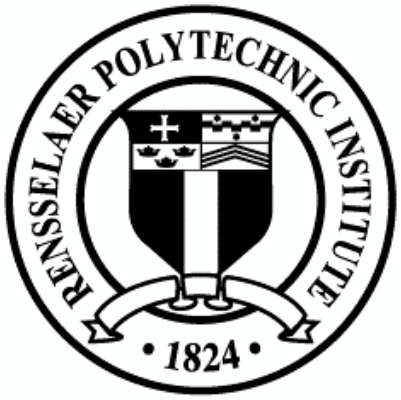

School of Engineering

Mechanical, Aerospace & Nuclear Engineering

Undergraduate Handbook

CLASS of 2019

rev. 08/01/15

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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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CAREERS IN ENGINEERING

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 and 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 aeronautical engineers not only develop airplanes and rockets, they design high-speed trains and submarines, hydrofoils and wind turbines. 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 their 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.

Aeronautical/Aerospace Engineering at a Glance

Aeronautical engineers work on things like:

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

Aeronautical/Aerospace engineering disciplines include:

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

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

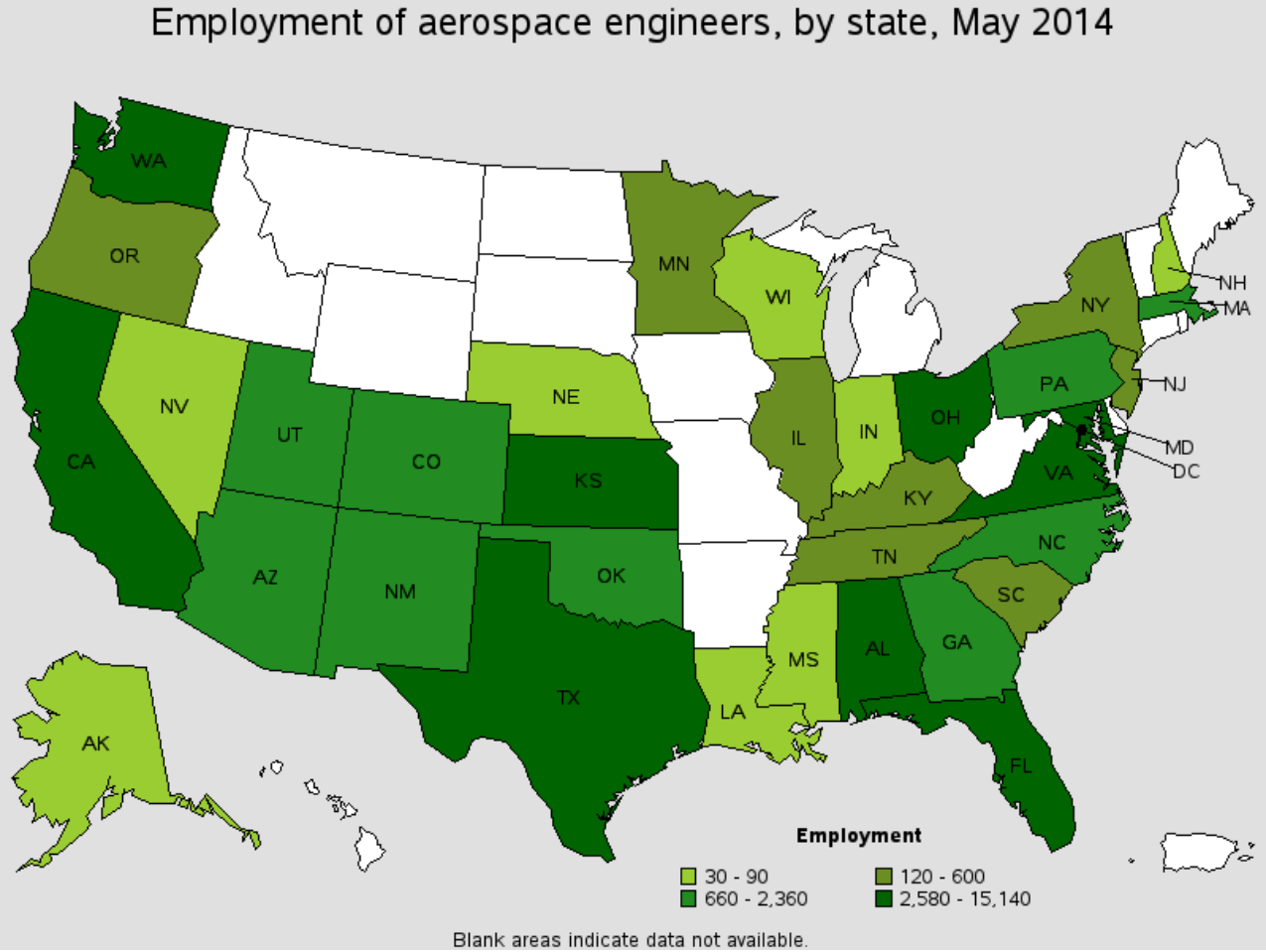
- High-speed aerodynamics
- High-temperature strength of jet engine blades
- Sale of aircraft and aircraft components

Graduates typically work for employers like:

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

Aeronautical Engineering Employment Data

2014 Employment Data	National Employment: 71,500				
Percentile	10%	25%	50%	75%	90%
Annual Wage	$66,110	$82,500	$105,380	$130,260	$155,240



Bureau of Labor Statistics, U.S. Department of Labor, Occupational Employment Statistics, May 2014 www.bls.gov/oes/ (NOTE: white areas indicate data not available , and not necessarily a lack of employment opportunities; colored areas indicate regions with significant employment opportunities.)

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 will 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, design, manufacturing, energy systems, 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
- Mechanisms and machine dynamics
- Manufacturing plants
- Forensic engineering of failed systems

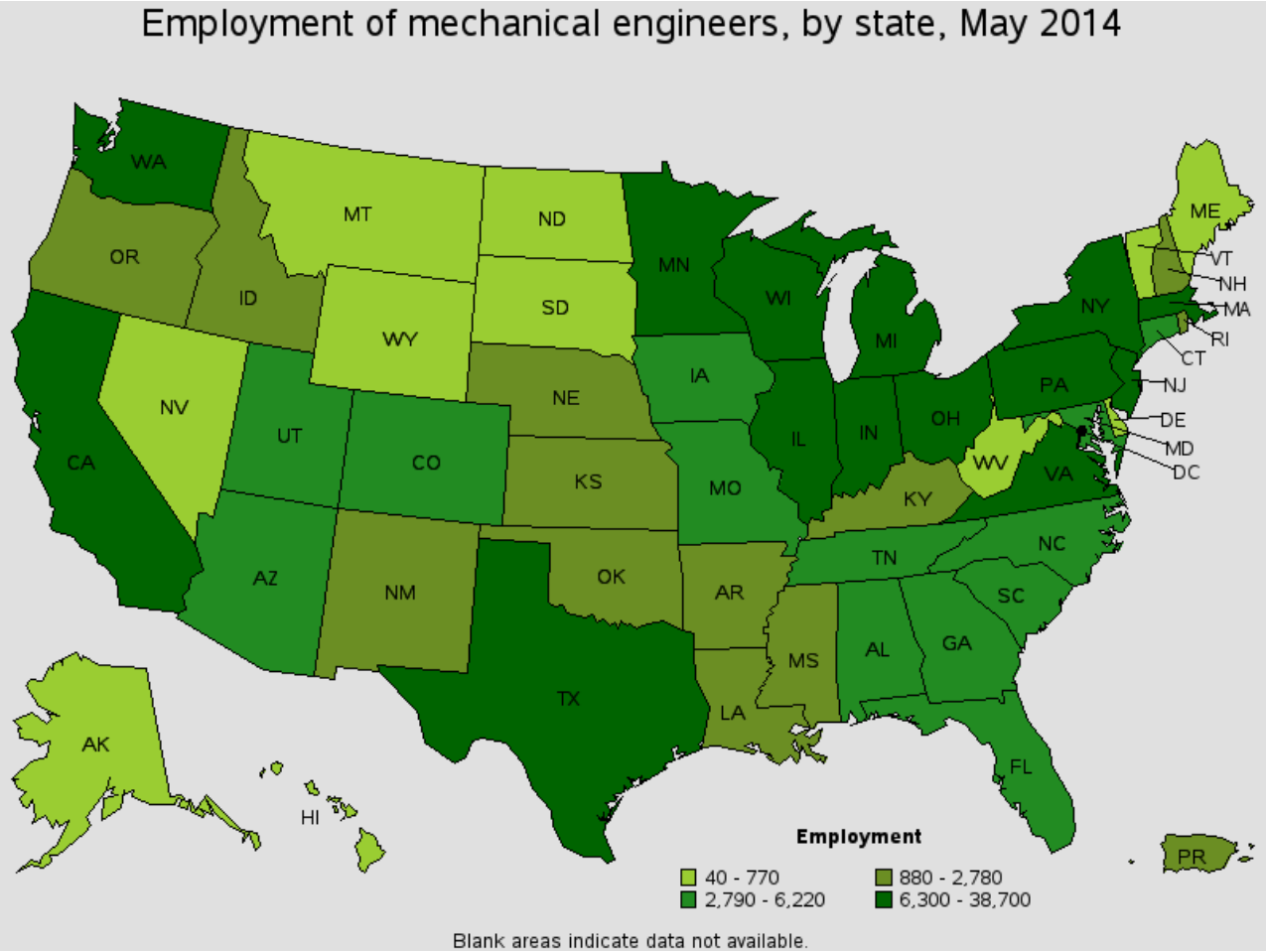
Mechanical Engineering disciplines include:

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

Mechanical Engineering graduates work throughout the field 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.

Mechanical Engineering Employment Data

2014 Employment Data	National Employment: 252,540				
Percentile	10%	25%	50%	75%	90%
Annual Wage	$53,210	$66,110	$83,060	$104,310	$126,430



Bureau of Labor Statistics, U.S. Department of Labor, Occupational Employment Statistics, May 2014 www.bls.gov/oes/ (NOTE: white areas indicate data not available, and not necessarily a lack of employment opportunities; colored areas indicate regions with significant employment opportunities.)

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 will begin with fundamentals in chemistry, physics, and 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:

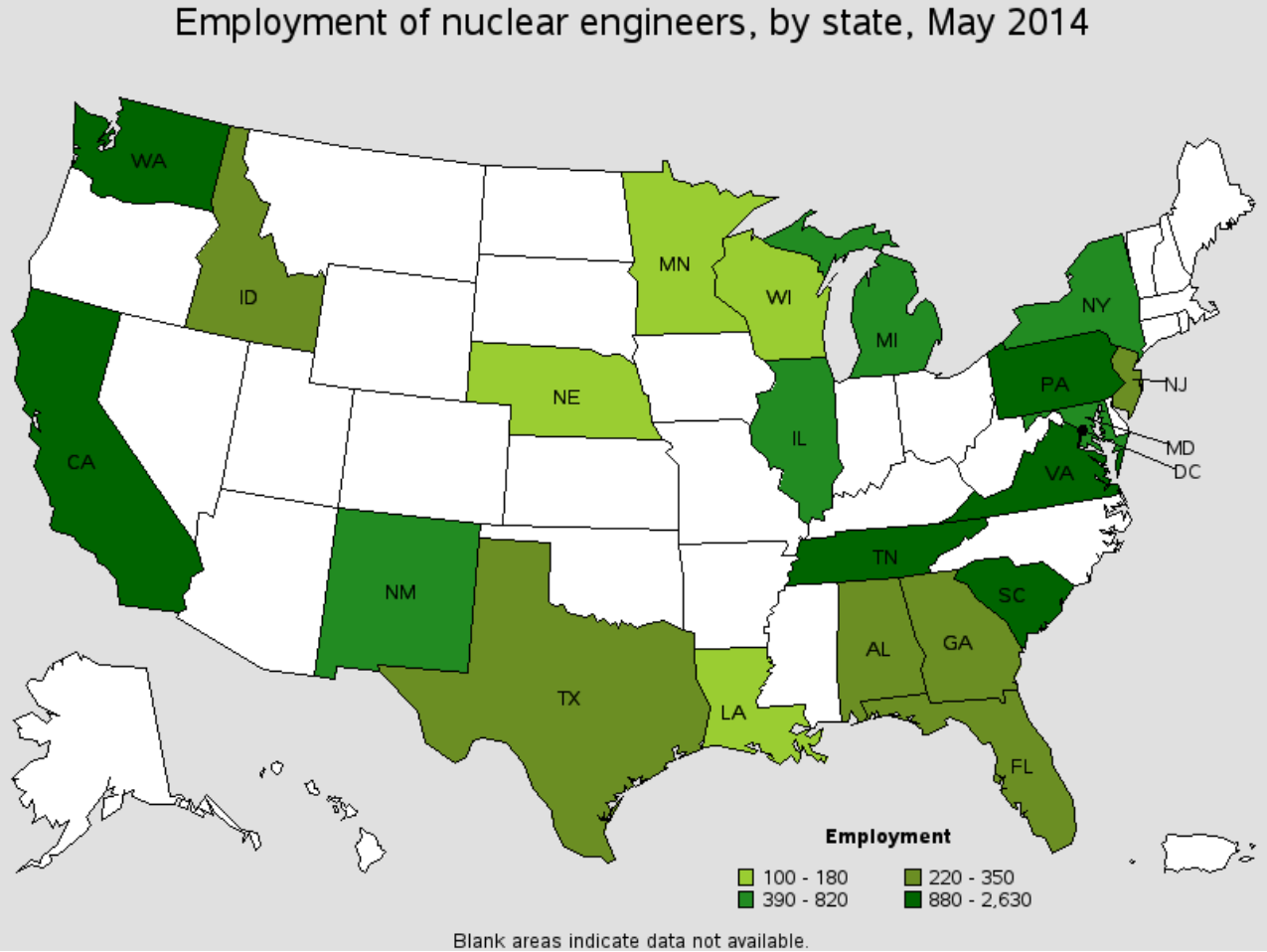
- Nuclear energy production
- Health and medical physics
- Nuclear systems engineering
- Radiation technology

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

Nuclear Engineering Employment Data

2014 Employment Data	National Employment: 16,400				
Percentile	10%	25%	50%	75%	90%
Annual Wage	$66,890	$81,440	$100,470	$120,210	$151,710



Bureau of Labor Statistics, U.S. Department of Labor, Occupational Employment Statistics, May 2014 www.bls.gov/oes/ (NOTE: white areas indicate data not available, and not necessarily a lack of employment opportunities; colored areas indicate regions with significant employment opportunities.)

BACHELOR OF SCIENCE IN AERONAUTICAL ENGINEERING

Minimum credit hour requirements for the Bachelor's Degree in Aeronautical Engineering: 128

FIRST YEAR					
	FALL	Credits		SPRING	Credits
CHEM-1100	Chemistry I	4	ENGR-1300	Engineering Processes	1
ENGR-1100	Introduction to Engineering Analysis	4	MANE-2060	Fundamentals of Flight	3
ENGR-1200	Engineering Graphics & CAD [1]	1	MATH-1020	Calculus II	4
MATH-1010	Calculus I	4	PHYS-1100	Physics I	4
HASS	Hum. or Soc. Sci. Elective	4	HASS	Hum. or Soc. Sci. Elective	4
		17			16
SECOND YEAR					
	FALL	Credits		SPRING	Credits
ENGR-2530	Strength of Materials	4	ENGR-2050	Introduction to Engineering Design	4
MATH-2400	Introduction to Differential Equations	4	ENGR-2090	Engineering Dynamics	4
PHYS-1200	Physics II	4	ENGR-2250	Thermal and Fluids Engineering I	4
HASS	Hum. or Soc. Sci. Elective	4	CSCI- 1190	Beginning Programming for Engineers	1
			MATH-2010	Multivariable Calculus and Matrix Algebra	4
		16			17
THIRD YEAR [2]					
	FALL	Credits		SPRING	Credits
MANE-4060	Aerospace Structures and Materials	4	ENGR-2600	Modeling and Analysis of Uncertainty	3
MANE-4070	Aerodynamics I	3	MANE-4050	Modeling & Control of Dynamic Systems	4
MATH-4800	Numerical Computing	4	MANE-4900	Aeroelasticity and Structural Vibration	3
HASS	Hum. or Soc. Sci. Elective	4	MANE-4920	Aerospace Structures and Controls Lab	2
			HASS	Hum. or Soc. Sci. Elective	4
		15			16
FOURTH YEAR					
	FALL	Credits		SPRING	Credits
ENGR-4010	Professional Development III	1		Capstone Design Elective [5]	3
MANE-4080	Propulsion Systems	4		Free Elective	4
MANE-4800	Boundary Layers and Heat Transfer	3		Free Elective	4
MANE-4910	Fluid Dynamics Lab	2		Free Elective	4
	Flight Mechanics Elective [3]	4			
	Professional Development II [4]	2			
		16			15

[1] Choice of: ENGR-1200 Engineering Graphics & CAD or ENGR-1400 Engineering Communication.

[2] AE students should start planning for their Flight Mechanics/Capstone track during third year. Those on the Space Flight track must take MANE-4100 Spaceflight Mechanics during spring semester of third year to assure timely graduation. In such cases, MANE 4050 or ENGR 2600 can be delayed until spring semester of fourth year.

[3] Choice of: MANE-4090 Flight Mechanics, MANE-4200 Rotorcraft Performance, Stability & Control, or MANE-4100 Spaceflight Mechanics (as noted, the latter must be taken in spring semester of third year to assure timely graduation).

[4] For a list of courses that satisfy the PD II requirement refer to the link "Courses which satisfy the PD II requirement" on the SIS home page.

[5] Choice of: MANE-4230 Air Vehicle Design, MANE-4850 Space Vehicle Design, or MANE-4860 Intro to Helicopter Design (students on the Space Flight track take MANE 4850 in fall of fourth year).

Aeronautical Engineering Course Prerequisites

Italics = this course has additional prerequisites

CHEM-1100 Chemistry I
N/A
ENGR-1100 Introduction to Engineering Analysis
N/A
ENGR-1200 Engineering Graphics and CAD (or ENGR-1400 Engineering Communication)
N/A
MATH-1010 Calculus I
(Calculus I is a co-requisite)
ENGR-1300 Engineering Processes
N/A
MANE-2060 Fundamentals of Flight
N/A
MATH-1020 Calculus II
MATH-1010 Calculus I
PHYS-1100 Physics I
(MATH-1010 Calculus I is a co-requisite)
ENGR-2530 Strength of Materials
ENGR-1100 Introduction to Engineering Analysis
MATH-2400 Introduction to Differential Equations
MATH-1020 Calculus II
PHYS-1200 Physics II
PHYS-1100 Physics I
ENGR-2050 Introduction to Engineering Design
ENGR-1100 Introduction to Engineering Analysis
ENGR-1200 Engineering Graphics and CAD
or ENGR-1400 Engineering Communication
(ENGR-1300 Engineering Processes is recommended, but not required)
ENGR-2090 Engineering Dynamics
ENGR-1100 Introduction to Engineering Analysis
PHYS-1100 Physics I
(*MATH-2400 Introduction to Differential Equations* is a co-requisite)
ENGR-2250 Thermal and Fluids Engineering I
ENGR-1100 Introduction to Engineering Analysis
PHYS-1100 Physics I
(*MATH-2400 Introduction to Differential Equations* is a co-requisite)
CSCI-1190 Beginning Programming for Engineers
N/A
MATH-2010 Multivariable Calculus and Matrix Algebra
MATH-1020 Calculus II
MANE-4060 Aerospace Structures and Materials
ENGR-2530 Strength of Materials
MANE-4070 Aerodynamics I
ENGR-2250 Thermal and Fluids Engineering I
MANE-2060 Fundamentals of Flight
MATH-4800 Numerical Computing
MATH-2010 Multivariable Calculus and Matrix Algebra
or ENGR-1100 Introduction to Engineering Analysis

MATH-2400 Introduction to Differential Equations

ENGR-2600 Modeling and Analysis of Uncertainty

MATH-1010 Calculus I

MANE-4050 Modeling and Control of Dynamic Systems

MATH-2400 Introduction to Differential Equations

PHYS-1200 Physics II

MANE-4900 Aeroelasticity and Structural Vibrations

MATH-2400 Introduction to Differential Equations

MANE 2060 Fundamentals of Flight

MANE 4060 Aerospace Structures and Materials

MANE-4920 Aerospace Structures and Controls Lab

MANE-4060 Aerospace Structures and Materials

ENGR-4010 Professional Development III

Senior standing

MANE-4080 Propulsion Systems

MANE-4070 Aerodynamics I

MANE-4800 Boundary Layers and Heat Transfer

MANE-4070 Aerodynamics I

MANE-4910 Fluid Dynamics Lab

MANE-4070 Aerodynamics I

Flight Mechanics Elective – choose one of the following three courses:

MANE-4090 Flight Mechanics (offered Fall semester only)

MANE 4070 Aerodynamics I

MANE-4100 Spaceflight Mechanics (offered Spring semester only)

ENGR-2090 Engineering Dynamics

MANE-2060 Fundamentals of Flight

MATH 2400 Introduction to Differential Equations

MANE-4200 Rotorcraft Performance, Stability, and Control (offered Fall semester only)

MANE-4070 Aerodynamics I

Capstone Design Elective – choose one of the following three courses:

MANE-4230 Air Vehicle Design (offered Spring semester only)

MANE-4060 Aerospace Structures and Materials

MANE-4090 Flight Mechanics

MANE-4850 Space Vehicle Design (offered Fall semester only)

(any Flight Mechanics Elective)

MANE 4860 Introduction to Helicopter Design (offered Spring semester only)

MANE 4200 Rotorcraft Performance, Stability, and Control

Professional Development II

For a list of courses that satisfy the PD II requirement, refer to the link "Courses which satisfy PD II requirement" on the SIS home page.

Additional Guidance for Building an Aeronautical Engineering Curriculum

- At least one *engineering computation* course is highly recommended as a free elective. Choose from the following.
  - Aerospace Structures Focus
    - MANE-4240 Introduction to Finite Elements
  - Aerodynamics Focus
    - MANE-496x Computational Fluid Dynamics

- A *technical writing* course is recommended as an H&SS elective. Examples include:
  - COMM-2961 Technical Writing in Print and Digital Media*
  - WRIT-1110 Writing for Classroom and Career*
  - WRIT-4410 Research Writing*
  - COMM-4420 Foundations of HCI Usability*

- Eligible students who intend to become co-terminal students should try to complete at least one course applicable to their masters degree in their senior year. Some graduate courses are offered only every other year, so plan ahead for what courses to take in your senior and co-terminal years.

*Please note that these courses are not offered every semester and there are not enough seats to accommodate all of the students who wish to take them. Please do not stress out if you are unable to register for one of these courses. The recommendation is a suggestion, not a requirement.

BACHELOR OF SCIENCE IN MECHANICAL ENGINEERING

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

FIRST YEAR					
	FALL	Credits		SPRING	Credits
ENGR-1100	Introduction to Engineering Analysis	4	ENGR-1300	Engineering Processes	1
ENGR-1200	Engineering Graphics & CAD [1]	1	ENGR-1600	Materials Science for Engineers	4
CHEM-1100	Chemistry I	4	MATH-1020	Calculus II	4
MATH-1010	Calculus I	4	PHYS-1100	Physics I	4
HASS	Hum. or Soc. Sci. Elective	4	HASS	Hum. or Soc. Sci. Elective	4
SECOND YEAR					
	FALL	Credits		SPRING	Credits
ENGR-2530	Strength of Materials	4	ENGR-2050	Introduction to Engineering Design	4
MATH-2400	Introduction to Differential Equations	4	ENGR-2090	Engineering Dynamics	4
PHYS-1200	Physics II	4	ENGR-2250	Thermal and Fluids Engineering I	4
HASS	Hum. or Soc. Sci. Elective	4	CSCI- 1190	Beginning Programming for Engineers	1
			MATH-2010	Multivariate Calculus & Matrix Algebra	4
THIRD YEAR			FOURTH YEAR		
		Credits			Credits
ENGR-2350	Embedded Control	4	ENGR-4010	Professional Development III	1
ENGR-2300	Electronic Instrumentation	4	MANE-4260	Design of Mechanical Eng. Systems	3
ENGR-2600	Modeling and Analysis of Uncertainty	3		Science Elective [4]	3
MANE-4010 MANE-4020	Thermal and Fluids Core Module [2] Thermal and Fluids Engineering II (TFE II) Thermal and Fluids Lab (concurrent or after TFE II)	4 2	MANE-4xxx	Technical Elective I [5]	3
MANE-4030 MANE-4040	Mechanical Systems Core Module [2] Elements of Mechanical Design (EMD) Mechanical Systems Lab (concurrent or after EMD)	4 2	MANE-4xxx	Technical Elective II [5]	3
MANE-4050	Modeling and Control of Dynamic Systems	4	HASS	Hum. or Soc. Sci. Elective	4
HASS	Hum. or Soc. Sci. Elective	4		Free Elective	4
	Professional Development II [3]	2		Free Elective	4
				Free Elective	4

[1] Choice of: ENGR-1200 Engineering Graphics & CAD or ENGR-1400 Engineering Communication.

[2] The laboratory component of each Core Module (MANE-4020/-4040) must be taken concurrent with or after the theoretical component (MANE-4010/-4030). The laboratory courses have lecture components to review the theory, so there is no disadvantage to taking the laboratory in any later semester.

[3] For a list of courses that satisfy the PD II requirement, refer to the link "Courses which satisfy PD II requirement" on the SIS home page.

[4] The Science Elective may be selected from any 2000-level or above course in the School of Science with an ASTR, BCBP, BIOL, CHEM, ERTH, MATH, or PHYS prefix. An independent study course may not be used to satisfy this requirement. The Science Elective may not be taken on a Pass/No Credit basis.

[5] The Technical Electives shall be two upper level (4000 or above) MANE courses. An independent study course may not be used to satisfy this requirement. The Technical Electives may not be taken on a Pass/No Credit basis. ME students are encouraged to use their technical electives, science elective, and possibly free electives to develop a mechanical engineering concentration (e.g., in applied mechanics, energy systems, manufacturing and design, mechatronics, aerospace systems, nuclear systems, etc.) they can market themselves with.

Mechanical Engineering Course Prerequisites

Italics ≡ this course had additional prerequisites

ENGR-1100 Introduction to Engineering Analysis

N/A

ENGR-1200 Engineering Graphics & CAD (or ENGR-1400 Engineering Communication)

N/A

CHEM-1100 Chemistry I

N/A

MATH-1010 Calculus I

N/A

ENGR-1300 Engineering Processes

N/A

ENGR-1600 Materials Science for Engineering

CHEM-1100 Chemistry I

MATH-1020 Calculus II

MATH-1010 Calculus I

PHYS-1100 Physics I

(MATH-1010 Calculus I is a co-requisite)

ENGR-2530 Strength of Materials

ENGR-1100 Introduction to Engineering Analysis

MATH-2400 Introduction to Differential Equations

MATH-1020 Calculus II

PHYS-1200 Physics II

PHYS-1100 Physics I

ENGR-2050 Introduction to Engineering Design

ENGR-1100 Introduction to Engineering Analysis
ENGR-1200 Engineering Graphics and CAD
or ENGR-1400 Engineering Communication
(ENGR-1300 Engineering Processes is recommended, but not required)

ENGR-2090 Engineering Dynamics

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

ENGR-2250 Thermal and Fluids Engineering I

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

CSCI-1190 Beginning Programming for Engineers

N/A

MATH-2010 Multivariable Calculus and Matrix Algebra

MATH-1020 Calculus II

ENGR-2350 Embedded Control

CSCI-1190 Beginning Programming for Engineers

ENGR-2300 Electronic Instrumentation

PHYS-1200 Physics II

ENGR-2600 Modeling and Analysis of Uncertainty

MATH-1010 Calculus I

Thermal and Fluids Core Module – consists of the following two courses:

MANE-4010 Thermal and Fluids Engineering II

ENGR-2250 Thermal and Fluids Engineering I

MANE-4020 Thermal and Fluids Engineering Laboratory

(must be concurrent with or after *MANE-4010 Thermal and Fluids Engineering II*; there is no disadvantage to taking the laboratory in any later semester.)

Mechanical Systems Core Module – consists of the following two courses:

MANE-4030 Elements of Mechanical Design

MATH-2400 Introduction to Differential Equations
ENGR-2530 Strength of Materials

MANE-4040 Mechanical Systems Laboratory

(must be concurrent with or after *MANE-4030 Elements of Mechanical Design*; there is no disadvantage to taking the laboratory in any later semester.))

MANE-4050 Modeling and Control of Dynamic Systems

MATH-2400 Introduction to Differential Equations
PHYS-1200 Physics II

Professional Development II

For a list of courses that satisfy the PD II requirement, refer to the link "Courses which satisfy PD II requirement" on the SIS home page.

ENGR-4010 Professional Development III

Senior standing

MANE-4260 Design of Mechanical Engineering Systems

Senior standing

Additional Guidance for Building a Mechanical Engineering Curriculum

- An *engineering computation* course is recommended as a technical or free elective (or MATH-4800 Numerical Computing as a science elective). Choose from the following.
  - Applied Mechanics Focus
    - MANE-4240 Introduction to Finite Elements
  - Energy Systems Focus
    - MANE-496x Computational Fluid Dynamics
  - Broad Mechanical Engineering Application
    - MATH-4800 Numerical Computing

- A *technical writing* course is recommended as an H&SS elective. Examples include:
  - COMM-2961 Technical Writing in Print and Digital Media*
  - WRIT-1110 Writing for Classroom and Career*
  - WRIT-4410 Research Writing*
  - COMM-4420 Foundations of HCI Usability*

- Independent study courses, such as a design project or an undergraduate research project, may not be used to satisfy any of the Technical Elective or Science Elective requirements. They may be used as free elective credits.

- Eligible students who intend to become co-terminal students should try to complete at least one course applicable to their masters degree in their senior year. Some graduate courses are offered only every other year, so plan ahead for what courses to take in your senior and co-terminal years.

- Some mechanical engineering students feel that it is beneficial to take ENGR-2300 Electronic Instrumentation before ENGR-2350 Embedded Control, even though it is not a prerequisite. One of the best predictors of success in Embedded Control is experience in computer programming, independent of the computer language used. Students who know they want to focus on mechatronics and control systems may wish to consider the four credit CSCI-1100 Computer Science I to satisfy the one credit CSCI-1190 Beginning Programming requirement and three credits of free elective.

- Some mechanical engineering students feel that the following courses are less predictable in their time requirements, and so should be taken in separate semesters if possible.
  ENGR-2050 Introduction to Engineering Design
  ENGR-2350 Embedded Control
  MANE-4260 Design of Mechanical Systems or MANE-4220 Inventor's Studio

*Please note that these courses are not offered every semester and there are not enough seats to accommodate all of the students who wish to take them. Please do not stress out if you are unable to register for one of these courses. The recommendation is a suggestion, not a requirement.

BACHELOR OF SCIENCE IN NUCLEAR ENGINEERING

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

FIRST YEAR					
	FALL	Credits		SPRING	Credits
ENGR-1100	Introduction to Engineering Analysis	4	ENGR-1200	Engineering Graphics & CAD	1
CHEM-1100	Chemistry I	4	ENGR-1600	Materials Science for Engineers	4
MANE-1961	Introduction to Nuclear Engineering [1]	1	MATH-1020	Calculus II	4
MATH-1010	Calculus I	4	PHYS-1100	Physics I	4
HASS	Hum. or Soc. Sci. Elective	4	HASS	Hum. or Soc. Sci. Elective	4
		17			17
SECOND YEAR					
	FALL	Credits		SPRING	Credits
MATH-2400	Introduction to Differential Equations	4	CSCI- 1190	Beginning Programming for Engineers	1
PHYS-1200	Physics II	4	ENGR-2050	Introduction to Engineering Design	4
HASS	Hum. or Soc. Sci. Elective	4	MANE-2830	Nuclear Phenomena for Eng. Applications	4
	Free Elective I	4	MATH-2010	Multivariable Calculus and Matrix Algebra	4
			HASS	Hum. or Soc. Sci. Elective	4
		16			17
THIRD YEAR					
	FALL	Credits		SPRING	Credits
ENGR-2250	Thermal and Fluids Engineering I	4	ENGR-2600	Modeling and Analysis of Uncertainty	3
MANE-4350	Nuclear Instrumentation & Measurement	3	MANE-4400	Nuclear Power Systems Engineering	4
MANE-2400	Fundamentals of Nuclear Engineering	4	MANE-4470	Radiological Engineering	3
HASS	Hum. or Soc. Sci. Elective	4	MANE-4480	Physics of Nuclear Reactors	4
				Professional Development II [2]	2
		15			16
FOURTH YEAR					
	FALL	Credits		SPRING	Credits
MANE-4050	Modeling & Control of Dynamic Systems	4	MANE-4390	NE Senior Design Project II	2
MANE-4370	Nuclear Engineering Lab	4	MANE-4440	Critical Reactor Laboratory	3
MANE 4380	NE Senior Design Project I	1		Technical Elective [4]	3
ENGR-4010	Professional Development III	1		Restricted Elective II [3]	3
	Restricted Elective I [3]	3		Free Elective III	4
	Free Elective II	4			
		17			15

[1] Other 1-credit Engineering Exploration courses, such as ENGR-1300 Engineering Processes, may be substituted.

[2] For a list of courses that satisfy the PD II requirement, refer to the link "Courses which satisfy PD II requirement" on the SIS home page.

[3] Restricted Electives focus on a student's technical interests or area of specialization within the Nuclear Engineering field. Restricted electives are MANE 4000-level or higher courses related to Nuclear Engineering that are taken for 3 credits or more. If you have questions regarding whether a specific course satisfies your Restricted Elective requirements, please consult with your advisor. Restricted Electives may not be taken on a Pass/No Credit basis.

[4] The Technical Elective can be any 2000-level or higher School of Engineering or School of Science course taken for 3 credits or more. Technical Electives may not be taken on a Pass/No Credit basis.

Nuclear Engineering Course Prerequisites

Italics = this course has additional prerequisites

ENGR-1100 Introduction to Engineering Analysis

N/A

CHEM-1100 Chemistry I

N/A

MANE-1961 Introduction to Nuclear Engineering (or any 1-credit Engineering Exploration)

N/A

MATH-1010 Calculus I

N/A

ENGR-1200 Engineering Graphics and CAD (or ENGR-1400 Engineering Communication)

N/A

ENGR-1600 Materials Science for Engineering

CHEM-1100 Chemistry I

MATH-1020 Calculus II

MATH-1010 Calculus I

PHYS-1100 Physics I

(MATH-1010 Calculus I is a co-requisite)

MATH-2400 Introduction to Differential Equations

MATH-1020 Calculus II

PHYS-1200 Physics II

PHYS-1100 Physics I

CSCI-1190 Beginning Programming for Engineers

N/A

ENGR-2050 Introduction to Engineering Design

ENGR-1100 Introduction to Engineering Analysis
ENGR-1200 Engineering Graphics and CAD
or ENGR-1400 Engineering Communication

MANE-2830 Nuclear Phenomena for Engineering Applications

PHYS-1100 Physics I
CHEM-1100 Chemistry I
(*MATH-2400 Introduction to Differential Equations* is recommended but not required)
(PHYS-1200 Physics II is recommended but not required)

MATH-2010 Multivariable Calculus and Matrix Algebra

MATH-1020 Calculus II

ENGR-2250 Thermal and Fluids Engineering

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

MANE-4350 Nuclear Instrumentation and Measurement

MANE-2830 Nuclear Phenomena for Engineering Applications

MANE-2400 Fundamentals of Nuclear Engineering

MANE-2830 Nuclear Phenomena for Engineering Applications

MATH-2400 Introduction to Differential Equations

ENGR-2600 Modeling and Analysis of Uncertainty

MATH-1010 Calculus 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 recommended but not required)

MANE-4480 Physics of Nuclear Reactors

MANE-2400 Fundamentals of Nuclear Engineering

Professional Development II

For a list of courses that satisfy the PD II requirement, refer to the link "Courses which satisfy PD II requirement" on the SIS home page.

MANE-4050 Modeling and Control of Dynamic Systems

MATH-2400 Introduction to Differential Equations
PHYS-1200 Physics II

MANE-4370 Nuclear Engineering Lab

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

MANE-4380 NEEP Senior Design Project I

Prerequisite: permission of instructor.

ENGR-4010 Professional Development III

N/A

MANE-4390 NEEP Senior Design Project II

MANE-4380 NEEP Senior Design Project I

MANE-4440 Critical Reactor Laboratory

MANE-4480 Physics of Nuclear Reactors

Additional Guidance for Building a Nuclear Engineering Curriculum

- A *technical writing* course is recommended as an H&SS elective. Examples include:
  - COMM-2961 Technical Writing in Print and Digital Media*
  - WRIT-1110 Writing for Classroom and Career*
  - WRIT-4410 Research Writing*
  - COMM-4420 Foundations of HCI Usability*

- One independent study course in nuclear engineering, such as an undergraduate research project, may be used to satisfy a Technical Elective or Restricted Elective requirement. Independent study courses may also be used as free elective credits.

- Eligible students who intend to become co-terminal students should try to complete at least one course applicable to their masters degree in their senior year. Some graduate courses are offered only every other year, so plan ahead for what courses to take in your senior and co-terminal years.

*Please note that these courses are not offered every semester and there are not enough seats to accommodate all of the students who wish to take them. Please do not stress out if you are unable to register for one of these courses. The recommendation is a suggestion, not a requirement.

H&SS AND PD II – POLICIES FOR ENGINEERING STUDENTS

Engineering students at Rensselaer are required to successfully complete
- 20 credits of H&SS (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 alternatively as ENGR-1010 Professional Development I if ENGR-2050 transferred in as less than a 4 credit course)
- 1 credit of ENGR-4010 PD III

for a total of 24 credits to fulfill the H&SS Core requirement.

ENGINEERING STUDENTS SHALL DISTRIBUTE THE 20 CREDITS OF H&SS AS FOLLOWS.

≥ 8 credits of H (ARTS, COMM, IHSS, LANG, LITR, PHIL, STSH, WRIT)
≥ 8 credits of SS (COGS, ECON, IHSS, PSYC, STSS)
≥ 4 credits at the 4000+ level

≤ 3 courses at the 1000 level (but note depth sequence restriction, below)
≤ 4 credits from 1-credit courses (e.g., music ensembles)
≤ 6 credits as pass/no-credit (but note depth sequence and CI restrictions, below)
≤ 2 courses (8 credits maximum) as transfer courses (including AP courses)

a depth sequence of two courses, each of ≥ 4 credits, from the same area code (ARTS, COMM, etc., but not including IHSS) where a minimum of one course (≥ 4 credits) is at an advanced level (2000+), and no courses are taken on a Pass/No Credit basis. STSS and STSH count as the same area code.

In addition, students are required to take at least one HASS course that is "CI" (Communications Intensive – a list of these courses is available from a link on the SIS home page, and here: http://srfs.rpi.edu/update.do?artcenterkey=208&setappvar=page(1)). This course may not be taken on a Pass/No Credit basis. This CI course is not required to be part of the 24 credits of H&SS Core; that is, it may instead be an HASS CI course taken as a free elective

Enrolled Rensselaer students wishing to take an H&SS course for credit at another accredited institution must obtain prior approval for the course from the HASS Manager of Student Services. Applicants must furnish a catalog description of the proposed course and a completed copy of Rensselaer's Transfer Credit Approval form to the HASS Manager of Student Services 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 Assistant Registrar.

THE 2-CREDITS OF PD II SHALL BE SATISFIED AS FOLLOWS:

Either of the 2-credit courses, PSYC-4170 or STSS-4840, will satisfy the PD II requirement. **At some future time these will transition to a single 2-credit IHSS-4xxx course that will satisfy the PD II requirement.** Only **one** of these 2-credit PD II courses can be taken for credit.

A 4-credit PD II alternate course at any level (1000-4000) can be substituted for the 2-credit course. A list of these PD II alternate courses is available from a link on the SIS home page, and here: http://registrar.rpi.edu/update.do?artcenterkey=325.

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 H&SS. These credits:

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

However,

- they can count toward the overall 20 credits of H&SS,
- they can count toward the H and SS 8-credit minimums,
- they can count toward the H&SS "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 either PSYC-4170 or STSS-4840 (the 2-credit PD II courses), they may furnish a catalog description of the transfer course and a completed copy of Rensselaer's Transfer Credit Approval form to the Associate Dean of Engineering 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 of Academic Affairs is: **Mike Kalsher** (kalshm@rpi.edu, Sage 4302)
The Assistant Registrar is: **Kim Herkert** (herkek@rpi.edu, Academy Hall 2713)
The Associate Dean of Engineering is: **Kurt Anderson** (anderk5@rpi.edu, JEC 3018)

NEED AN EXTRA CREDIT?

Q: What if I'm short 1-2 credits in H&SS?
A: Use a 4-credit PD II alternate, with 2 credits to PD II, 1-2 credits to H&SS 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),
and
– 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)
- 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-1960 / ENVE-1960 AutoCAD CIVL 3D
  - ENGR-1300 Engineering Processes (if not required for your major)
  - ENGR-4962 Fortran Programming
  - ISYE-1100 Introduction to Industrial and Systems Engineering
  - MANE-1100 Introduction to Nuclear Engineering
  - MANE-2961 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-2960 Ensemble Congeros
- ROTC courses (USAF, USAR, USNA, up to six credits maximum)
- most one-credit topics courses (see http://srfs.rpi.edu/update.do?artcenterkey=305)

FRIENDLY ADVICE

Coming to Rensselaer is in part about learning to sip from a fire hose. The courses 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 is very similar to homework problems you have been assigned, just with a few minor changes.
- The one you still see coming, but from a different direction: If the homework asked you 2+2=?, the test may 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 have 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 do not do this as much, but starting with sophomore classes like Thermal and Fluids Engineering I 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.

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 Ms. Crandall.
- 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 on 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".

MANE'S GRATITUDE PROJECT

The MANE Department always tries to foster a sense of community and encourage awareness of kind acts between faculty, staff, and students. As a result, MANE's Gratitude Project was rolled out last year with great reception! A red mail box is mounted outside of JEC 2012 along with nomination forms. If someone does something nice for you- nominate them! For more information see Karen or Marie in JEC 2012 or visit MANE's Facebook page at www.facebook.com/MANERPI.

ENGINEERING PROGRAM REQUIREMENTS

Bachelor's Degree Requirements and Academic Policies

In addition to understanding the requirements of your academic major, you will 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

Academic Advisors

Each undergraduate student is assigned an academic advisor who is a faculty member in the MANE department. You should meet with your advisor 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, research opportunities or financial assistance.

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 is 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, and even some candy to help you through your day! 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. You can also send an email to Marie (dieffm@rpi.edu) or Karen (phelak@rpi.edu) .

Student Advisor Meeting (SAM) Holds

Students are required to meet with their faculty 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 Karen Lewis in MANE's Office of Undergraduate Student Services at phelak@rpi.edu.

Registrar's Holds

Please contact Karen or Marie if you have a Registrar's hold. If you have a financial or other hold and need to take certain courses in order to graduate on time, we need to make sure we save you a slot in those classes.

Curriculum Advising and Program Planning (CAPP) reports

Your Curriculum Advising and Program Planning (CAPP) report 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 CAPP report via the main menu of the Student Information System (SIS).

Please be aware that the CAPP report 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.

The HUB

The SoE Student Services HUB is a great place for freshmen and sophomore engineering students to find answers to their most pressing academic and career related questions. The HUB is located in the Ansell Lounge on the third floor in the Jonsson Engineering Center (JEC). The HUB is comprised of experience faculty and staff members who specialize in many of the different engineering majors. The HUB is open weekdays during the academic year during the following hours:

Monday-Thursday 10:00-4:00, Friday 10:00-1:00

HUB personnel have been trained to answer questions regarding all engineering majors, including required courses, prerequisites, different concentrations, optimal time for co-ops and internships, traveling abroad, etc. We especially encourage undeclared engineering students to utilize The Hub as a resource while they decide what major to pursue. Each personnel member will have access to students' CAPP reports and will be able to supply the student with the best advice, or refer them to a more knowledgeable source. HUB personnel will not be able to sign Student-Advisor Meeting (Sam) requirements for students. Their job is to supplement, not replace, the student's appointed academic advisor.

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: undergrad.rpi.edu
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," transferred courses and Advanced Placement (AP) credits do not count toward earned credits.

School of Engineering Class Standing by Credit Hours Earned

Freshman: 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 through SIS is utilized. For MANE courses, stop by the Office of Undergraduate Student Services in JEC 2012 or email Karen Lewis (phelak@rpi.edu) or Marie Dieffenbach (dieffm@rpi.edu). 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 your preferred sections 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 in your email.

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 Marie Dieffenbach in the MANE Office of Undergraduate Student Services at dieffm@rpi.edu.

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 appropriate department(s) approve this designation prior to filing the dual major form with the registrar.
- Each student will be assigned an adviser in each department who will monitor progress towards degrees in that department.
- 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 established degree templates for the following dual majors:

- Aeronautical Engineering and Mechanical Engineering
- Mechanical Engineering and Biomedical Engineering
- Mechanical Engineering and Electrical Engineering
- Mechanical Engineering and Materials Engineering
- Mechanical Engineering and Nuclear Engineering
- Mechanical Engineering and Product Design and Innovation
- 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.

Dual Degree in Aeronautical and Mechanical Engineering:

Dual majors must satisfy all Aeronautical Engineering program requirements and take: and MANE-4030 Elements of Mechanical Design. Choose the following as Free Electives:

- MANE-4040 – Mechanical Systems Laboratory
- MANE-4030 – Elements of Mechanical Design
- ENGR-1600 – Materials Science for Engineers
- ENGR-2350 – Embedded Control
- ENGR-2300 – Electronic Instrumentation

This adds up to minimum total credit hours of 134 for the dual degree of BS in Aeronautical and Mechanical Engineering. You may also declare your dual major in Mechanical Engineering and Aeronautical Engineering, if that is your preferred order. Be sure to speak with your advisor regarding your dual degree plans. When you are ready to move forward, you can obtain the dual degree templates and assistance with completing them from Marie Dieffenbach in the MANE Office of Undergraduate Student Services in JEC 2012.

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.

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 JEC 2012 to complete the URP paperwork.

URPs can be done for pay, for credit or simply for the research experience. Note that Mechanical Engineers may not use a URP to satisfy the technical electives or the science elective. 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. The main research interests include:

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, Mark Steiner, 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: John Wen, Sandipan Mishra, and Kurt Anderson.

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, Assad Oberai, 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, Nikhil Koratkar, Emily Liu, Assad Oberai, Zahra Sotoudeh, 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, Onkar, Sahni, and Assad Oberai.

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 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, Thomas Haley, Wei Ji, Emily Liu, Jie Lian, Michael Podowski, Bimal Malaviya, Sastry Sreepada, George Xu and Wei Zhou.

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: Peter Caracappa, 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: Peter Caracappa, 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, Emily Liu, and Wei Zhou.

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, Assad Oberai, 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 includes 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, Zahra Sotoudeh, 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, Assad Oberai, John Tichy, George Xu, and Lucy Zhang.

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 (cpicu@scorec.rpi.edu) and Marie Dieffenbach (dieffm@rpi.edu) are the Study Abroad contacts 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 Log In 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 (H&SS) 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. 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 on the CAPP report. 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, prior approval of transfer credit is encouraged and from a student perspective, this prior approval is the "guarantee" they should have that coursework taken abroad will count towards their graduation requirements at RPI.

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 Kate Tomlin in the Graduate Student Services Office in JEC 2002. Kate can be reached at 276-2031 or tomlik2@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 Society 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 www.rpi.edu/dept/ne/public_html/Student_Groups.html

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 the advisor and/or the curriculum coordinator. The completed form is then submitted to the Core Engineering Office in JEC 3018.

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 Reactor Engineering or Medical Applications of Radiation Technology. For detailed information on Nuclear Engineering minors, please contact Marie Dieffenbach in the MANE Office of Undergraduate Student Services at dieffm@rpi.edu. Minors range in their requirements from 16 to 20 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 as one of my free electives?
Yes, you may take a graduate course as one of your free electives and in Mechanical or Nuclear Engineering, may be used as a technical elective or a restricted elective. 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 waived?
Waivers must be approved by the Degree Clearance Officer. Your advisor may recommend that a requirement be waived, 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.