

# Carnegie Institute of Technology

Pradeep Khosla, Dean  
Kurt Larsen, Assistant Dean for Undergraduate Studies Undergraduate  
Office: Scaife Hall 110  
<http://www.cit.cmu.edu/>

Carnegie Institute of Technology, the engineering college of the university, has three main activities - undergraduate education, graduate education, and research. Its continuing goal has been to maintain excellence in all these activities. The degree to which this goal has been achieved is attested to by the demand for its graduates, the success of its alumni, the quality of its students and faculty, the adoption elsewhere of its innovations, and the national and international recognition it receives in educational and research activities.

The college offers the degree of bachelor of science in chemical engineering, civil engineering, electrical and computer engineering, mechanical engineering, and materials science and engineering. All of these programs are accredited by the Engineering Accreditation Commission of the Accreditation Board for Engineering and Technology (ABET). An engineering student may also choose to pursue a minor in one of the CIT designated minor programs, or a double major in engineering and public policy or biomedical engineering, or to design minor, double-major or double-degree programs with other non-engineering departments.

## Educational Objectives

The overarching objective of our engineering curriculum is to provide our students with an education that enables them to be productive and fulfilled professionals throughout their careers. Our more specific, measurable objectives for graduates of our engineering curriculum are the following:

- Graduates recognize that they acquired a high quality, rigorous technical education from the College of Engineering at Carnegie Mellon.
- Graduates, in addition to their technical knowledge, recognize that they have acquired a broader body of knowledge that allows them to understand the larger context of the problems that they must address during their career.
- Graduates use their technical foundation and their broader base of knowledge to be successful in a diverse collection of individual careers inside and outside of the engineering profession.

From its earliest days, Carnegie Institute of Technology (CIT) has considered undergraduate education to be the key element in the development of future leaders. In this regard, CIT has adopted a plan for education that is designed to equip students with the capacity to learn and to continue the process of self-education throughout their lives. The present curriculum incorporates this philosophy by providing the opportunity for both breadth in a number of engineering, science, humanities and fine arts areas as well as depth in a major area of concentration. To achieve these goals, our flexible curriculum has been designed to allow students to customize their program to suit their needs and to help each student acquire:

A thorough and integrated understanding of fundamental knowledge in fields of a students' major interest and the ability to use this knowledge;

Competence in the orderly way of thinking, which professionals and scientists have always used in reaching sound, creative conclusions, with the goal that after graduation the student can, by such thinking, reach decisions both as a professional and as a citizen;

An ability to learn independently with scholarly orderliness, so that after graduation the student will be able to grow in wisdom and keep abreast of the changing knowledge and problems of the profession and the society in which he or she participates;

The philosophical outlook, breadth of knowledge, and sense of values which will increase the student's understanding and enjoyment of life and enable each student to recognize and deal effectively with the human, economic, ethical and social aspects of professional problems; and

The ability to communicate ideas to others in a comprehensive and understandable manner.

The curriculum encourages students to confront professional

problems, accomplished through team and problem-oriented courses, as well as courses which emphasize design or individual projects. These classes stress creativity and independent thought and require the student to define the problem, propose a solution or a design in the presence of technical and socioeconomic constraints, to make judgments among alternative solutions, and to explore innovative alternatives to more conventional solutions.

## First Year for Engineering Students

The Carnegie Mellon engineering education is based on engineering and science fundamentals that give students the skills to face new and challenging situations. The first year in engineering provides a broad foundation upon which students build a curriculum in their eventual major. Since students in CIT do not select a major until the end of the first year, all first year students share a common experience consisting of introductory courses in the engineering majors (one each semester), calculus, physics, other science courses which compliment specific introductory engineering courses, and courses in the College of Humanities and Social Sciences (General Education). This curriculum helps make an informed decision about a final major. Below is an example of a standard schedule for a first-year engineering student.

Fall Semester	Units
Introductory Engineering Elective	12
Restricted Technical Elective	9-12
Differential and Integral Calculus	10
A Writing/Expression Course	9
Computer Skills Workshop	3
CIT First-Year Seminar	0

Spring Semester	Units
Introductory Engineering Elective	12
Restricted Technical Elective	10
Integration, Differential Equations, Approximation	10
General Education Course	9

### Notes:

1. Each semester every CIT department offers its Introductory Engineering Elective\*. Every first year CIT student must select one such course each semester.

\* Except Engineering and Public Policy, offered only in the spring.

2. Each Introductory Engineering Elective requires a specific Restricted Technical Elective (to be taken prior to or contemporarily with the Introductory Engineering Elective) chosen as follows:

Introductory Engineering Subject	Restricted Technical Elective
Biomedical Engineering	03-121
Chemical Engineering	09-105
Civil & Environmental Engineering	33-106
Electrical & Computer Engineering	15-100
Engineering & Public Policy	33-106
Mechanical Engineering	33-106
Materials Science & Engineering	33-106

3. All students must complete Physics for Engineering Students I by the end of the first year. Therefore, if a student chooses to take Introduction to Chemical Engineering (with 09-105 as a co-requisite) during one semester and Introduction to Electrical and Computer Engineering (with 15-100 as a co-requisite), the student must take 33-106 in place of the General Education requirement in the Spring semester of the first year and take the General Education course in a subsequent semester. Alternatively, a student entering the university with AP credit in a required first year course may substitute 33-106 in its place.

## Program in General Education for CIT Students

### Breadth Requirement 27 Units

**Humanistic Studies (Cultural Analysis)\* 9 units**  
79-104 Introduction to World History

**Cognitions and Institutions\* 9 units**  
73-150 Microeconomics

or

85-100 Introduction to Intelligence

88-104 Decision Process in American Political Institutions

\* A list of alternative courses for Humanistic Studies and Cognitions and Institutions is available at [www.cit.cmu.edu](http://www.cit.cmu.edu).

**Writing/Expression 9 units**  
76-101 Interpretation and Argument

### Depth Sequence in Humanities, Social Science, or Fine Arts 27 units

A sequence of humanities, social science, or fine arts courses which provides depth in a specific area. Usually, 27 units from a single department meet this requirement. However, related courses from different departments may also satisfy this requirement. At least 9 of these units should be beyond the introductory or elementary level and CFA performance courses, if chosen, must also include theory or history of the subject. A depth sequence in language must include at least three nine-unit courses in the same language. Business Administration, Heinz School, and Statistics Department courses may NOT be used to satisfy this requirement. Although this requirement is typically satisfied by completing 3 courses of at least 9 units each, some acceptable courses are greater or less than 9 units (e.g. 6-unit Art courses). While mini courses of fewer than 9 units may be combined to equal 9 unit courses, the excess units from courses greater 9 units may NOT be used to satisfy this requirement. For example, a 12 unit, 6 unit, 9 unit combination is not acceptable. A 6 unit, 3 unit, 9 unit, 9 unit combination is acceptable.

### Non-Technical Electives 18 units

Two unrestricted humanities, social science or fine arts courses. Non-technical courses from Business Administration, or the Heinz School may also satisfy this requirement. Accounting, finance, management, marketing, production, and statistics courses are regarded as technical courses and may NOT be used to satisfy this requirement. Although this requirement is typically satisfied by completing 2 courses of at least 9 units each, some acceptable courses are greater or less than 9 units (e.g. 6-unit Art courses). While mini courses of fewer than 9 units may be combined to equal 9 unit courses, the excess units from courses greater 9 units may NOT be used to satisfy this requirement. For example, a 12 unit, 6 unit combination is not acceptable. A 6 unit, 3 unit, 9 unit combination is acceptable.

### Free Elective Courses

A free elective is any graded Carnegie Mellon course. However, a maximum of nine units in the form of pass/fail or non-factorable courses (including physical education, StuCo and military science) may be taken as free electives in most CIT degree programs (Except for ECE).

## Double Majors and Double Degrees in CIT

A major is defined as a program that must be completed for the granting of a degree. Double majors comprise a single degree with majors in two separate areas; for example, the degree of Bachelor of Science in Chemical Engineering and a double major in English. Although the double major requires the completion of two designated programs, they may have overlapping requirements that can be met simultaneously. The general principle used to measure eligibility for a Carnegie Institute of Technology double major is that the major (core) requirements of both departments must be completed. Finally, although the student is formally enrolled as an undergraduate in one of the

departments (the parent department, which is responsible for scheduling and other administrative actions for the student), the student should apply for the double major through the second department and coordinate requirements with both departments.

The double major is to be distinguished from a dual degree program, which results in two separate bachelor's degrees; for example, Bachelor of Science in Chemical Engineering and a Bachelor of Arts in English. The dual degree, though, requires a minimum of 90 units of work in addition to the units required for the first degree. The second degree may be earned in Bachelor of Science or Bachelor of Arts degree programs.

## Requirements for CIT students wishing to complete Double Majors

The student must satisfactorily pass requirements of the regular and complete program (with the permissible exceptions) leading to a degree in CIT. The minimum number of units required for the double major is the number required by the parent department or major.

The student takes and satisfactorily completes the courses specified by a second department, usually using elective space available in the first program.

The second department, on the basis of the specified number of courses plus the courses comprising the parent department's regular degree requirements, then certifies that the student has completed the requirements for a major in the second department.

At the CIT advisor's discretion, equivalent technical electives may be substituted from either MCS or SCS departments.

Non-technical courses in the curricula can be altered to meet the requirements of the second major. But if the second major is not an H&SS department, the program must include a minimum of 72 units of General Education courses to meet CIT requirements for graduation.

## Designated Minors Offered by CIT (for engineering students)

In addition to their regular majors for B. S. degrees, undergraduate students in the Carnegie Institute of Technology can elect to complete an interdisciplinary Designated Minor. These minors have been added to the Carnegie Institute of Technology curriculum to promote flexibility and diversity among the college's engineering students. Independent of major, a student is free, but not required, to pursue a selected designated minor from the following list:

- \* Automation and Control
  - \* Biomedical Engineering\*
  - \* Colloids, Polymers and Surfaces
  - \* Data Storage Systems Technology
  - \* Electronic Materials
  - \* Engineering Design
  - \* Environmental Engineering
  - \* International Engineering
  - \* Manufacturing Engineering
  - \* Material Science and Engineering
  - \* Mechanical Behavior of Materials
  - \* Robotics (described on the following page)\*
- \* Also available for non-CIT students

Complete descriptions of the designated minors can be found on p. 107-113. To add a CIT Designated Minor, please go to the CIT Dean's Office (Scaife Hall 110). Contact the director listed under each minor.

## Biomedical Engineering Minor

### (for non-engineering students)

Todd Przybycien, Director Office: Doherty Hall A-220  
General Requirements (five courses, 51-57 units, plus pre- and co-requisite courses including 03-121, Modern Biology). Students must earn a cumulative QPA of 2.00 in these five courses. Double counting of core courses in student's primary major is not permitted.

- Introduction to BHE (42-101) 12 units
- A secondary Introductory Engineering Course 12 units
- BME Elective or Domain\* 9-12 units
- BME Elective or Domain\*\* 9-12 units
- BME Elective or Domain\*\* 9-12 units

\*Cannot be a course required by your home department).

\*\* Courses marked with an (\*) must be offered by any of the CIT Departments  
(06-xxx, 12-xxx, 18-xxx, 19-xxx, 24-xxx, 27-xxx or 42-xxx)

### BME Domain Courses

03-121	Modern Biology
03-240	Cell Biology
03-310	Introduction to Computational Biology
03-311	Computational Molecular Biology
03-330	Genetics
03-343	Experimental Genetics and Molecular Biology
03-344	Experimental Biochemistry
03-345	Experimental Cell and Developmental Biology
03-350	Developmental Biology
03-438	Physical Biochemistry
03-439	Introduction to Biophysics
03-441	Molecular Biology of Prokaryotes
03-442	Molecular Biology of Eukaryotes
03-510	Computational Biology
03-533	NMR in Biomedical Sciences
03-534	Bio Imaging Fluorescence Spectroscopy
09-245	Physical Chemistry II
15-211	Fundamental Structures of Computer Science I
42-301	Physiology
42-377	Rehabilitation Engineering
42-501	Special Topics: Biomaterials I & II
42-560	Research Project (at CMU or UPMC)
42-604	Biological Transport
42-621/06-621	Biotechnology & Environmental Processes
42-622/06-622	Bio Process Design
42-644	Medical Devices
42-651/12-651	Air Quality Engineering
42-652	Introduction to Biomechanics
42-723/12-723	Biological Processes in Environmental Systems

### BME Electives

06-607	Phys Chem of Colloids and Surfaces
06-609/09-509	Physical Chemistry of Macromole
06-313 06-313	Exp Colloid Science
06-314	Exp Polymer Science
06-426	Experimental Colloid Surface Science
06-466	Experimental Polymer Science
18-3XX*	
19-607	Special Topics in Biotechnology
24-354	General Robotics
24-779	Human Systems and Control

## Engineering Studies Minor

### (for non-engineering students)

Kurt Larsen, Director Office: Scaife Hall 110  
Carnegie Mellon undergraduate students enrolled in colleges other than engineering can complete a Minor in Engineering Studies in addition to their regular majors. Students pursuing this minor are required to complete courses from at least two different engineering departments in order to assure some breadth of exposure to engineering. In addition, the minor provides students the opportunity to pursue an in-depth concentration in a particular field of engineering.

For the Minor in Engineering Studies, students must complete five engineering courses as follows and must earn a cumulative QPA of 2.00 in these five courses.

### Double counting of core courses in student's primary major is not permitted.

1. Two of the following:

06-101	Introduction to Chemical Engineering
12-100	Introduction to Civil and Environmental Engineering
18-100	Introduction to Electrical & Computer Engineering
19-101	Introduction to Engineering & Public Policy
24-101	Introduction to Mechanical Engineering
27-100	Engineering the Materials of the Future
42-101	Introduction to Biomedical Engineering

2. Three courses of at least 9 units each from one or more CIT departments

NOTE: The following courses may NOT be included as part of the Minor in Engineering Studies

12-090	Technology and the Environment
18-200/18-202	Math Foundations of Electrical Engineering
19-319	Law and the Engineer
19-321	Law and Technology
24-160	Engineering Graphics
42-500	Physiology
42-501	Physiology

Although a student generally can complete the minor in Engineering Studies without increasing the number of required units for graduation, early planning in selecting courses is important. Students interested in this minor are encouraged to seek advice in their own home department or college and in the CIT Office of Undergraduate Studies, Scaife Hall 110.

## Technology and Policy Minor

### (for non-engineering students)

Mark Kieler, Director Office: Baker Hall 129

The Technology and Policy Minor is administered by the Department of Engineering and Public Policy (EPP) for students who are majoring in areas other than engineering or computer science. The T&P Minor is designed to give students a basic understanding of the interactions between technology, society and policy and some project experience in problems involving technology and policy.

The T&P Minor requires satisfactory completion of a set of six courses totaling a minimum of 51 units. These courses are:

19-102	EPP Sophomore Seminar (Fall)	3 units
19-451 or 452	EPP Project (Fall or Spring)	12 units
	(see page 127 for a description of EPP Projects)	

73-150 Microeconomics (Fall or Spring) 9 units  
Two EPP Technical Electives totaling 18 units Page 149 shows examples of EPP technical electives. This is only a representative sample and should not be used for course selection. Always refer to the current list of EPP technical electives. EPP distributes this list prior to registration each semester.

Decision Science Course\* 9 units

\*Choose one of the following:

88-223	Decision, Analysis & Decision Support Systems
(Spring) 88-302	Behavioral Decision Making (Fall)
19-426	Environmental Decision Making (Fall)

Students who are interested in the T&P Minor should contact the Department of Engineering and Public Policy early in their course of study.

## Robotics Minor

The following courses are required for the Minor in Robotics:

### Prerequisites:

- 15-111 Intermediate/Advanced Programming (students with no prior programming experience take 15-100 & 15-111)  
 15-123 Effective Programming in C and UNIX

### Minor requirements:

- 16-311 Introduction to Robotics

One of the following courses:

- 15-384 Robotic Manipulation  
 24-355 Kinematics and Dynamics of Mechanisms

One of the following courses:

- 16-299 Introduction to Feedback Control Systems  
 18-370 Fundamentals of Control  
 24-451 Feedback Control Systems

Two of the following electives:

- 15-381 Artificial Intelligence: Representation & Problem Solving  
 15-385 Computer Vision  
 15-462 Computer Graphics  
 15-463 Computational Photography  
 15-681 Artificial Intelligence: Machine Learning  
 16-284 Humanoids  
 16-362 Mobile Robot Programming Laboratory  
 16-721 Advanced Perception  
 16-735 Motion Planning  
 16-778 Mechatronic Design  
 60-422 Advanced ETB: Robotic Art Studio  
 85-213 Information Processing and Artificial Intelligence  
 85-370 Perception

More information on the minor can be found at [http://www.ri.cmu.edu/education/ugrad\\_minor.html](http://www.ri.cmu.edu/education/ugrad_minor.html).

### Double-Counting Restriction

Courses in the Robotics Minor may not also be counted towards another SCS minor.

## Academic Standards Grading Practices

Undergraduate grading regulations are detailed starting on pages 54.

### CIT Dean's Honor List

Each semester, Carnegie Institute of Technology recognizes students who have earned outstanding academic records by naming them on the dean's honor list. The criterion for such recognition is a semester quality point average of at least 3.75 while completing at least 36 factorable units and earning no incomplete grades.

### Transfer into CIT Departments

Undergraduate students admitted to colleges other than CIT who wish to transfer into a CIT department during their first year should consult with the assistant dean of CIT. Students admitted to CIT but excluded from certain departments must also consult with the assistant dean if they wish to transfer into a restricted CIT department. No first-year student will be considered for transfer until after mid-semester grades for the spring semester have been posted. At that time, a decision will be based on availability of space and the student's academic performance.

CIT undergraduate students beyond the first year wishing to transfer into another CIT department may do so if they are not on academic probation and if there is room in the department of their choice. If the demand for any department exceeds the space available, then the department will admit students based on a comparative evaluation of all applicants at the end of each semester, up to the limit of available space.

Undergraduate students not in CIT who wish to transfer into a CIT department beyond the first year will be considered for transfer on a rolling space available/academic performance basis.

Procedure for transfer of students from another university into CIT departments: A student first applies through the Office of

Admission. If the Office of Admission believes the applicant is acceptable, the student's record is sent to the appropriate department for evaluation and a decision on acceptance. The CIT department head has the right to refuse to accept the student if there are space restrictions and/or if the student's chance for success in the CIT department is determined to be questionable based on past academic performance.

### Academic Actions

In the first year, a student's quality point average below 1.75 in either semester invokes an academic action. For all subsequent semesters, a student's semester QPA or the cumulative QPA (excluding the first year) below 2.0 invokes an academic action.

### Probation

The action of probation occurs in the following cases:

One semester QPA of the first year falls below 1.75.

The semester QPA of a student in good standing beyond the first year falls below 2.00.

The term of probation is one semester as a full-time student. First year students are no longer on probation at the end of the semester if their semester QPA is 1.75 or above. Students in the third or subsequent semester of study are no longer on probation at the end of one semester if the semester QPA AND cumulative QPA (excluding the first year) are 2.00 or above.

### Probation Continued

A student who is currently on one semester of probation but whose record indicates that the standards are likely to be met by the end of the next semester may be continued on probation at the discretion of the associate dean.

### Suspension

A student who does not meet minimum standards at the end of one semester of probation will be suspended.

A first year student will be suspended if the QPA from each semester is below 1.75.

A student in the third or subsequent semester of study will be suspended if the semester QPA or the cumulative QPA (excluding the first year) is below 2.00 for two consecutive semesters.

The normal period of suspension is one academic year (two semesters). At the end of that period a student may petition to return to school (on probation) by completing the following steps:

1. Writing a formal petition requesting to return and receiving permission in writing from the assistant dean for undergraduate studies.
2. Completing a Return from Leave of Absence form from Enrollment Services; and
3. Providing transcripts and clearance forms if the student has been in a degree program at another college or university even though academic credit earned will not transfer back to Carnegie Mellon.

Students who are suspended, take a leave of absence or withdraw are required to vacate the campus (including residence halls and Greek houses) within a maximum of two days after the action and to remain off the campus for the duration of the time specified. This action includes debarment from part-time or summer courses at the university for the duration of the period of the action.

### Drop

This is a permanent severance. A student is dropped when it seems clear that the student will never be able to meet minimum standards. A student who has been suspended and fails to meet minimum standards after returning to school is dropped.

If students are dropped, they are required to vacate campus (including dormitories and fraternity houses) within a maximum of two days after the action. This action includes debarment from part-time or summer courses.

The relation indicated above between probation, suspension, and drop is normal, not binding. In unusual circumstances, College Council may suspend or drop a student without prior probation.

## Graduation Requirements

For graduation, students must complete the requirements for their specified degrees with a cumulative quality point average of 2.00 or higher for all courses taken after the freshman year. In addition, a student is expected to achieve a cumulative quality point average of 2.00 in core departmental courses.

Students must be recommended for a degree by the faculty of CIT.

A candidate must meet the residence requirement of having completed at least 180 units at Carnegie Mellon University.

Students must meet all financial obligations to the university before being awarded a degree.

Modification of Graduation Requirements: A student may seek permission to modify graduation requirements by petition to the CIT College Council.

## Other Regulations Affecting Students Status Schedule Changes

(See page 31 for add/drop procedure information and page 55 for grading procedures for dropped courses)

### Course Add Deadline

The last date to ADD courses is stipulated for each semester on the university calendar - about two weeks after the beginning of a term. This applies to all courses with the following exception: the final date to add half-semester mini-courses is the last class day of the first week of the course.

### Course Drop/Withdraw Deadline

CIT undergraduate students may DROP a course on-line on or before the deadline published in the official university calendar. This deadline is two weeks after mid-semester grades are due in The HUB. The deadline to drop a half-semester mini course is the last day of the fourth week of the mini course. When a course is dropped by the deadlines, the course is removed entirely and disappears from a student's academic record. After the official university deadline to drop, undergraduate students may WITHDRAW from a course on-line on or before the last day of classes, excluding final examinations. The deadline to withdraw from a half-semester mini course is the last class day of the mini course. When a student withdraws from a course between the official university deadline to drop a course and the last day of classes, a "W" (Withdrawal) is assigned as a grade, which appears on the student's academic record. This "W" grade does not affect a student's QPA.

CIT undergraduates who are registered as full time students as of the tenth class day are expected to remain full time for the duration of a semester. Full time is defined by being registered for a minimum of 36 factorable units. Students may not drop or withdraw from courses that will reduce their factorable units below 36 unless there are extenuating circumstances for which they obtain approval from the CIT College Council. Undergraduates who are registered as part time (those carrying fewer than 36 factorable units) as of the 10th class day are also subject to the above deadlines to drop or withdraw from a course.

Exceptions to the regulations above will be granted only upon approval of a petition to the College Council.