

The Physician-Engineer (PE) Program

A combined program of Albany Medical College and the Biomedical Engineering Department of Rensselaer Polytechnic Institute

Biomedical Engineering students following the pre-med template are eligible to be considered for admission to the Physician-Engineer Program after the second academic year at Rensselaer.

Application Procedure

1. Submit application materials to the Department of Biomedical Engineering no later than the end of the Spring semester of the second year, *i.e.*, **no later than May 31**. Required materials are:
 - a. Essay on why you want to be a Physician Engineer and how you will use the research component of this program to advance your medical career
 - b. Letter of recommendation
 - c. Official Rensselaer transcript
 - d. Waiver/Release Form allowing the BME Department to obtain your materials from your application for admission to Rensselaer
2. The Biomedical Engineering Department Head will conduct a preliminary review of all applications and forwards applications of candidates with excellent credentials and high likelihood of success in the program to Albany Medical College by **July 1**.
3. The Faculty at Albany Medical College will review forwarded applications and invite students to submit Supplemental Application forms. Students will have **10-14 days** to complete the Supplemental Application and return it, with a \$115 application fee, to Albany Medical College.
4. Selected students will be invited to interview at Albany Medical College in the second half of the summer.
5. Students will be notified of their admission to the Program before the end of the summer.
6. Students admitted to the Program should plan to spend their “away semester” at AMC participating in the Training as Personal Care Assistant program. Furthermore, the required research project for this program will occur during the 8th undergraduate semester, the summer after graduating from RPI and before matriculating at AMC, and the summer between First and Second Years at AMC.

The Physician-Engineer (PE) Program

General Information Sheet

The Physician-Engineer Program is an enriched program leading to the B.S. Biomedical Engineering degree from Rensselaer and the M.D. degree with Distinction in Research from Albany Medical College (AMC). Through this program, both degrees can be obtained within eight calendar years, including some summers. The Physician-Engineer track complements Rensselaer's long standing Physician Scientist track and brings a new type of students to the program: *individuals committed to bring engineering science and technology research to the practice of medicine.*

Approximately half of the Biomedical Engineering students graduating from Rensselaer traditionally either pursue advanced degrees in biomedical research or attend medical school. Many undergraduate Biomedical Engineering students at Rensselaer participate in biomedical research on campus as part of their engineering training.

The curriculum requires a minimum of 136 credit hours to be completed within the first four years (at Rensselaer). Only 128 credits are required for the BS degree in Biomedical Engineering. The remaining 8 credits are needed for the pre-medical requirements and count towards the Research Distinction part of the degree. The Engineering degree is awarded by Rensselaer at the end of the Fourth Year. The MD degree is received at the end of the eighth year and is dependent upon completing all requirements for the BS and MD degrees.

Participation in a research project is a desirable asset to have when applying to this program as research forms an important component even after having earned the BS degree. For students admitted to the Physician Engineer program, the 'required' research project consists of three somewhat distinct time periods but is intended as one continuous project. These time periods are: 8th undergraduate semester (the Transition semester), the summer between undergrad and medical school, and the summer between First and Second Years of medical school

The MCAT requirement is waived for this combined degree program.

The Physician-Engineer (PE) Program

Requirements

Admission to the program is limited to students after their second year of undergraduate study at Rensselaer (Biomedical Engineering) who display the motivation, maturity, and intellectual capacity necessary to pursue this enriched course of study. Rensselaer conducts initial reviews during the Summer Arch and forwards applications of candidates with excellent credentials and high likelihood of success in the program to Albany Medical College for further review. Those applicants with uniformly superior academic credentials and the highest test scores are invited to the required interview at Albany Medical College. Some experience or demonstrated interest in biological or biomedical research during high school and/or freshman year at Rensselaer is considered as a factor in admission. The interview assesses the applicant's motivation for medicine, level of maturity, and level of personal development.

The PE program seeks and admits students without discrimination based on race, religion, color, gender, age, or handicap as defined in the Rehabilitation Act of 1973, or national or ethnic origin. Ordinarily, admission to the program is limited to citizens of the United States.

Provided that the student maintains satisfactory standards of academic achievement, admission leads automatically to entrance into Albany Medical College after four years (eight semesters) of study at Rensselaer. A minimum grade point average of 3.50 (overall GPA and science/math GPA) is required each semester at Rensselaer for promotion to the medical portion of the curriculum. A grade of D or F in any science course generally requires immediate transfer out of this program. Grades of I (Incomplete) are not accepted without justification involving illness or specific course structure. When an Incomplete is granted, the course work must be completed no later than one month after the last day of the examination period of the semester in which the incomplete was received.

Promotion to the medical portion of the curriculum is based on academic achievement and the student's fitness to enter the medical profession.

Since many biomedical engineering students will enter Rensselaer with advanced placement credit, a large proportion will have undergraduate course work credit in excess of standard requirements. These advanced placement credits will allow them to take advanced or additional course work, but cannot be used to decrease the length of time allotted to their undergraduate experience or to decrease the number of courses prescribed in the curriculum. Furthermore, all courses specifically named in the curriculum must be taken at Rensselaer, or given AP credit, or transferred in from courses taken prior to admission at Rensselaer, i.e., no courses can be transferred to the program after the student has started at Rensselaer. After completing the fourth year of the program, students receive a B.S. degree from Rensselaer. The M.D. degree is received at the end of the eighth year

Physician Engineer Program

First Year

| Fall | | Credit hours | Spring | | Credit hours |
|-----------|---------------------------------|--------------|-----------|-----------------------------|--------------|
| ENGR 1100 | Intro to Engineering Anal | 4 | ENGR 1300 | Engineering Processes | 1 |
| CHEM 1100 | Chemistry I | 4 | MATH 1020 | Calculus II | 4 |
| MATH 1010 | Calculus I | 4 | PHYS 1100 | Physics I | 4 |
| BIOL 1010 | Intro to Biology | 3 | BIOL 2120 | Intro to Cell & Mol Biology | 4 |
| BIOL 1015 | Intro to Biology Lab | 1 | CHEM 1200 | Chemistry II | 4 |
| ENGR 1200 | Eng Graphics & CAD ⁴ | 1 | | | |

Second Year

| Fall | | Credit hours | Spring | | Credit hours |
|-----------|--------------------------|--------------|-----------|--------------------------------|--------------|
| CSCI 1190 | Begin. Prog. for Engrs. | 1 | ENGR 2600 | Mod. & Analysis of Uncertainty | 3 |
| PHYS 1200 | Physics II | 4 | BMED 2100 | Biomaterials Science and Eng | 4 |
| MATH 2400 | Intro to Differential Eq | 4 | BMED 2540 | Biomechanics | 4 |
| CHEM 2250 | Organic Chem I | 3 | BMED 2300 | Bioimaging and Bioinstrument | 4 |
| CHEM 2230 | Organic Chem Lab I | 1 | | | |
| MATH 2010 | Multi. Calc and Mat Alg. | 4 | | | |

Summer Arch

| | | |
|-----------|--------------------------|---|
| BMED 4200 | Modeling of Biomed Sys | 4 |
| CHEM 2260 | Organic Chem II | 3 |
| CHEM 2240 | Organic Chem Lab II | 1 |
| BCBP 4760 | Molecular Biochemistry I | 4 |
| STSS 1520 | Sociology | 4 |

Third Year

| Fall | | Credit hours | Spring | | Credit hours |
|---|--|--------------|-----------|-----------------------------------|--------------|
| Personal Care Assistant Training at AMC | | | BMED 4500 | Advanced Systems Physiology | 4 |
| | | | | Concentration I | 4 |
| | | | PSYC 1200 | General Psychology | 4 |
| | | | ENGR 2050 | Intro to Eng Design | 4 |
| | | | | Prof. Development II ¹ | 2 |

Fourth Year

| Fall | | Credit hours | Spring | | Credit hours |
|-----------|---------------------------------------|--------------|-----------|--|--------------|
| BMED 4010 | Bioeng Lab ² | 4 | BMED 4600 | BME Design ³ | 3 |
| BMED 4260 | BME Prod. Dev & Com | 3 | BMED 47xx | Investigative Medicine II ⁶ | 1 |
| | Concentration II | 3 | BMED 47xx | Biomedical Research ⁶ | 4 |
| | Concentration III | 3 | | HASS Elective ⁵ | 4 |
| BMED 47xx | Investigative Medicine I ⁶ | 1 | | HASS Elective ⁵ | 4 |
| | HASS Elective ⁵ | 4 | ENGR 4010 | Professional Development III | 1 |

The minimum number of credit hours for the degree is 136

BS in Biomedical Engineering is awarded at Rensselaer

¹ Professional Development II will be fulfilled from a published list at the start of each semester and can be taken either semester. Professional Development III can be taken either semester of the senior year. Professional Development I is part of ENGR 2050.

² BMED 4010 may be taken in either Spring Year 3 or Fall Year 4.

³ Capstone writing-intensive course.

⁴ ENGR 1400 may be taken as alternative to ENGR 1200. This course may be taken either semester.

⁵ Two of the HASS courses need to be COMM, LITR, or WRIT to satisfy the English requirement

⁶ These three classes are taught at AMC and are only open to students in the Physician Engineer or Physician Scientist programs. The classes replace the two concentration electives.

Summer after Fourth Year

Research at AMC or Rensselaer

Fifth Academic Year**

Subjects: Anatomy, Histology, Embryology, Biochemistry, Physiology, Radiology, OB/GyN, Pediatrics, Medicine, Neurology, Psychiatry, Surgery, Epidemiology, Social Sciences, and Library.

Summer after Fifth Year**

Research at AMC or Rensselaer

Completion of Research Thesis for the Distinction in Research (MDDR) degree requirement.

Sixth Academic Year

Subjects: Pathology, Pharmacology, Immunology, Medicine, OB/GyN, Neurology, Pediatrics, Radiology, Radiation Oncology, PM&R, Psychiatry, Epidemiology, Social Sciences, and Library.

Summer after Sixth Year

2nd Year Medical School Exams (First Medical Board Exam) USMLE Step I

Seventh Academic Year

Required Ambulatory based Clerkships (Medicine, Family Practice, Pediatrics, Psychiatry, OB/GyN, Surgery).

Summer after Seventh Year

USMLE Step II Clinical Knowledge; USMLE Step II Clinical Skills

Eighth Academic Year

Required Hospital based Clerkships.

MD is awarded at AMC

**** See next page for details on how subject-based curriculum in 5th and 6th years is now woven into a system/theme-based curriculum.**

Year 5 Theme Schedule

Medical Cell Biology and Genetics

Musculoskeletal System I

Nervous System I

Cardiovascular System I

Renal/Respiratory Systems I

Gastrointestinal System I

Endocrine, Reproductive Systems and Integrative Metabolism

Immunology and Microbiology

Year 6 Theme Schedule

Principles of Drug Therapy

Introduction to Pathology

Disease and Defense

Introduction to Oncology

Lymphohematopoetic Systems

Nervous Systems II

Behavioral Science

Gastrointestinal Systems II

Respiratory Systems II

Renal and Urinary Systems II

Endocrinology

Cardiovascular Systems II

Musculoskeletal Systems II

Reproductive Systems

Defense of Thesis

BME Bachelor's Degree Requirements

Humanities, Arts, and Social Science Requirements

- The total HASS core requirement is 22 credits. Included in these credits are the following:
- A minimum of two 4-credit courses in Humanities
- A minimum of two 4-credit courses in the Social Sciences
- No more than three 1000 level HASS courses may be applied to the HASS core
- No more than 6 credits may be taken Pass/No Credit
- At least one 4 credit course must be at the 4000 level
- Depth requirement: Two 4-credit courses in the same H or SS subject area with at least one above the 1000 level and none on Pass/No Credit
- 2 credits must meet the Professional Development 2 requirement.

Core BME Courses (and recommended semesters for taking them)

| | | |
|-----------|--|--------------------------------|
| BMED 2100 | Biomaterials Science and Engineering | (4CR) (S2) |
| BMED 2540 | Biomechanics | (4CR) (S2) |
| BMED 2300 | Bioimaging and Bioinstrumentation | (4CR) (S2) |
| BMED 4200 | Modeling of Biomedical Systems | (4CR) (F3 or Summer Arch) |
| BMED 4010 | BME Lab | (4CR) (S3, F4, or Summer Arch) |
| BMED 4500 | Advanced Systems Physiology | (4CR) (S3) |
| BMED 4260 | BME Product Devel. & Commercialization | (3CR) (F4) |
| BMED 4600 | BME Design | (3CR) (S4) |

Concentrations Courses

Each concentration includes three required courses and two elective courses, such that the total number of credit hours for a concentration is equal to or greater than 17. The elective courses for Physician Engineers are Investigative Medicine I and II and Biomedical Research. It is not possible to take the same course at the 4000- and 6000-level.

1) Biomaterials Concentration (3 required courses):

| | | |
|-----------|------------------------------------|----------------------------|
| ENGR 1600 | Materials Science for Engineers | (4 CR) (F, S, Summer Arch) |
| ENGR 2250 | Thermal and Fluids Engineering I | (4 CR) (F, S, Summer Arch) |
| MTLE 2100 | Structure of Engineering Materials | (4 CR) (S) |

Plus an additional 5 or more credits hours from concentration electives.

2) Biomechanics Concentration (3 required courses):

| | | |
|----------------|----------------------------------|----------------------------|
| BMED 4540 | Biomechanics II | (4 CR) (F) |
| BMED 4580/6480 | Biomedical Fluid Mechanics | (3 CR) (F) |
| ENGR 2250 | Thermal and Fluids Engineering I | (4 CR) (F, S, Summer Arch) |

Plus an additional 6 or more credits hours from concentration electives.

3) Bioimaging/Instrumentation Concentration (3 required courses):

| | | |
|-----------|---------------------|----------------------------|
| ECSE 2010 | Electric Circuits | (4 CR) (F, S, Summer Arch) |
| ECSE 2410 | Signals and Systems | (4 CR) (F, S, Summer Arch) |
| ENGR 2350 | Embedded Control | (3 CR) (F, S, Summer Arch) |

Plus an additional 6 or more credits hours from concentration electives.

Prerequisite Chart

Course

Pre requisite

Biology, Chemistry, Math, Physics:

| | | |
|-----------|---|-----------------------------|
| BIOL 2120 | Cell and Molecular Biology | none |
| CHEM 1100 | Chemistry I | none |
| MATH 1010 | Calculus I | none |
| MATH 1020 | Calculus II | MATH 1010 |
| MATH 2010 | Multivariable Calculus and Matrix Algebra | MATH 1020 |
| MATH 2400 | Diff Equations | MATH 1020 |
| PHYS 1100 | Physics I | none |
| PHYS 1200 | Physics II | PHYS 1100, co-req MATH 1020 |

Engineering Core Courses:

| | | |
|-----------|--------------------------------------|---|
| CSCI 1190 | Beginning Programming for Engineers | none |
| ENGR 1100 | Intro to Engineering Analysis | none |
| ENGR 1200 | Engineering Graphics and CAD | none |
| ENGR 1300 | Engineering Processes | none |
| ENGR 2050 | Intro to Engineering Design | ENGR 1100 and either ENGR 1200 or ENGR 1400, co-req PHYS 1200 |
| ENGR 2600 | Modeling and Analysis of Uncertainty | MATH 1010 |
| ENGR 4010 | Professional Development III | Senior standing |
| PSYC 4170 | Professional Development II | ENGR 2050, Junior or Senior standing |
| STSS 4840 | Professional Development II | ENGR 1010 |

BME Core:

| | | |
|-----------|--|--|
| BMED 2100 | Biomaterials Science and Engineering | none |
| BMED 2300 | Bioimaging and Bioinstrumentation | PHYS 1200 |
| BMED 2540 | Biomechanics | ENGR 1100 |
| BMED 4010 | BME Lab | co-req BMED 4200 |
| BMED 4200 | Modeling of Biomedical Systems | MATH 2400, PHYS 1200, co-req CSCI 1190 |
| BMED 4260 | BME Product Devel. & Commercialization | ENGR 2050, Senior standing |
| BMED 4500 | Advanced Systems Physiology | BIOL 2120 |
| BMED 4600 | BME Design | Senior standing |

Common Concentration Courses:

| | | |
|-----------|------------------------------------|--|
| BMED 4540 | Biomechanics II | BMED 2540 |
| BMED 4580 | Biomedical Fluid Mechanics | ENGR 2250 |
| ECSE 2010 | Electric Circuits | MATH 2400, PHYS 1200 |
| ECSE 2410 | Signals and Systems | ECSE 2010 |
| ENGR 1600 | Mat Science for Engineers | CHEM 1100 |
| ENGR 2250 | Thermals and Fluids Engineering I | ENGR 1100, PHYS 1100, co-req MATH 2400 |
| ENGR 2350 | Embedded Control | CSCI 1010, CSCI 1100 OR CSCI 1190 |
| MTLE 2100 | Structure of Engineering Materials | ENGR 1600 |

Premed Courses (pre-requisites adjusted to satisfy premed requirements):

| | | |
|-----------|-----------------------------|---|
| BIOL 1010 | Introduction to Biology | Co-req BIOL 1015 |
| BIOL 1015 | Introduction to Biology Lab | Needs to be taken with BIOL 1010 |
| CHEM 2250 | Organic Chemistry I | CHEM 1100, Co-req CHEM 2230 |
| CHEM 2230 | Organic Chemistry Lab I | Needs to be taken with CHEM 2250 |
| CHEM 2260 | Organic Chemistry II | CHEM 2250, Co-req CHEM 2240 |
| CHEM 2240 | Organic Chemistry Lab II | Needs to be taken with CHEM 2260 |
| BCBP 4760 | Molecular Biochemistry I | CHEM 2250 and either BIOL 1010 or BIOL 2120 |
| PSYC 1200 | General Psychology | None |
| STSS 1520 | Sociology | None |
| | Investigative Medicine I | Physician Engineer status |
| | Investigative Medicine II | Physician Engineer status |
| | Biomedical Research | Physician Engineer status |