC 2012 - we're here to help!