FOUNDATION COURSES REQUIRED OF ALL MAJORS:

i. MATHEMATICS
   - The full sequence of Calculus I, II, III (MATH 135, MATH 136, MATH 241).

ii. PHYSICS
   - Mechanics and Thermodynamics (PHYS 111 or PHYS 115)
   - Electricity, Magnetism, and Optics (PHYS 112 or PHYS 116)

iii. CHEMISTRY
    - General Chemistry I and Lab (CHEM 181)
    Please see individual programs below for details. Some programs require an additional second semester of General Chemistry (CHEM 231) or have possible substitutions.

iv. LABORATORY REQUIREMENT
    Either one-semester physics lab or one-semester chemistry lab is generally required. Please see individual programs below for more details.

v. COMPUTER SCIENCE
   - Introduction to computer science and programming in C++ (CSCI 131)
   Some majors require a specific programming language (see requirements for majors below).

vi. HUMANITIES AND SOCIAL SCIENCES
   - Twenty-seven credit hours non-technical requirement is satisfied by the course work taken for the bachelor’s degree awarded by the home institution. Among these courses the students must include:
     a. Principles of Economics (ECON 111 or 112)  
     b. English Composition (ENGL 120, 121, 122, 123, 124 or check with the 3-2 Program Advisor for an appropriate course).

Additional courses are required for certain majors. See the list below for additional requirements by major.
REQUIRED MAJOR SPECIFIC COURSES
Additional, major-specific, requirements are bulleted. Courses that are underlined are not available at Holy Cross but may be available at Consortium schools. In some instances where noted, it may be possible to take these courses the summer prior to registering at Columbia or while enrolled at Columbia.

APPLIED MATHEMATICS or APPLIED PHYSICS

MATHEMATICS
- Ordinary Differential Equations (MATH 304 or PHYS 221)

PHYSICS
- Classical and Quantum Waves (PHYS 223)
- Physics Lab

CHEMISTRY / BIOLOGY (Choose one course listed below. Chemistry/Biology labs not required.)
- General Chemistry I (CHEM 181)
- Environmental Biology: Molecules to Cells (consortium course)
- Introduction to Molecular and Cellular Biology (BIOL 131)

BIOMEDICAL ENGINEERING (ALL TRACKS)

MATHEMATICS
- Introduction to applied mathematics (PHYS 221) or Ordinary Differential Equations & Linear Algebra (MATH 304 and MATH 244). Students who take an ODE course must also take a Linear Algebra course.
- Introduction to Statistics (MATH 299) [may be taken the summer before entering or while at Columbia]

PHYSICS
- Classical and Quantum Waves (PHYS 223)

CHEMISTRY
- General Chemistry II and Lab (CHEM 231)
- Organic Chemistry I (CHEM 221)

ELECTRICAL ENGINEERING
- Introduction to Electrical Engineering [may be taken the summer before entering or while at Columbia]

ENGINEERING MECHANICS
- Mechanics [may be taken the summer before entering or while at Columbia]

COMPUTER SCIENCE
- Introduction to Computer Science and Programming (CSCI 131) (Programming in MATLAB preferred and may be available through the consortium)
CHEMICAL ENGINEERING

MATHEMATICS (choose one course listed below)
  • Ordinary Differential Equations (MATH 304)
  • Introduction to applied mathematics (PHYS 221) or Ordinary Differential Equations & Linear Algebra (MATH 304 and MATH 244)

PHYSICS
  • Physics Lab

CHEMISTRY
  • General Chemistry II and Lab (CHEM 231)
  • Organic Chemistry I and Lab (CHEM 221)

CIVIL ENGINEERING

MATHEMATICS
  • Introduction to applied mathematics (PHYS 221) or Ordinary Differential Equations & Linear Algebra (MATH 304 and MATH 244).

Students who take an ODE course must also take a Linear Algebra course.

PHYSICS/CHEMISTRY LAB (choose one course listed below)
  • Physics Lab
  • General Chemistry Lab

ENGINEERING MECHANICS
  • Mechanics [may be taken the summer before entering or while at Columbia]

COMPUTER SCIENCE
  • Introduction to Computer Science and Programming (CSCI 131) (Programming in MATLAB preferred and may be available through the consortium)

COMPUTER ENGINEERING

MATHEMATICS
  • Introduction to applied mathematics (PHYS 221) or Ordinary Differential Equations & Linear Algebra (MATH 304 and MATH 244).

Students who take an ODE course must also take a Linear Algebra course.

PHYSICS/CHEMISTRY LAB (choose one course listed below)
  • Physics Lab
  • General Chemistry Lab
COMPUTER SCIENCE
  • Computer Programming in JAVA (consortium course)
  • Discrete Mathematics (CSCI 132)

ELECTRICAL ENGINEERING
  • Introduction to Electrical Engineering [may be taken the summer before entering or while at Columbia]

EARTH AND ENVIRONMENTAL ENGINEERING

MATHEMATICS
  • Introduction to applied mathematics (PHYS 221) or Ordinary Differential Equations & Linear Algebra (MATH 304 and MATH 244).

Students who take an ODE course must also take a Linear Algebra course.

CHEMISTRY
  • General Chemistry II and Lab (CHEM 231)

OTHER SCIENCE ELECTIVE (choose one course listed below)
  • Organic Chemistry (CHEM 221)
  • Classical & quantum waves (PHYS 223)
  • Introduction to Molecular and Cellular Biology (BIOL 131)

EARTH AND ENVIRONMENTAL SCIENCES (choose one course listed below)
  • Advanced General Geology [may be taken while at Columbia.]
  • The Climate System [may be taken while at Columbia.]
  • The Solid Earth System [may be taken while at Columbia.]

EARTH AND ENVIRONMENTAL ENGINEERING
  • Alternative Energy Resources [may be taken at Columbia]

ELECTRICAL ENGINEERING

MATHEMATICS
  • Introduction to applied mathematics (PHYS 221) or Ordinary Differential Equations & Linear Algebra (MATH 304 and MATH 244).

Students who take an ODE course must also take a Linear Algebra course.

PHYSICS
  • Classical and Quantum Waves (PHYS 223)
  • Physics Lab

COMPUTER SCIENCE
  • Computer Programming in JAVA is recommended (consortium course).
ELECTRICAL ENGINEERING

- **Introduction to Electrical Engineering** [may be taken the summer before entering or while at Columbia]

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**IEOR: ENGINEERING MANAGEMENT SYSTEMS**

**MATHEMATICS**

- Linear Algebra (MATH 244)

**PHYSICS/CHEMISTRY LAB (choose one course listed below)**

- Physics Lab
- General Chemistry Lab

**COMPUTER SCIENCE (choose one set of courses below)**

- Computer Programming in C (CSCI 131)
- Data Structures in C (CSCI 132)
- or-
- Computer Programming in JAVA (consortium course)
- Data Structures in JAVA (consortium course)

The Department strongly recommends JAVA over C.

**ECONOMICS**

- Introduction to Accounting and Finance (ECOA 181)

**PROBABILITY AND STATISTICS**

- Introduction to Probability and Statistics (MATH 375 and MATH 376)

Please note that the course must have calculus as a pre-requisite. The Department strongly suggests taking two separate courses: one in Probability and one in Statistics.

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**IEOR: FINANCIAL ENGINEERING**

Students cannot apply directly to IEOR: Financial Engineering because this concentration in Operations Research requires an application after one semester of study at Columbia. Entrance into this program is very competitive. Students interested in this concentration must adhere to the following pre-requisite requirements:

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**IEOR: INDUSTRIAL ENGINEERING**

**MATHEMATICS**

- Linear Algebra (MATH 244)

**PHYSICS/CHEMISTRY LAB (choose one course listed below)**

- Physics Lab
• General Chemistry Lab

COMPUTER SCIENCE (choose one set of courses below)
• Computer Programming in C++ (CSCI 131)
• Data Structures in C++ (CSCI 132)
-or-
• Computer Programming in JAVA (consortium course)
• Data Structures in JAVA (consortium course)
The Department strongly recommends JAVA over C++.

ECONOMICS
• Introduction to Accounting and Finance (ECOA 181)

PROBABILITY AND STATISTICS
• Introduction to Probability and Statistics (MATH 375 and MATH 376)
Please note that the course must have calculus as a pre-requisite. The Department strongly suggests taking two separate courses: one in Probability and one in Statistics.

IEOR: OPERATIONS RESEARCH

MATHEMATICS
• Linear Algebra (MATH 244)

PHYSICS/CHEMISTRY LAB (choose one course listed below)
• Physics Lab
• General Chemistry Lab

COMPUTER SCIENCE (choose one set of courses below)
• Computer Programming in C++ (CSCI 131)
• Data Structures in C++ (CSCI 132)
-or-
• Computer Programming in JAVA (consortium course)
• Data Structures in JAVA (consortium course)
The Department strongly recommends JAVA over C++.

ECONOMICS
• Introduction to Accounting and Finance (ECOA 181)

PROBABILITY AND STATISTICS
• Introduction to Probability and Statistics (MATH 375 and 376)
Please note that the course must have calculus as a pre-requisite. The Department strongly suggests taking two separate courses: one in Probability and one in Statistics.

ENGINEERING MECHANICS

MATHEMATICS
• Ordinary Differential Equations (MATH 304)

PHYSICS/CHEMISTRY LAB (choose one course listed below)
• Physics Lab
• General Chemistry Lab

ENGINEERING MECHANICS
• Mechanics [may be taken the summer before entering or while at Columbia]

MATERIALS SCIENCE AND ENGINEERING

MATHEMATICS
• Ordinary Differential Equations (MATH 304)

PHYSICS
• Classical and Quantum Waves (PHYS 223)
• Physics Lab

CHEMISTRY
• General Chemistry II and Lab (CHEM 231)

MECHANICAL ENGINEERING

MATHEMATICS
• Introduction to applied mathematics or Ordinary Differential Equations & Linear Algebra (PHYS 221, or MATH 304 and MATH 244).
Students who take an ODE course must also take a Linear Algebra course.

PHYSICS/ BIOLOGY (choose one course listed below)
• Classical and Quantum Waves (PHYS 223)
• Environmental Biology: Molecules to Cells (consortium course)
• Introduction to Molecular and Cellular Biology (BIOL 131)

PHYSICS/CHEMISTRY LAB (choose one course listed below)
• Physics Lab
• General Chemistry Lab

ENGINEERING MECHANICS
• Mechanics [may be taken while at Columbia]

ELECTRICAL ENGINEERING
• Intro. to Electrical Engineering or equivalent [may be taken while at Columbia]