

# DUAL DEGREE PROGRAM COLUMBIA UNIVERSITY

## 2014-15 CURRICULUM GUIDE

### FOR WESLEYAN UNIVERSITY STUDENTS

(September 4, 2014)

The following tables list the courses that Columbia University requires for acceptance into the Dual Degree or Combined Plan program. On the left half of the tables, Columbia's courses with number and (short) title are listed and on the right half their Wesleyan equivalents. When no equivalent Wesleyan course exists, the entry NA is shown.

Part I enumerates the foundation courses that have to be taken by all students. Part II lists the additional courses and requirements for each engineering major.

Note 1: It is possible that certain Wesleyan courses are not offered every year.

Note 2: In any given semester, Introduction to Programming (COMP 112) may be taught in a language different than C or JAVA.

Note 3: If a course is not available at Wesleyan, it is the student's responsibility to find alternative solutions such as arranging graded tutorials at Wesleyan or taking summer courses.

Note 4: In general, *all* courses required for the Dual Degree program need to be taken letter graded (and not pass/fail).

Note 5: Only if all conditions stipulated by Columbia University on their [Combined Plan website](#) are satisfied is acceptance into the program guaranteed. In any other case, it is at the discretion of Columbia to accept students.

# I. FOUNDATION COURSES REQUIRED OF ALL MAJORS:

## Columbia

## Wesleyan

<b>Mathematics</b>			
MATH V1101	Calculus I	MATH 121	Calculus I, Part I
MATH V1102	Calculus II	MATH 122	Calculus I, Part II
MATH V1201	Calculus III	MATH 221 or MATH 223	Vectors and Matrices Linear Algebra
MATH V1202	Calculus IV	MATH 222	Multivariable Calculus
<b>Physics</b>			
PHYS C1401	Introduction to Mechanics and Thermodynamics	PHYS 113	General Physics I
PHYS C1402	Introduction to Electricity, Magnetism, and Optics	PHYS 116	General Physics II
<b>Chemistry</b>			
<i>Please see individual programs below for details. Some programs require an additional second semester of General Chemistry (C1404) or have possible substitutions.</i>			
CHEM C1403	General Chemistry	CHEM 141	Introductory Chemistry I
<b>Lab Requirement</b>			
<i>Either one-semester physics lab or one-semester chemistry lab is generally required. Please see individual programs below for more details</i>			
		PHYS 123 or PHYS 124 or CHEM 152	General Physics Laboratory I General Physics Laboratory II Introductory Chemistry Laboratory
<b>Computer Science</b>			
<i>Some majors require a specific programming language (see requirements for majors below).</i>			
COMS W1003  or COMS W1004 or COMS W1005 or COMS W1007	Introduction to Computer Science and Programming in C <i>ditto</i> in Java <i>ditto</i> in Matlab Object-Oriented Programming and Design in Java	COMP 112  COMP 112 NA NA	Introduction to Programming   Note that in any given semester, COMP 112 may be taught in a language different than JAVA or C.
<b>Humanities and Social Sciences</b>			
<i>Principles of Economics, English Composition and twenty seven (27) non-technical credit hours.</i>		<i>In addition to the following two courses, nine (9) full credit courses in the Humanities and Arts and/or Social and Behavioral Sciences are required.</i>	
ECON W1105	Principles of Economics	ECON 101 or ECON 110	Introduction to Economics Introduction to Economic Theory
ENGL C1010	University Writing	ENGL 130 or ENGL 132  or ENGL 292 or other writing intensive courses	The English Essay Writing Medicine and the Doctor-Writer Techniques of Nonfiction

## REQUIRED FOR MAJORS IN:

### APPLIED MATHEMATICS AND PHYSICS

#### Columbia

#### Wesleyan

<b>Mathematics</b>			
MATH E1210	Ordinary Differential Equations	MATH 229	Differential Equations
<b>Physics</b>			
PHYS C1403	Classical and Quantum Waves	PHYS 213	Waves & Oscillations
PHYS C1493 & 4	Introduction to Experimental Physics	PHYS 123 & 4	General Physics Laboratory
<b>Chemistry / Biology</b> <i>(Choose one course listed below. Chemistry/Biology labs not required.)</i>			
CHEM C1403	General Chemistry I	CHEM 141	Introductory Chemistry I
EEEB W2001	Environmental Biology I: Molecules to Cells	BIOL 181	Principles of Biology I: Cell Biology and Molecular Basis of Heredity
BIOL C2005	Introduction to Molecular and Cellular Biology	BIOL 181	Principles of Biology I: Cell Biology and Molecular Basis of Heredity

## **BIOMEDICAL ENGINEERING (all tracks)**

### **Columbia**

### **Wesleyan**

<b>Mathematics</b>			
APMA E2101	Introduction to Applied Mathematics – Ordinary Differential Equations & Linear Algebra <i>(Students who take an ODE course must also take a Linear Algebra course.)</i>	MATH 229	Differential Equations
STAT W1211	Introduction to Statistics (with Calculus) <i>(be taken the summer before entering or while at Columbia)</i>	NA	
<b>Physics</b>			
PHYS C1403	Classical and Quantum Waves	PHYS 213	Waves & Oscillations
<b>Chemistry</b>			
CHEM C1404	General Chemistry II	CHEM 142	Introductory Chemistry II
CHEM C1500	General Chemistry Lab	CHEM 152	Introductory Chemistry Laboratory
CHEM C3443	Organic Chemistry I	CHEM 251	Principles of Organic Chemistry I
<b>Electrical Engineering &amp; Engineering Mechanics</b> <i>(may be taken the summer before entering or while at Columbia)</i>			
ELEN E1201	Introduction to Electrical Engineering	NA	
ENME E3105	Mechanics	NA	
<b>Computer Science</b>			
<i>Introduction to Computer Science and Programming in MATLAB (COMS W1005) preferred</i>			

## CHEMICAL ENGINEERING

### Columbia

### Wesleyan

<b>Mathematics</b> (choose one course listed below)			
MATH E1210	Ordinary Differential Equations	MATH 229	Differential Equations
APMA E2101	Introduction to Applied Mathematics – Ordinary Differential Equations & Linear Algebra <i>(Students who take an ODE course must also take a Linear Algebra course.)</i>	MATH 229	Differential Equations
<b>Physics</b>			
PHYS C1493 & 4	Physics Lab	PHYS 123 & 4	General Physics Laboratory
<b>Chemistry</b>			
CHEM C1404	General Chemistry II	CHEM 142	Introductory Chemistry II
CHEM C1500	General Chemistry Lab	CHEM 152	Introductory Chemistry Laboratory
CHEM C3443	Organic Chemistry I	CHEM 251	Principles of Organic Chemistry I
CHEM C3543	Organic Chemistry Lab	CHEM 257	General Chemistry Laboratory

## CIVIL ENGINEERING

### Columbia

### Wesleyan

<b>Mathematics</b>			
APMA E2101	Introduction to Applied Mathematics – Ordinary Differential Equations & Linear Algebra <i>(Students who take an ODE course must also take a Linear Algebra course.)</i>	MATH 229	Differential Equations
<b>Physics / Chemistry Lab (choose one course listed below)</b>			
PHYS C1493 or PHYS C1494 or CHEM C1500	Physics Lab I Physics Lab II General Chemistry Lab	PHYS 123 or PHYS 124 or CHEM 152	General Physics Laboratory I General Physics Laboratory II Introductory Chemistry Laboratory
<b>Engineering Mechanics (may be taken the summer before entering or while at Columbia)</b>			
ENME E3105	Mechanics	NA	
<b>Computer Science</b>			
<i>Introduction to Computer Science and Programming in MATLAB (COMS W1005) preferred</i>			

## COMPUTER ENGINEERING

**Columbia**

**Wesleyan**

<b>Mathematics</b>			
APMA E2101	Introduction to Applied Mathematics – Ordinary Differential Equations & Linear Algebra <i>(Students who take an ODE course must also take a Linear Algebra course.)</i>	MATH 229	Differential Equations
<b>Physics / Chemistry Lab (choose one course listed below)</b>			
PHYS C1493 or PHYS C1494 or CHEM C1500	Physics Lab I Physics Lab II General Chemistry Lab	PHYS 123 or PHYS 124 or CHEM 152	General Physics Laboratory I General Physics Laboratory II Introductory Chemistry Laboratory
<b>Computer Science</b>			
COMS W3203	Discrete Mathematics	MATH 228	Discrete Mathematics
<i>Computer Programming in JAVA is required.</i>			
<b>Electrical Engineering (may be taken the summer before entering or while at Columbia)</b>			
ELEN E1201	Introduction to Electrical Engineering	NA	

## COMPUTER SCIENCE

### Columbia

### Wesleyan

Physics / Chemistry Lab (choose one course listed below)			
PHYS C1493 or PHYS C1494 or CHEM C1500	Physics Lab I Physics Lab II General Chemistry Lab	PHYS 123 or PHYS 124 or CHEM 152	General Physics Laboratory I General Physics Laboratory II Introductory Chemistry Laboratory
Computer Science			
COMS W3137	Data Structures and Algorithms	COMP 212	Data Structures (see note below)
COMS W3203	Discrete Mathematics	MATH 228	Discrete Mathematics
COMS W3210	Scientific Computation	NA	
<i>Computer Programming in JAVA is required.</i>			

**Note:** The Wesleyan course COMP 212 is the second course in a two-course sequence (COMP 211-212). Because of the non-programming topics that are addressed in COMP 211, permission to take COMP 212 without having taken COMP 211 will be decided on a case-by-case basis by the instructor. COMP 112 is not typically acceptable as a prerequisite for this course.



## **EARTH AND ENVIRONMENTAL ENGINEERING**

### **Columbia**

### **Wesleyan**

<b>Mathematics</b>			
APMA E2101	Introduction to Applied Mathematics – Ordinary Differential Equations & Linear Algebra <i>(Students who take an ODE course must also take a Linear Algebra course.)</i>	MATH 229	Differential Equations
<b>Chemistry</b>			
CHEM C1404	General Chemistry II	CHEM 142	Introductory Chemistry II
CHEM C1500	General Chemistry Lab	CHEM 152	Introductory Chemistry Laboratory
<b>Other Science Electives Chemistry</b> <i>(choose one course listed below)</i>			
CHEM C3443	Organic Chemistry I	CHEM 251	Principles of Organic Chemistry I
PHYS C1403	Classical and Quantum Waves	PHYS 213	Waves & Oscillations
BIOL C2005	Introduction to Molecular and Cellular Biology	BIOL 181	Principles of Biology I: Cell Biology and Molecular Basis of Heredity
<b>Earth and Environmental Sciences</b> <i>(choose one course listed below; may be taken while at Columbia)</i>			
EESC W4001	Advanced General Geology	E&ES 223	Structural Geology
EESC V2100	The Climate System	NA	
EESC V2200	The Solid Earth System	E&ES 101	Dynamic Earth
<b>Earth and Environmental Engineering</b> <i>(may be taken while at Columbia)</i>			
EAAE E2002	Alternative Energy Resources	NA	

## ELECTRICAL ENGINEERING

**Columbia**

**Wesleyan**

<b>Mathematics</b>			
APMA E2101	Introduction to Applied Mathematics – Ordinary Differential Equations & Linear Algebra <i>(Students who take an ODE course must also take a Linear Algebra course.)</i>	MATH 229	Differential Equations
<b>Physics</b>			
PHYS C1403	Classical and Quantum Waves	PHYS 213	Waves & Oscillations
PHYS C1493 & 4	Introduction to Experimental Physics	PHYS 123 & 124	General Physics Laboratory
<b>Computer Science</b>			
<i>Computer Programming in JAVA (W1107) is recommended</i>			
<b>Electrical Engineering</b> <i>(may be taken the summer before entering or while at Columbia)</i>			
ELEN E1201	Introduction to Electrical Engineering	NA	

## IEOR: ENGINEERING MANAGEMENT SYSTEMS

### Columbia

### Wesleyan

<b>Mathematics</b> (choose one course listed below)			
MATH V2010	Linear Algebra	MATH 223	Linear Algebra
APAM E3101	Linear Algebra	MATH 221	Vectors and Matrices
<b>Physics / Chemistry Lab</b> (choose one course listed below)			
PHYS C1493 or PHYS C1494 or CHEM C1500	Physics Lab I Physics Lab II General Chemistry Lab	PHYS 123 or PHYS 124 or CHEM 152	General Physics Laboratory I General Physics Laboratory II Introductory Chemistry Laboratory
<b>Computer Science</b> (choose one set of courses listed below)			
COMS W1003	Introduction To Computer Science and Programming In C	COMP 112	Introduction to Programming
COMS W3133	Data Structures In C	COMP 212	Data Structures
<i>or:</i>			
COMS W1007	Introduction To Computer Science and Programming In JAVA	COMP 112	Introduction to Programming
COMS W3134	Data Structures In JAVA	COMP 212	Data Structures (see note on page 8)
<i>The Department strongly recommends JAVA over C.</i>			
<b>Economics</b>			
ECON E2261	Introduction to Accounting and Finance	ECON 127	Introduction to Financial Accounting
<b>Probability and Statistics</b>			
<i>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.</i>			
W3600	Introduction to Probability and Statistics	ECON 300	Quantitative Methods in Economics

## **IEOR: FINANCIAL ENGINEERING**

**Note:** Students can apply to Financial Engineering only after one semester of study at Columbia. Students interested in this concentration of Operations Research must adhere to the following pre-requisite requirements:

### **Columbia**

### **Wesleyan**

<b>Mathematics</b>			
MATH V2010 or APAM E3101	Linear Algebra	MATH 223 or MATH 221	Linear Algebra or Vectors and Matrices
MATH E1210	Ordinary Differential Equations	MATH 229	Differential Equations
<b>Physics / Chemistry Lab</b> ( <i>choose one course listed below</i> )			
PHYS C1493 or PHYS C1494 or CHEM C1500	Physics Lab I Physics Lab II General Chemistry Lab	PHYS 123 or PHYS 124 or CHEM 152	General Physics Laboratory I General Physics Laboratory II Introductory Chemistry Laboratory
<b>Computer Science</b> ( <i>choose one set of courses listed below</i> )			
COMS W1003	Introduction To Computer Science and Programming In C	COMP 112	Introduction to Programming
COMS W3133	Data Structures In C	COMP 212	Data Structures ( <i>see note on page 8</i> )
<i>or:</i>			
COMS W1007	Introduction To Computer Science and Programming In JAVA	COMP 112	Introduction to Programming
COMS W3134	Data Structures In JAVA	COMP 212	Data Structures
<i>The Department strongly recommends JAVA over C.</i>			
<b>Economics</b>			
ECON E2261	Introduction to Accounting and Finance	ECON 127	Introduction to Financial Accounting
<b>Probability and Statistics</b>			
<i>Please note that the course must have calculus as a pre-requisite.</i>			
W3658	Probability	ECON 300	Quantitative Methods in Economics
W3659	Statistical Inference	NA	

## IEOR: INDUSTRIAL ENGINEERING

### Columbia

### Wesleyan

<b>Mathematics</b> (choose one course listed below)			
MATH V2010	Linear Algebra	MATH 223	Linear Algebra
APAM E3101	Linear Algebra	MATH 221	Vectors and Matrices
<b>Physics / Chemistry Lab</b> (choose one course listed below)			
PHYS C1493 or PHYS C1494 or CHEM C1500	Physics Lab I Physics Lab II General Chemistry Lab	PHYS 123 or PHYS 124 or CHEM 152	General Physics Laboratory I General Physics Laboratory II Introductory Chemistry Laboratory
<b>Computer Science</b> (choose one set of courses listed below)			
COMS W1003	Introduction To Computer Science and Programming In C	COMP 112	Introduction to Programming
COMS W3133	Data Structures In C	COMP 212	Data Structures (see note on page 8)
<i>or:</i>			
COMS W1007	Introduction To Computer Science and Programming In JAVA	COMP 112	Introduction to Programming
COMS W3134	Data Structures In JAVA	COMP 212	Data Structures
<i>The Department <b>strongly</b> recommends JAVA over C.</i>			
<b>Economics</b>			
ECON E2261	Introduction to Accounting and Finance	ECON 127	Introduction to Financial Accounting
<b>Probability and Statistics</b>			
<i>Please note that the course must have calculus as a pre-requisite. The Department <b>strongly</b> suggests taking two separate courses: one in Probability and one in Statistics.</i>			
W3600	Introduction to Probability and Statistics	ECON 300	Quantitative Methods in Economics

## IEOR: OPERATIONS RESEARCH

### Columbia

### Wesleyan

<b>Mathematics</b> (choose one course listed below)			
MATH V2010	Linear Algebra	MATH 223	Linear Algebra
APAM E3101	Linear Algebra	MATH 221	Vectors and Matrices
<b>Physics / Chemistry Lab</b> (choose one course listed below)			
PHYS C1493 or PHYS C1494 or CHEM C1500	Physics Lab I Physics Lab II General Chemistry Lab	PHYS 123 or PHYS 124 or CHEM 152	General Physics Laboratory I General Physics Laboratory II Introductory Chemistry Laboratory
<b>Computer Science</b> (choose one set of courses listed below)			
COMS W1003	Introduction To Computer Science and Programming In C	COMP 112	Introduction to Programming
COMS W3133	Data Structures In C	COMP 212	Data Structures
<i>or:</i>			
COMS W1007	Introduction To Computer Science and Programming In JAVA	COMP 112	Introduction to Programming
COMS W3134	Data Structures In JAVA	COMP 212	Data Structures (see note on page 8)
<i>The Department strongly recommends JAVA over C.</i>			
<b>Economics</b>			
ECON E2261	Introduction to Accounting and Finance	ECON 127	Introduction to Financial Accounting
<b>Probability and Statistics</b>			
<i>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.</i>			
W3600	Introduction to Probability and Statistics	ECON 300	Quantitative Methods in Economics

## ENGINEERING MECHANICS

**Columbia**

**Wesleyan**

<b>Mathematics</b>			
MATH E1210	Ordinary Differential Equations	MATH 229	Differential Equations
<b>Physics / Chemistry Lab</b> ( <i>choose one course listed below</i> )			
PHYS C1493 or PHYS C1494 or CHEM C1500	Physics Lab I Physics Lab II General Chemistry Lab	PHYS 123 or PHYS 124 or CHEM 152	General Physics Laboratory I General Physics Laboratory II Introductory Chemistry Laboratory
<b>Engineering Mechanics</b> ( <i>may be taken the summer before entering or while at Columbia</i> )			
ENME E3105	Mechanics	NA	

## MATERIALS SCIENCE AND ENGINEERING

**Columbia**

**Wesleyan**

<b>Mathematics</b>			
MATH E1210	Ordinary Differential Equations	MATH 229	Differential Equations
<b>Physics</b>			
PHYS C1403	Classical and Quantum Waves	PHYS 213	Waves & Oscillations
PHYS C1493 & 4	Physics Lab	PHYS 123 & 124	General Physics Laboratory
<b>Chemistry</b>			
CHEM C1404	General Chemistry II	CHEM 142	Introductory Chemistry II
CHEM C1500	General Chemistry Lab	CHEM 152	Introductory Chemistry Laboratory



## MECHANICAL ENGINEERING

### Columbia

### Wesleyan

<b>Mathematics</b>			
APMA E2101	Introduction to Applied Mathematics – Ordinary Differential Equations & Linear Algebra <i>(Students who take an ODE course must also take a Linear Algebra course.)</i>	MATH 229	Differential Equations
<b>Physics / Biology</b> <i>(Choose one course listed below. Chemistry/Biology labs not required.)</i>			
PHYS C1403	Classical and Quantum Waves	PHYS 213	Waves & Oscillations
EEEB W2001	Environmental Biology I: Molecules to Cells	BIOL 181	Principles of Biology I: Cell Biology and Molecular Basis of Heredity
BIOL C2005	Introduction to Molecular and Cellular Biology	BIOL 181	Principles of Biology I: Cell Biology and Molecular Basis of Heredity
<b>Physics / Chemistry Lab</b> <i>(choose one course listed below)</i>			
PHYS C1493 or PHYS C1494 or CHEM C1500	Physics Lab I Physics Lab II General Chemistry Lab	PHYS 123 or PHYS 124 or CHEM 152	General Physics Laboratory I General Physics Laboratory II Introductory Chemistry Laboratory
<b>Electrical Engineering / Engineering Mechanics</b> <i>(may be taken the summer before entering or while at Columbia)</i>			
ELEN E1201 <i>or equivalent</i>	Introduction to Electrical Engineering	NA	
ENME E3105	Mechanics	NA	