Bulletin of the
Massachusetts
Institute of Technology
The Undergraduate
Catalogue Issue

THIS IS M.I.T. 1960-1961

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Massachusetts Institute
of Technology Bulletin
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ACADEMIC CALENDAR

1959

September 17	FIRST TERM 1959 BEGINS FOR FRESHMEN
September 21	FIRST TERM BEGINS FOR UPPERCLASSMEN
October 12	COLUMBUS DAY (HOLIDAY)
November 11	VETERANS' DAY (HOLIDAY)
November 26 *through November* 29	THANKSGIVING VACATION
December 19 *through January* 3	CHRISTMAS VACATION

1960

January 20	LAST EXERCISES OF THE FIRST TERM
January 21 *through January* 23	READING PERIOD
January 25 *through January* 29	EXAMINATION PERIOD
February 8	SECOND TERM BEGINS
February 22	WASHINGTON'S BIRTHDAY (HOLIDAY)
March 28 *through April* 3	SPRING VACATION
April 19	PATRIOTS' DAY (HOLIDAY)
May 24	LAST EXERCISES OF THE SECOND TERM
May 25 *through May* 27	READING PERIOD
May 28 *through June* 3	EXAMINATION PERIOD
May 30	MEMORIAL DAY (HOLIDAY)
June 10	COMMENCEMENT DAY
September 15	FIRST TERM 1960 BEGINS FOR FRESHMEN
September 19	FIRST TERM BEGINS FOR UPPERCLASSMEN
October 12	COLUMBUS DAY (HOLIDAY)
November 11	VETERANS' DAY (HOLIDAY)
November 24 *through November* 27	THANKSGIVING VACATION
December 22 *through January* 3	CHRISTMAS VACATION

1961

January 18	LAST EXERCISES OF THE FIRST TERM
January 19 *through January* 21	READING PERIOD
January 23 *through January* 27	EXAMINATION PERIOD
February 6	SECOND TERM BEGINS
February 22	WASHINGTON'S BIRTHDAY (HOLIDAY)
April 3 *through April* 9	SPRING VACATION
April 19	PATRIOTS' DAY (HOLIDAY)
May 23	LAST EXERCISES OF THE SECOND TERM
May 24 *through May* 26	READING PERIOD
May 27 *through June* 2	EXAMINATION PERIOD
May 30	MEMORIAL DAY (HOLIDAY)
June 9	COMMENCEMENT DAY

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1 *This is M.I.T.*

The Massachusetts Institute of Technology is an independent, endowed, coeducational institution which has concentrated its resources in certain broad areas: science, engineering, architecture and planning, industrial management, and the related humanities and social studies.

Through this principle of concentration M.I.T. brings to the areas of its major interests the services of a distinguished faculty, together with physical facilities of unparalleled variety and completeness. Indeed, Dr. James R. Killian, Jr., Chairman of M.I.T.'s Corporation, has described the Institute as a "new kind of university"—a school polarized about science where teaching and creative activities of highest professional stature are pursued in a limited range of fields now deeply relevant to the world's social, economic, and political opportunities.

On the next pages are excerpts from the inaugural address of Dr. Julius A. Stratton, M.I.T.'s eleventh President, restating as he sees them the philosphy and grand plan to which M.I.T. is now devoted.

An alumnus of M.I.T., after recently revisiting the Institute, has written: "The moment you are inside M.I.T., its calm exterior is forgotten. You are in a world of intense activity. Along five miles of corridors flows a constant tide of students, resolutely moving on urgent business. Through hundreds of doors you see shirt-sleeved professors and students working together at desks and benches. The air pulses with life."

"... the measure of our greatness is our capacity to educate for leadership."

In these excerpts from his Inaugural address as its eleventh President, Dr. Julius A. Stratton describes M.I.T.'s essential character and purpose.

This institution was created by William Barton Rogers as an expression of faith in certain new concepts of professional education, and from the very outset our academic policies have been directed by a few central ideas. In essence, Rogers maintained that there is dignity and importance in the mastery of useful knowledge; that the foundations of a professional life may profitably be laid in the undergraduate years, combining with and contributing to a liberal education, to the enrichment of both; and that science and engineering can be the legitimate foundations of a higher education.

M.I.T. has been built upon these convictions. The contributions of our graduates over the years both at home and abroad provide ample proof of their essential worth.

* * *

Throughout the entire history of the Institute, much of the strength of our educational plan has been derived from the rigor and thoroughness of our method. From the day he enters as a freshman, the undergraduate learns to work in depth and to be held accountable for the results. He learns also to work under pressure and to marshal and employ his knowledge under test. From this discipline and mastery of fundamentals comes an intellectual self-reliance that will stand him in good stead.

But the formal instruction of lectures and classroom is properly only part of the educational process. The intellectual discipline of tests and problems must be supplemented and enlivened by other forces that will arouse and stimulate the impulses of originality latent in every student. We seek to stir our students' imaginations, to encourage them to break free from the channels of conventional thought, and to teach them to bring to bear upon their problems the facts and methods acquired in the classroom.

From his earliest history, man has been driven to build and to do, and the fulfillment of this urge finds its highest expression in the work of the engineer. The engineer is concerned with making and with producing, with converting the yields of pure science to useful products and services. His function is to adapt knowledge to beneficial ends, to find ways and means of solving the practical problems of human existence. There is there-

fore in the education of the engineer the most compelling reason to develop by all possible means the creative and constructive powers of each student.

* * *

The contributions that the humanities and social sciences have to make to the education of the architect, the scientist, and the engineer have been clearly established. Over the past decade the Institute has won wide recognition for the support that has been given to these more liberal aspects of our curricula.

The range of our professional activities at M.I.T. has for some time been steadily widening. We are concerned not alone with architecture, science, and engineering for their own sake, but increasingly with fields on which these disciplines have a direct impact in contemporary society. In addition to the obviously related fields of management and economics, we are also active in such areas as psychology, political science, international relations, and other social studies.

* * *

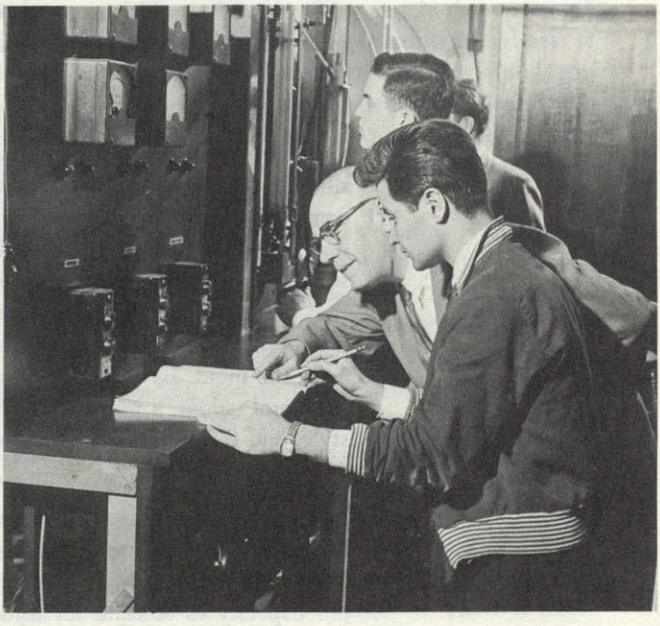
M.I.T. is a professional school and as such we have an obligation to impart to our students an understanding of both the privileges and responsibilities inherent in the professional estate. Above and beyond all technical competence, the truly professional man must be imbued with a sense of responsibility to employer and client, a high code of personal ethics, and a feeling of obligation to contribute to the public good.

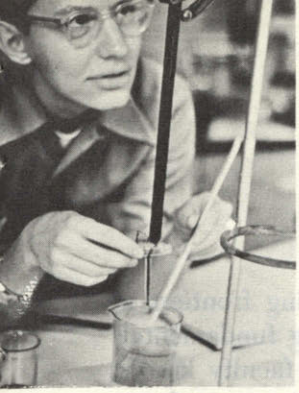
As a great educational institution, we shall fall short of our mission if we fail to inspire in our students a concern for things of the spirit as well as of the mind. By precept and example we must convey to them a respect for moral values, a sense of the duties of citizenship, a feeling for taste and style, and the capacity to recognize and enjoy the first-rate.

* * *

M.I.T. is a product of our age. By its aims, its methods, and its ideals it is keyed to the needs and problems of the contemporary world. Today, more than ever, the measure of our greatness will be determined by our capacity to educate for leadership.

CREATIVE EDUCATION: *". . . a feel for materials, an experimental attitude, theory tested by reality."*





THESE ARE THE CONCEPTS

The typical M.I.T. student enters his freshman year directly from high or preparatory school; he follows a program of four years for the bachelor's degree. (In architecture, and in the case of a few choices within other fields, the undergraduate program requires five years of study.) He finds an environment at once friendly and extraordinarily stimulating, one which will help him develop his interests and powers to the fullest extent.

His educational experience results from these concepts upon which M.I.T.'s program is built:

1. ADVANCEMENT OF KNOWLEDGE

By charter and in spirit, M.I.T. exists for the purpose of advancing knowledge. Teaching and research go hand in hand here, each strengthening the other, in fulfilling this purpose. The Institute's primary duty is to provide young men and women with a sound and well-ordered education.

2. CREATIVE EDUCATION AND RESEARCH

M.I.T. is restless, ever-changing. "Dynamic" and "creative" are time-worn adjectives used here for lack of fresher words to describe the environment created by top-flight teaching and pioneering research. Here are undergraduates learning for the first time the fascinating disciplines of science and engineering; graduate students beginning to discover in detail one field of special interest; and faculty, at once exploring new knowledge and teaching the fundamentals which underlie it. Dr. George R. Harrison, Dean of the School of Science, believes this creative professional atmosphere to be "the quality that most distinguishes undergraduate education at M.I.T."

3. EDUCATION BASED ON FUNDAMENTALS

Today's rapid changes in science and technology emphasize the value of fundamentals. The scientists, engineers, architects, and managers who can grow to meet tomorrow's challenges are those who understand basic concepts so well that they can return to them again and again as the foundations of new structures. Some students find the first years at M.I.T. disappointing and frustrat-

ing because they never seem to reach the exciting frontiers of their fields. But these years of rigorously learning fundamentals are the best insurance against obsolescence this faculty knows, insurance that students can stay with today's fast-moving frontiers, once they reach them.

4. LEARNING BY DOING

"Learning by doing" was an important concept in founding M.I.T., when experimental laboratories were uncommon in higher education. It is still a basic concept at M.I.T.; today "learning by doing" means learning by *thinking about* what one is doing. It is an expression of the interdependence of the theoretical and the practical, of the lecture room and the laboratory. The questions "Why does it work?" and "Why does it happen?" are discussed in the lecture room; the questions "How does it work?" and "How does it happen?" are answered in the laboratory, where students themselves construct the practical application of a theory and watch it work. The Geology Camp, practice schools, Cooperative Courses,[1] and many opportunities for students of M.I.T. to visit industrial plants carry further this idea of learning by doing.

An alumnus has recently written that "the core of M.I.T.'s success is its power to vitalize its students' hidden reserve of energy and imagination. Constant contact with experiment gives them the habit of vigorous attack upon any problem—a habit that soaks into their bones and serves them for the rest of their lives."

5. THE IMPORTANCE OF USEFUL KNOWLEDGE

The man doing research in nuclear physics, the engineer in the field, the executive in industry, and the architect of the city are all holding responsible positions; their work affects the entire structure of society. No one needs much imagination to see these effects. Science has brought visible changes in towns and cities, and engineering has revolutionized the pattern of everyday living. Advances in transportation and communication have created a

[1]M.I.T. makes a clear distinction between the words *Course* and *subject*. At the Institute, *Course* refers to an organized curriculum—sequence of studies—approved by the faculty as leading to a specified degree. *Subjects* are the individual classes.

smaller world, which in turn has influenced national and international politics and culture; the atomic age has influenced the world of ideas as well as the course of world events. Constant examples of the effects of scientific progress on society emphasize for those who teach and study at M.I.T. the importance and worth of their work.

Operating one of the nation's great computers in the Computation Center.

Student-faculty architecture conference.

6. DEVOTION TO THE HIGHEST STANDARDS

A basic characteristic of the Institute is its devotion to the highest standards. There is what Dr. Killian has described as a "traditional and established role of stressing excellence." M.I.T. students expect hard work; no one can achieve the highest standards without it. But this is an environment in which hard work can be challenge—and in which it is combined with non-professional activities of great intensity and variety.

7. EDUCATION FOR CITIZENSHIP

With science and technology assuming a central role in our culture, graduates of such institutions as M.I.T. are certain to have great influence. This new role requires of scientist and engineer a new form of leadership, one which is based on a thorough knowledge of the entire cultural environment of which his work is a part.

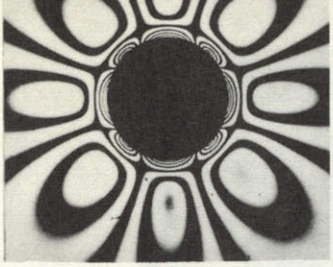
To prepare students for these great responsibilities is a primary objective at M.I.T. Every student takes an integrated program in the School of Humanities and Social Studies to introduce him to the wider world of ideas, attitudes, and beliefs, historical and current, that determine the structure of present-day society. Here, for instance, an engineer studies history, literature, and philosophy not as ornaments but rather because today he cannot be a first-rate engineer without them.

Dean John T. Rule

This aim cannot be achieved solely by formal study. Student government, athletics, and campus living offer every student the opportunity to practice democracy on a campus-wide scale and provide all the members of this community with a chance to exercise responsibility and leadership.

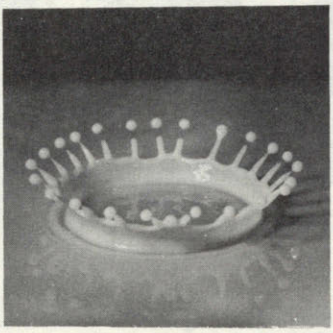
Professor John T. Rule, Dean of Students at M.I.T., believes "the best source of general education for all maturing students is other students who have developed successfully. We are certain that the acceptance by students of the responsibility for managing their own affairs most effectively develops their judgments and understandings of the world of action within which they will always live."

Studying at M.I.T. is thus a broad gauge undertaking. Undergraduates find a thorough basic knowledge of their professions; a concept of the effects of their work in its social context; and preparation for the non-professional demands of life to fulfill *more than adequately* the new requirements of good citizenship.

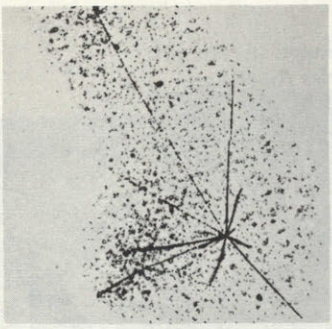


Stress analysis by photoelasticity.

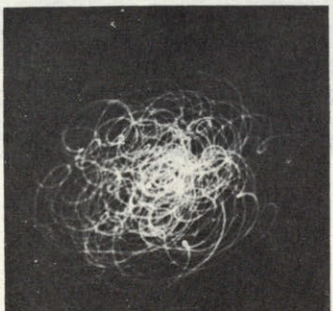
Crystals of a new nickel-chrome alloy.



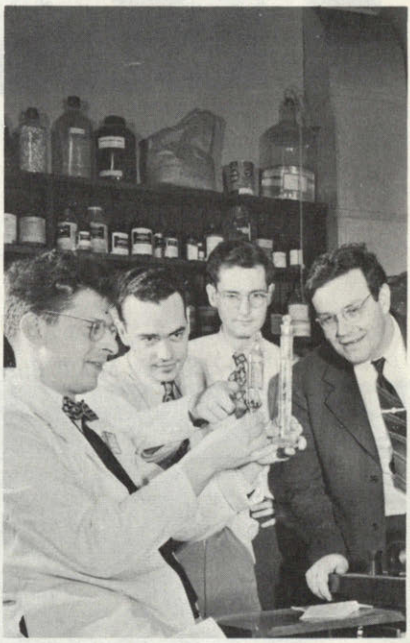
High-speed camera: sculptor of liquids.



A cosmic ray in a nuclear emulsion.



Sound pictured on an oscilloscope.



Music: a rehearsal of the M.I.T. Concert Band

"AS LONG AS YOU LIVE, KEEP LEARNING TO LIVE"

Sports: M.I.T. dinghies on the Charles River Basin

Philosophy: Visiting Professor Philipp Frank with a Humanities seminar.

Fellowship: student and teacher share experiences.

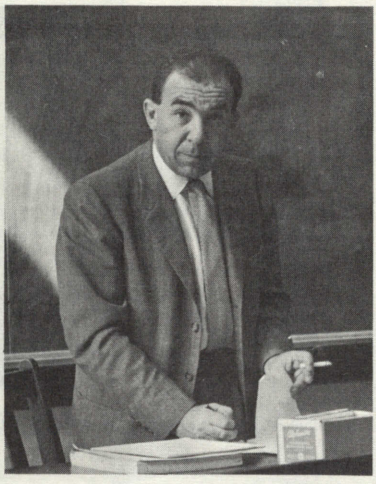
Parties: the annual Junior Prom.

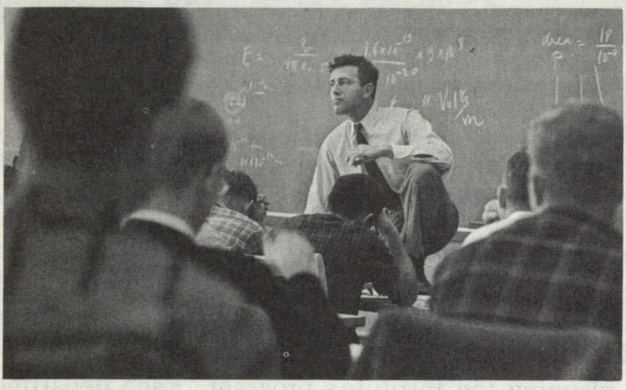
Members of the Aeronautical Engineering Department's Visiting Committee watching a wind tunnel demonstration.

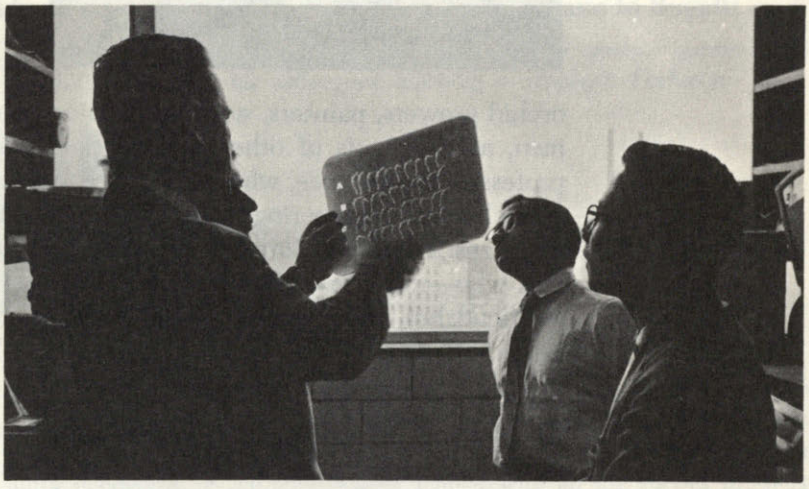
THESE ARE THE PEOPLE

In a legal sense, the Institute (which is not a state university) is a body of trustees known as the Corporation, chartered by the Commonwealth of Massachusetts in 1861. These men, distinguished leaders of science, industry, and education, are active in guiding and planning the Institute's program. Each department has as its counselors members of the Corporation's Visiting Committees, men who are leaders in their respective professions. Members of the M.I.T. faculty, through their own activities and through their committees, share in this responsibility of charting M.I.T.'s course. Students, through their elected student government, administer their own affairs and take their share of responsibility for operating the total enterprise. Alumni are represented in the membership of the Corporation and of the Visiting Committees; through the Alumni Association they fulfill other obligations in guiding the Institute. Through the Educational Council, many alumni are active in the important work of counseling high school students. The Alumni Fund is among the nation's largest.

M.I.T.'s academic departments are grouped for administrative purposes into the five schools—each administered by a dean—which are shown in the chart in the second section of this book. The Dean of the Graduate School supervises graduate study, and the Dean of Students is directly concerned with student life and welfare.







THE FACULTY

The teaching staff of the Institute totals about 1,800, of whom about 600 Professors, Associate Professors, and Assistant Professors are members of the faculty. Since teaching is done not only by the faculty but also by Instructors, Technical Instructors, Teaching Assistants, Lecturers, and others, there is in general more than one teacher to every four students. This proportion, unusual in university education, assures a personal relationship between teachers and students, an essential part of M.I.T.'s philosophy of education.

Teachers at M.I.T. are a varied and interesting group. Many are scholars of distinguished achievement. Some are scientists and engineers internationally known for applications of science and engineering knowledge in enterprises of great magnitude. Some are theorists who are working daily on the most remote frontiers of new knowledge. All bring into the classroom and lecture hall a wide range of firsthand professional experience which helps render their teaching immediate and compelling.

A special committee of M.I.T. faculty members has recently reported that "effective teaching in all its aspects can flourish only when fed by continuous, active contact with research and with the realities of our industrial, economic, and social life. It is safe to assert that the Institute owes its educational position to a large extent to the possibility of such variegated activities."

A versatile group as well—with broad interests outside their professional lives—the M.I.T. instructing staff includes

orchid growers, painters, writers, sculptors, boat builders, woodsmen, and all sorts of other hobbyists. There is a mathematics professor, for instance, who has pitched professional baseball and a mechanical engineering professor whose paintings have carried off prizes. There are scores of people who are interesting as people and who—more than that—are interested in people, responsive to friendship, and therefore ready to go more than half way in helping their students. M.I.T. is a friendly place.

THE STUDENTS

In selecting its students, the Institute seeks quality rather than numbers. Only a limited number of students can receive education of high calibre with a given number of teachers, laboratories, and libraries. Such a limitation on the number of students, coupled with the large number of applications for admission each year, makes it certain that those who attend M.I.T. will be young men and women outstanding as students and also as people.

If there were an "average" freshman, he would be an 18-year-old graduate of a public or independent secondary school. He would not be very different from any other top-ranking, wide-awake college student. No bookworm or genius, he would have a good basic intelligence, perhaps a more-than-average interest in mathematics, and a sincere and conscientious attitude toward all his work; he would enjoy athletics and campus activities.

In all, there are about 3,500 undergraduate and 2,500 graduate students at M.I.T.

Students come here from every state and virtually every country of the world; indeed, the Institute's proportion of foreign students is the largest in any college in the nation.

". . . a wide diversity of interests from Bach to Boltzmann to Bugatti . . ."

The editor of the Freshman Week-end Issue of the student government's newsletter describes his colleagues, advising a neophyte Techman.

Who am I? Never mind my name—that's unimportant. I'm one of those "faces in the crowd" you see pass. I may be that fellow with the slide rule doing a dangling dance by his side, or the bleary-eyed chemist with the sulfur deodorant, or the management scholar with all the Brooks Brothers labels sewed on the outside. No matter what form I take, it is worth your while to get to know me. I am a fellow M.I.T. student.

You will find that I am a pretty interesting chap once you take the opportunity to introduce yourself. Like yourself, I am of superior intelligence, have a wide diversity of interests from Bach to Boltzmann to Bugatti, and enjoy a good time.

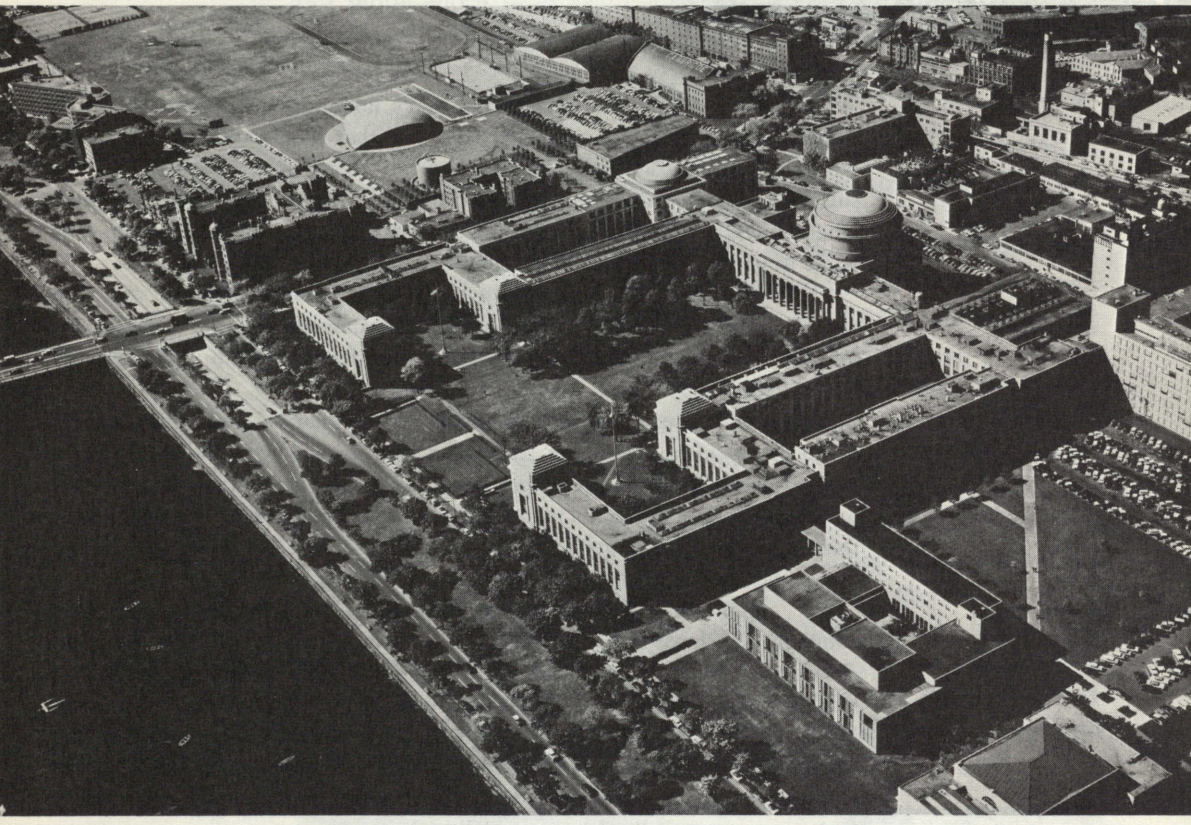
Sure, you will find that I have my peculiarities, but who doesn't? Some of my ideas may seem strange to you, especially if my social background was a little different from yours, or if the shade of my skin doesn't match yours exactly. But I will never be able to understand your way of thinking if we do not get to meet each other—somebody smart somewhere once called that the most productive part of education.

You will notice, however, that we always have one thing in common. We have come to M.I.T. in the honest pursuit of knowledge—to develop a way of thought that will characterize us as analytical, productive thinkers, people who can attack problems in an unprejudiced frame of mind and establish solutions by applying logical principles. We are in that search together, and we will develop ourselves together. However, if we are to learn to be unprejudiced in our scientific thought, we must insure that we are unprejudiced in our social thinking.

The M.I.T. campus is the most cosmopolitan in the United States. It offers unequalled opportunities to learn about people from people, in a direct and comprehensive way.

It offers everyone an opportunity to learn by exchanging ideas with those of divergent as well as similar backgrounds and attitudes.

It offers such an understanding of others as could be acquired at few places in the world. Yet it demands of us that we recognize the right of each man to live the way he believes that he should.



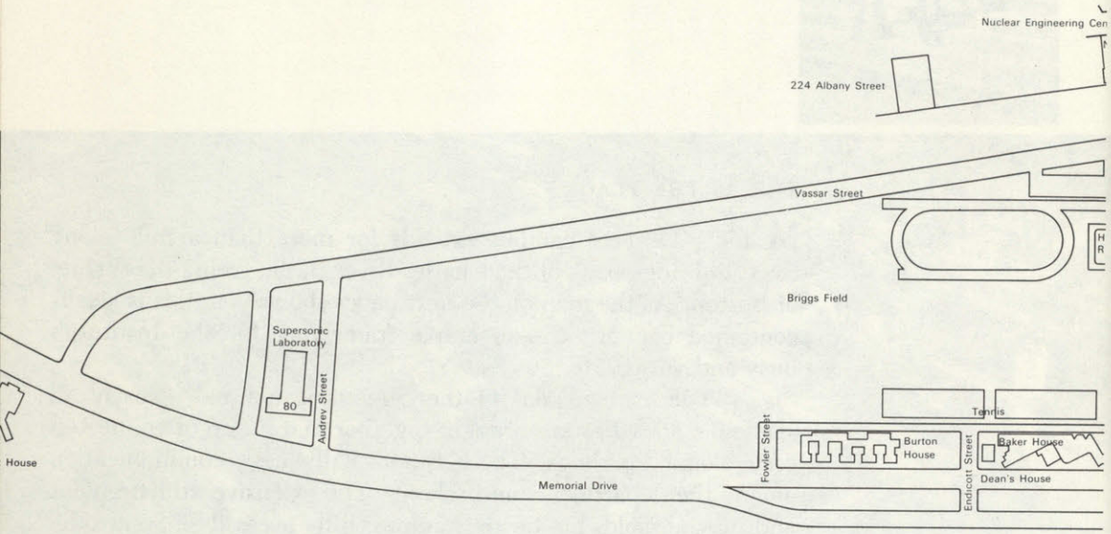
THIS IS THE PLACE

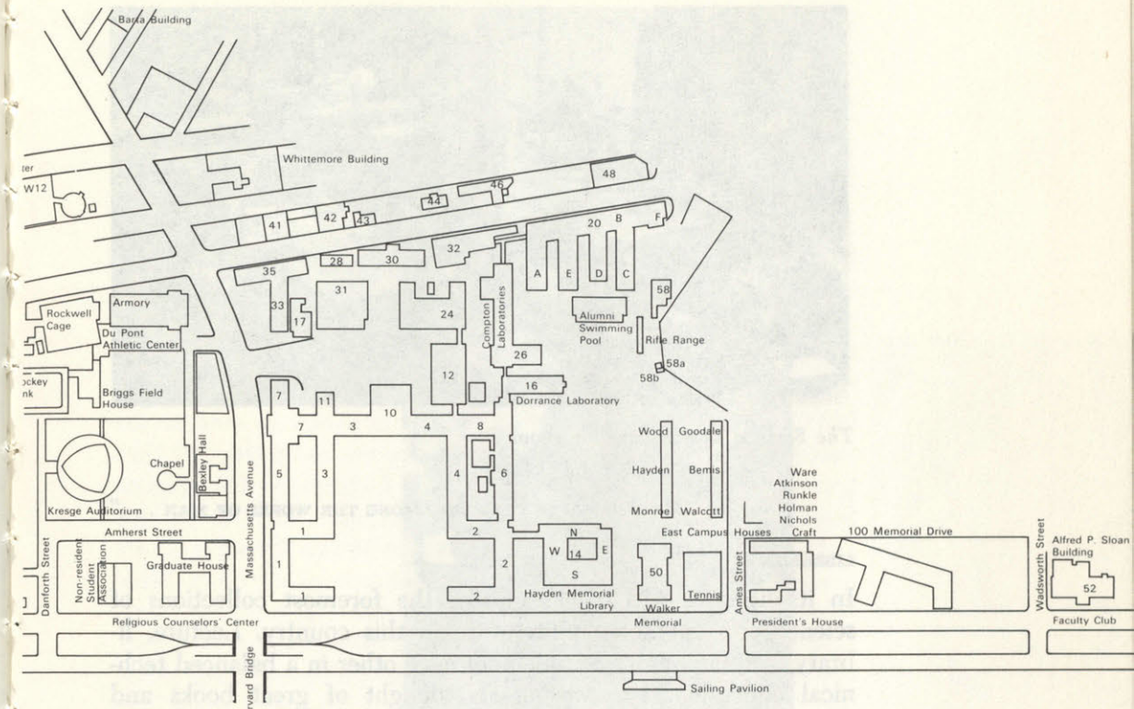
M.I.T.'s 115-acre campus extends for more than a mile along the Cambridge bank of the Charles River Basin, facing the skyline of Boston. As the map on the next pages shows you, this is a self-contained community—an ample framework for the Institute's busy and varied life.[1]

The arrangement of the campus is unusual. Nearly all academic activities are brought together in a group of connected educational buildings. There is unusually easy communication among the departments and schools. The extensive athletic plant and playing fields are on the campus, fully accessible. So are the recreational buildings, dormitories, and dining halls.

This convenient arrangement of the campus is no accident. It is an expression of the unity that pervades the Institute—unity among the sciences and humanities, among faculty, students, and administration, among the intellectual, social, and recreational aspects of living. M.I.T. was built to contain, in harmonious grouping, a single intellectual family.

[1] Some of M.I.T.'s diversified technical activities spread beyond Cambridge. The School of Chemical Engineering Practice operates two field stations—in Bound Brook, New Jersey (at the American Cyanamid Company); and Linden, New Jersey (at the Bayway Refinery). There is an Engineering Practice School at Oak Ridge, Tennessee, and the Department of Geology and Geophysics shares in the Nova Scotia Centre for Geological Sciences near Antigonish, Nova Scotia. Projects in meteorology and other fields are carried on at Round Hill near South Dartmouth, Massachusetts. The Institute operates the Lincoln Laboratory in Lexington, Massachusetts, and aircraft used in meterology, instrumentation, and other studies are based in an M.I.T. hangar at Bedford Airport, near Lexington.





Directory

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14S-200	Humanities
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Bldg. NW-12	Nuclear Reactor
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	Radio Station WTBS (Ware House basement, East Campus)
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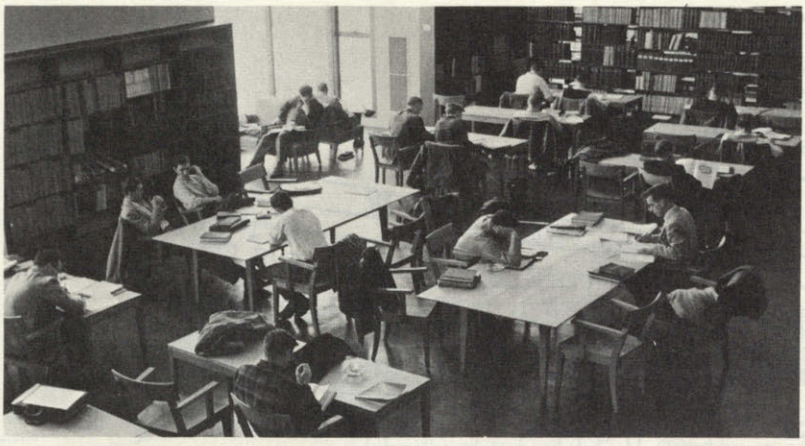
50-basement	The Tech



The Science Library reading room

"... A PLEASURABLE VENTURE AMONG THE WORKS OF MAN ..."

LIBRARIES

In its libraries M.I.T. has one of the foremost collections of science and engineering literature in this country. Lecture, library, and laboratory complement each other in a balanced technical education. Discovering the delight of great books and learning one's way around among them, as well as learning to use the research facilities of a truly great library, are important parts of an M.I.T. education.

The Charles Hayden Memorial Library

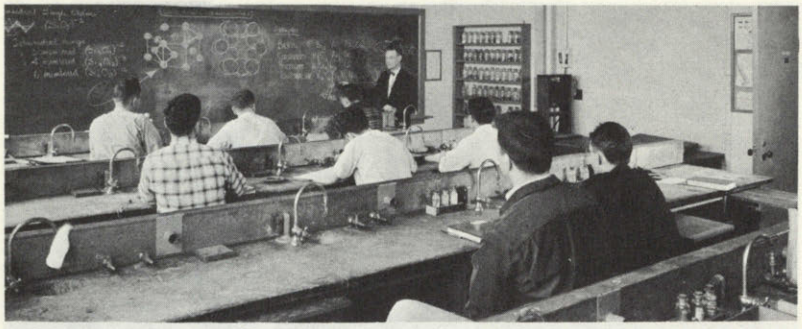
The Music Library

In the Central Library reading room

The Map Room

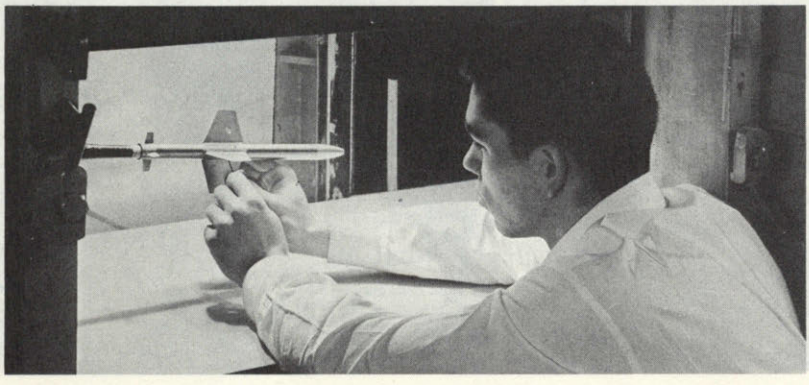
The Engineering Library

The Hayden Library Court

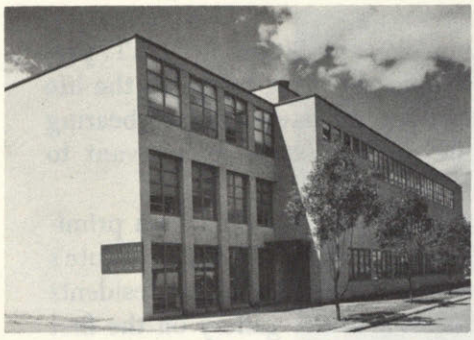


LABORATORIES

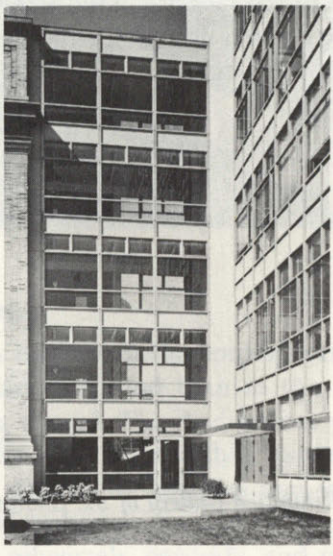
Most of the laboratories which have brought national fame to M.I.T. are devoted to teaching as well as research—and so are familiar to many M.I.T. students. There are more than 70 such special laboratories—among them the Laboratory for Nuclear Science, the Research Laboratory of Electronics, the Gas Turbine Laboratory, the Acoustics Laboratory, the Metals Processing Laboratory, the Samuel Cate Prescott Laboratories of Food Technology, the Spectroscopy Laboratory, the Guggenheim Aeronautical Laboratory, the Wright Brothers Memorial Wind Tunnel, the Supersonic Wind Tunnel, the Eastman Laboratories for chemistry and physics, the Sloan Automotive and Aircraft Engine Laboratory, the Nuclear Engineering Laboratory and nuclear reactor, the Computation Center, and the Laboratories of Steam and Compressed Air, Refrigeration, Testing Materials, Hydrodynamics, Ceramics, Servomechanisms, High Voltage, Physical Chemistry, Applied Physics, Insulation Research, Corrosion, and Geology and Mineralogy.



THESE VARIED EXTERIORS SPEAK FOR THE DIVERSE ACTIVITIES OF M.I.T. LABORATORIES . . .



. . . for aircraft and automotive engines



. . . for biology and food technology

. . . for high-energy nuclear particles

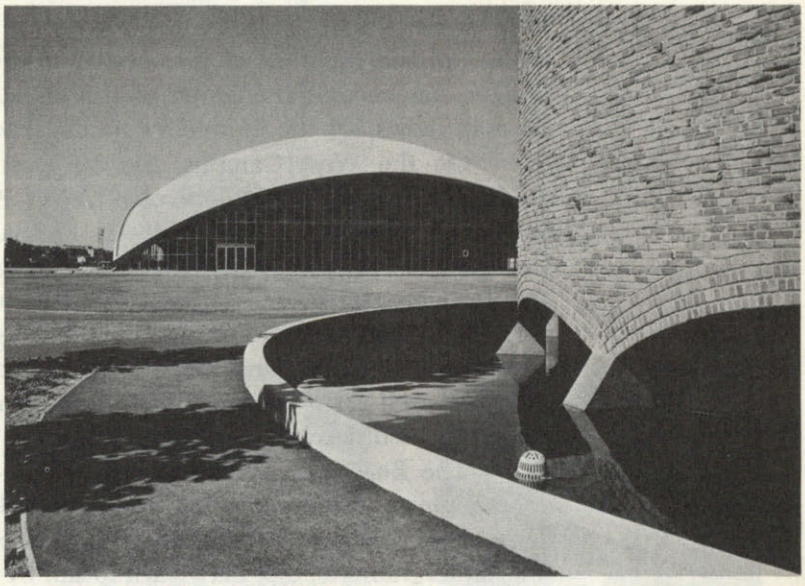
. . . for aeronautics and astronautics

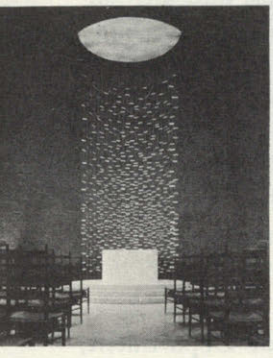
MUSEUMS

The museums, permanent exhibits, and exhibitions at M.I.T. present a wide variety of ideas, both old and new, to enrich the life of the entire Institute community. Many have a direct bearing on the studies in humanities and so are especially relevant to undergraduate purposes.

Everything from handcraft to machine craft, from primitive through contemporary art, may turn up in the Institute's monthly exhibitions, which draw many Greater Boston residents to M.I.T. These exhibitions are shown in the gallery on the first floor of the Charles Hayden Memorial Library—a spacious, well-lighted room designed with a simplicity that enhances the appeal of its exhibitions.

The Exhibition Gallery of the Charles Hayden Memorial Library.





KRESGE AUDITORIUM

The Institute's interest in the contemporary point of view is nowhere better demonstrated than in the Kresge Auditorium and its neighboring chapel. The Auditorium provides equipment and environment for the finest public performances of music and drama . . . as well as for lectures and many less formal events. A typical week's schedule for the Kresge Auditorium—including play readings, rehearsals, concerts, and movies—would go far to suggest the varied interests of this academic community.

M.I.T. CHAPEL

The M.I.T. Chapel, widely recognized for its unusual and effective design, is the center of many religious activities. It is open to—and used by—all religious groups for daily, weekly, or monthly services.

Dr. Killian has recently written of M.I.T.'s responsibility to maintain an atmosphere of religious freedom and, within this environment of freedom, to provide "adequate opportunity for its students to deepen their own understanding of their spiritual heritage and freely to pursue their own religious interests and to worship God in their own way." M.I.T.'s new chapel provides a focal point for these widening activities.

RECREATIONAL FACILITIES

Walker Memorial, built in memory of President Francis Amasa Walker, has become the center of student social life. Nearby, as the map shows, are the Alumni Swimming Pool and squash courts.

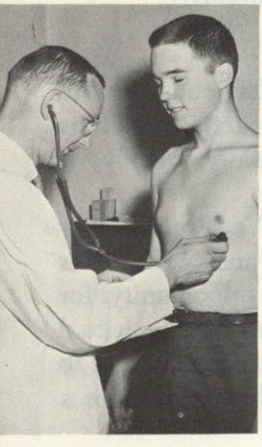
On the West Campus, the du Pont Athletic Center is the focus of a complete athletic plant. West of it are playing fields for soccer, lacrosse, baseball, softball, football, track, and tennis. Here, too, are the John Rockwell Athletic Cage, which has a large area for wintertime recreational and varsity athletics—including a portable basketball floor and stands; the Briggs Field House, with lockers and showers; and an outdoor artificial-ice skating rink, which is used from November through March. Dressing rooms and other facilities for women are located in the du Pont Center.

The Boathouse on the Charles River is supplied with indoor rowing machines as well as eight-oared shells, and any undergraduate may learn this sport under competent coaching. Any undergraduate, too, may learn to sail by joining the Nautical Association at the Sailing Pavilion on the Charles River in front of Walker Memorial.

A Hobby Shop provides students with tools for woodworking, metal working, gem polishing, bookbinding, radio, photography, electroplating, printing, and telescope making.

MEDICAL FACILITIES

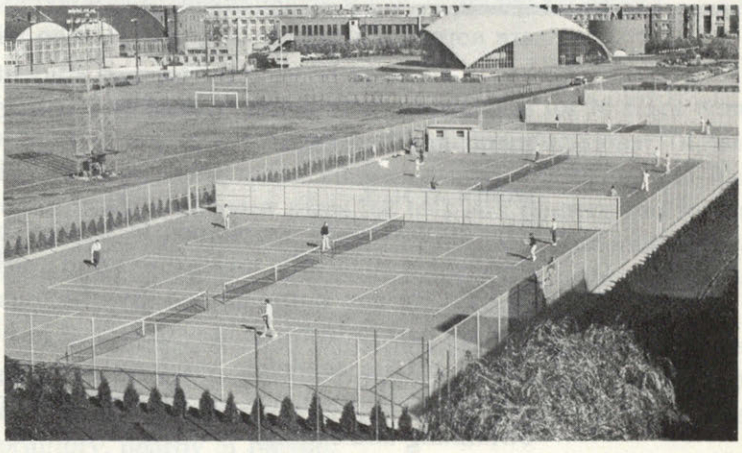
The Institute maintains a well-equipped Medical Department, centrally located in the Homberg Memorial Infirmary, a wing of M.I.T.'s main buildings. On the first two floors are doctors' offices and special facilities for minor surgery, ophthalmology, otolaryngology, dentisty, x-ray, and laboratory diagnosis. An infirmary of 21 beds and an operating room are located on the upper floors. Facilities of the Boston and Cambridge hospitals are used in cases involving major operations or complicated medical procedures, after which students may return to the Infirmary for convalescence.



The clinic is staffed by about thirty doctors, four of whom are on a full-time basis. Charges for medical services are described fully in Section 3 of this book.

In addition to treatment services, the Department cooperates with the Athletic Association in providing medical supervision for contact sports.

M.I.T.'s recreational assets include swimming pool, skating rink, sailing pavilion, and playing fields.



RESIDENTIAL PLAN

M. I. T. is essentially a residential college.

On the basis of its living arrangements, the student body divides into three major groups. The largest, consisting of about 2,000 men, is housed on the campus in the Institute houses: Baker House for 350 students, with dining service; Burton House for 339 and Conner Hall for 230, with dining service (beginning in the fall of 1960); the Graduate House for 452 graduate students, with dining service; and the East Campus Residence Houses for 618, with dining service adjacent in Walker Memorial. The Women's Dormitory has comfortable rooms for 17 first-year co-eds, and 33 upperclass and graduate women live in Bexley Hall. Members of the faculty live with their families as Faculty Residents in these Institute houses.

Second, about 800 undergraduates live in the 28 fraternities, all of which serve meals for their members. Freshmen who elect, upon invitation, to join fraternities commonly do so early in their first year; they usually take up residence immediately in the chapter houses.

The third group consists of those students who live away from the campus—either at home or in lodgings or apartments in the Cambridge and Boston areas.

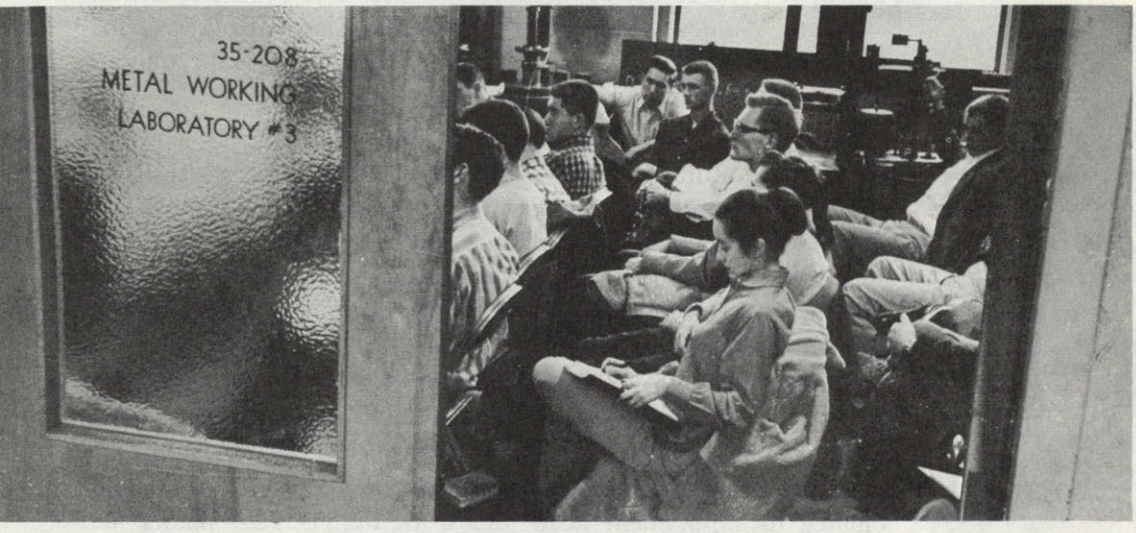
In order that freshmen may enjoy to the fullest the associations and benefits of campus living, they are expected to live in the undergraduate houses (up to the limit of capacity) unless they live at home or in fraternities. Upperclassmen may make whatever living arrangements they choose; rooms on the campus are normally available to nearly all who wish them.

Campus housing for married students is not available, but the Dean of Residence maintains a listing of off-campus apartments and houses.

WOMEN AT M.I.T.

The opportunities for women in science, engineering, and management are clearly increasing. And, although the women at M.I.T. are far outnumbered by the men, they have an important part in Institute life. Co-eds at M.I.T. participate in every aspect of the academic program and in almost every student activity, and they use all the facilities for athletics, including swimming and sailing.

Women at M.I.T. share with men all of the Institute's academic life.



In addition to the dormitory facilities for M.I.T.'s women students, there is a lounge in the main educational buildings where a large living room, kitchen, study, rest room, and locker room provide a pleasant place for teas and dinners and for business meetings of the Association of Women Students. Between classes women students often stop here for a snack, for an hour of study, or for conversation and relaxation.

Upperclass women are designated to help introduce freshmen to the Institute during Freshman Weekend. Women freshmen who do not live at home are required to live in the Women's Dormitory, nearby in Boston.

THE ENVIRONMENT

Boston and its suburbs contribute richly to the facilities and experiences which await M.I.T. students.

There are still many reminders of colonial days: Faneuil Hall, the "Cradle of Liberty;" the narrow, winding streets of a more leisurely age; the Old North Church where Paul Revere's warning lanterns were hung; his home just around the corner; and Boston Common, first set aside in 1634 as a cow pasture and training field.

Nearby are many other places whose names have been in history books for generations . . . Concord, Lexington, and Salem . . . The House of the Seven Gables, Plymouth Rock, Wayside Inn, Walden, John Alden's home, and Sleepy Hollow Cemetery. In the Boston area is a concentration of historical reminders unequalled in this country.

But Boston is not living in the past. Today its has as wide a spread of cultural interest as can be found anywhere else in the United States, outside of New York. Many important musicians, chamber groups, and symphony orchestras give yearly concerts here; there is an active and varied theatrical season; and local organizations—the Museum of Fine Arts, the great Boston Symphony Orchestra, and many others—have real breadth and strength. Here, too, are educational institutions with a diversity perhaps unique in the United States. Going to college in Boston offers an unparalleled adventure outside the classroom.

Nearness to many large industries, too, gives students a chance to supplement academic work by visits to plants and discussions with business leaders. New England is one of America's famous vacationlands, and students here explore the attractions of mountains, beach, and rock-bound shore.

This remarkable aerial photograph shows M.I.T. (at the bottom), Boston, the islands of the harbor, the picturesque South Shore, and–in the far distance–the hook of Cape Cod.

THESE ARE THE OUTCOMES

Few of the activities of mankind are so constantly changing as the fields of the scientist, the engineer, the architect, the economist, and the executive. Few are so secure from the monotony of repetitive routine, and few make so many stimulating new demands. Here is interesting and useful work for many temperaments and minds.

PLACEMENT

Our national and industrial progress cannot continue unless we continue to know more and more about science and its applications to human affairs. There has never been a time when more was expected of graduates in these fields and when such a wide range of important work awaited them. Thus a student majoring in fields represented at M.I.T.—science, engineering, architecture, humanities, economics, political science, and management—today has opportunities which were never before so great. Industry, education, and government call on M.I.T. for graduates to fill many responsible posts, and their representatives come here to interview seniors. An M.I.T. graduate normally may choose among several positions and thus find the job for which he is best suited. Nearly one-third of M.I.T's undergraduates go on to school, at the Institute or elsewhere, for advanced work.

M.I.T.'s Student Placement Bureau helps students plan for placement and brings them together with prospective employers and their representatives. Students who wish summer work will also find similar help here.

SELECTIVE SERVICE

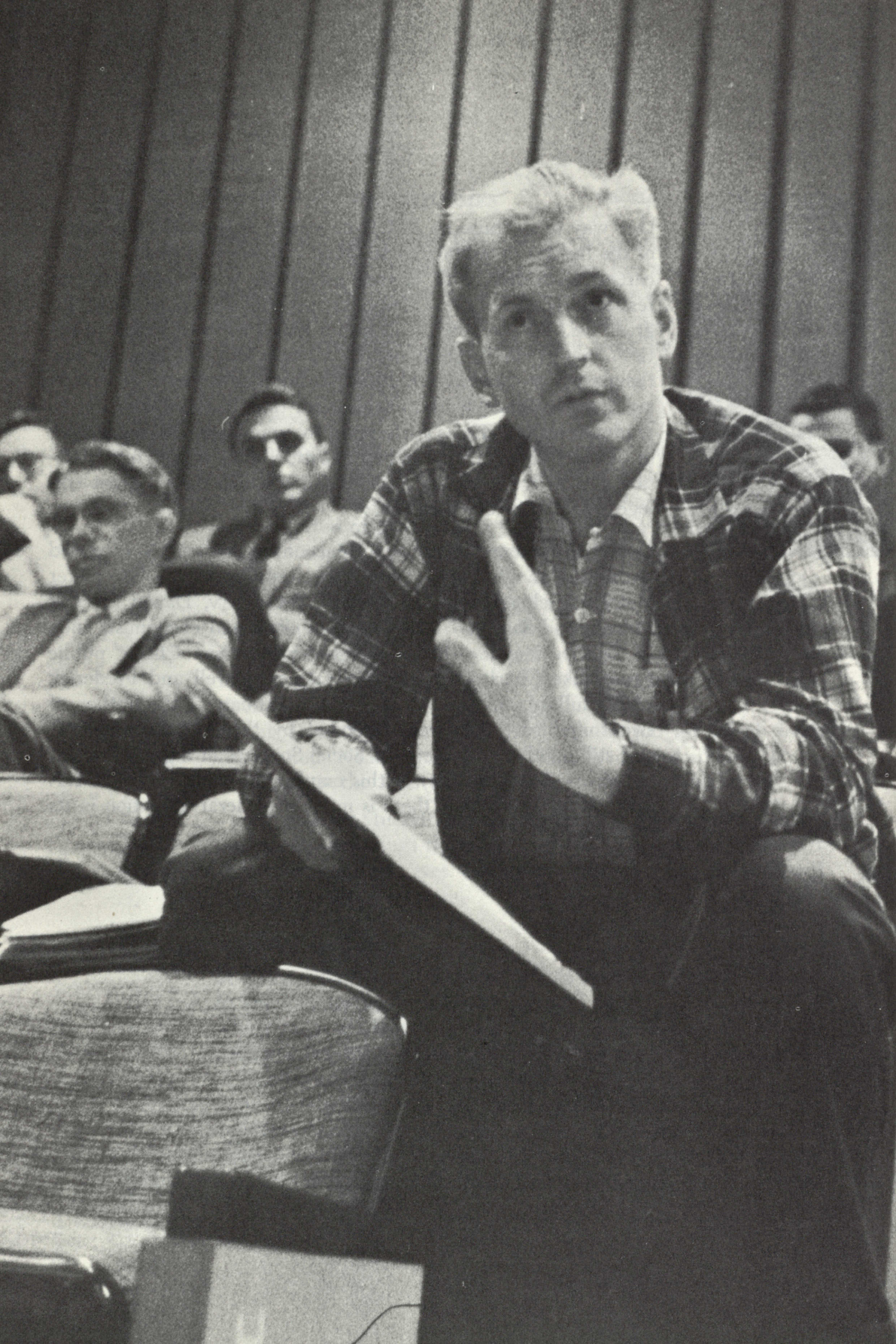
M.I.T. students who may be subject to selective service will wish to know of the Institute's Military and Selective Service Office, which helps students in their dealings with their draft boards. Selective Service College Qualification Tests are given each year at M.I.T., and freshmen are advised to take this test as soon as they are eligible. Students should report to the Military and Selective Service Office upon receiving a classification questionnaire from their local boards, in order to complete Forms 109. Class 2-S deferments are advised, now that men 26 and over are not being inducted.

Alumni reunions on Kresge Plaza

ALUMNI

One way to appraise an M.I.T. education is to study the record of the Institute's 50,000 alumni. Most of them find their way into careers associated with science and engineering, and the professional records of these alumni are an important part of M.I.T.'s greatness. Two trends in this group have attracted recent attention: many M.I.T. graduates in science and engineering find themselves in executive positions within a few years; and many are doing technical work in fields other than those of their undergraduate majors. These facts serve to emphasize the importance of M.I.T.'s concept of a basic education without overspecialization and with the richness and breadth which only a great college community can provide.

Newcomers on the M.I.T. scene are invariably surprised at the wide range of activities which alumni represent. The roster includes such artists as Charles H. Woodbury, Daniel Chester French, and Samuel Chamberlain; bankers and economists such as Charles Hayden, Roger Babson, and Stuart Chase; public figures like Charles Edison; and Arthur Farwell and Frederick Field Bullard, composers. An M.I.T. graduate is the author of two song-bird guides recommended by the Audubon Society, and still another is Director of Social Sciences at a great Eastern university. Such diversity as this emphasizes that, though M.I.T. is a professional school, there is much of general education in its program.



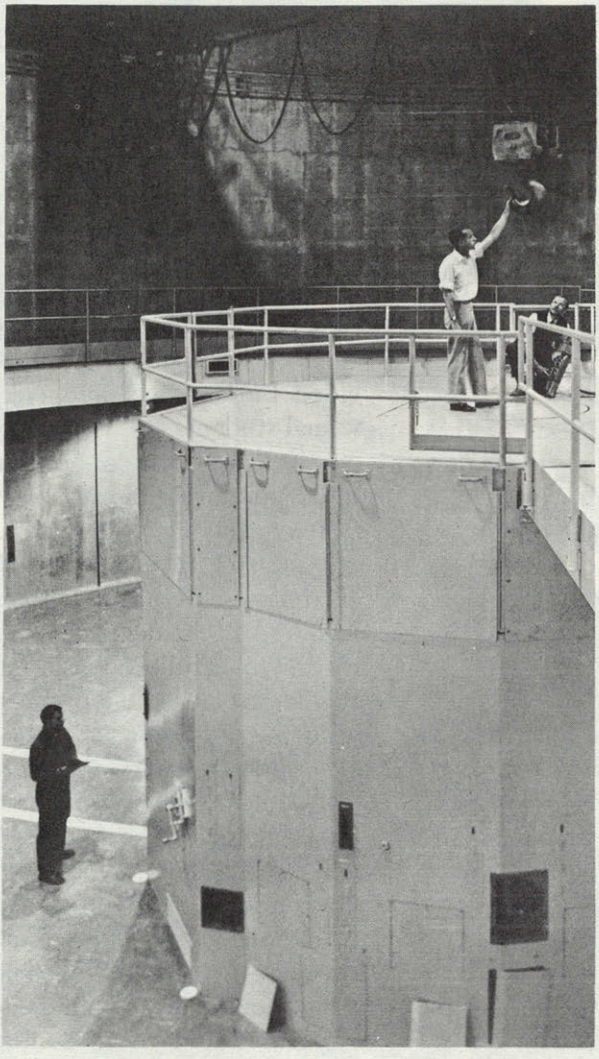
2 *Education at M. I. T.*

There are 21 academic departments at M.I.T., each within one of the five schools. Of these, 17 departments give one or more undergraduate degrees—usually the Bachelor of Science (S.B.) degree—which require four years (five years for Architecture) of work at M.I.T. These undergraduate degrees are given on the basis of "Courses," or major fields of study. Within these Courses some subjects are required, but much flexibility is provided by "options" and electives; the special interests of individual students are thus easily fulfilled.

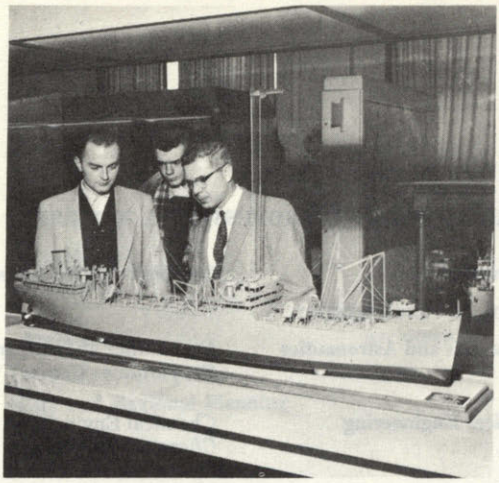
Some of these "options" are so-called *Co-operative Courses*, in which, during the last two years, a student's time is divided between academic work at M.I.T. and practical experience at leading industrial plants. These Courses usually require a longer overall time—or permit fewer vacations—than the regular programs leading to S.B. degrees. But they represent "learning-by-doing" carried to its fullest development, and many students value highly this kind of on-the-job experience in close relationship to their academic studies.

Some Courses require work in one or more Summer Sessions, and—even when it is not required—some students choose to study during the summer in order to increase their experience and background. But this is not necessary and in most cases is not recommended.

M.I.T. offers graduate degrees—but no undergraduate degrees—in Building Engineering and Construction, Ceramics, City and Regional Planning, Meteorology, Mineral Engineering, Nuclear Engineering, Sanitary Engineering, and Textile Tech-



The 1000 kw. M.I.T. nuclear reactor.



Naval architecture, industrial management, and nuclear engineering—many disciplines meet in the M.I.T. community.

nology. However, students may follow undergraduate programs which give them excellent preparation for graduate study in any one of these fields. More information may be found in the General Catalogue, which each student receives soon after his arrival in Cambridge.

All this may seem at first reading to be a complicated and difficult arrangement. But the chart on the following pages lists *all* the departments and *all* the undergraduate Courses; it should help to guide you through the more detailed descriptions of the fields at M.I.T. which appear in the section on "Educational Opportunities" at the back of this book. Most departments give advanced degrees as well as the bachelor's degrees shown on the chart.

(*text continues on page 42*)

DEPARTMENTS AND PROFESSIONAL COURSES

Department	*Undergraduate Courses*	*Degree*
SCHOOL OF ENGINEERING		
Aeronautics and Astronautics	Aeronautics and Astronautics	S.B.
	Cooperative Course°	S.B.
Chemical Engineering	Chemical Engineering	S.B.
	Chemical Engineering Practice°	S.B.
Civil and Sanitary Engineering	Civil Engineering	S.B.
Electrical Engineering	Electrical Engineering	S.B.
	Cooperative Course°	S.B., S.M.°°
	Electrical Science and Engineering	S.B., S.M.°°
Mechanical Engineering	Mechanical Engineering	S.B.
	Cooperative Course°	S.B.
Metallurgy	Metallurgy	S.B.
Naval Architecture and Marine Engineering	Naval Architecture and Marine Engineering	S.B.
	Shipping and Shipbuilding Management	S.B., S.M.°°
Nuclear Engineering		
SCHOOL OF SCIENCE		
Biology	Quantitative Biology	S.B.
Chemistry	Chemistry	S.B.
Food Technology	Food Technology	S.B.
	Biochemical Engineering	S.B.
Geology and Geophysics	Geology and Geophysics	S.B.
	Geology and Geophysics	S.B., S.M.°°
Mathematics	Mathematics	S.B.
Meteorology		
Physics	Physics	S.B.

°Including several months of work and study with leading industries.

°°Requires five years, at the end of which both bachelor's and master's degrees are awarded.

Department	*Courses*	*Degree*
SCHOOL OF ARCHITECTURE AND PLANNING		
Architecture	Architecture	B.Arch.***
City and Regional Planning		
SCHOOL OF HUMANITIES AND SOCIAL STUDIES		
Economics and Social Science	Economics, Politics, and Engineering	S.B.
	Economics, Politics, and Science	S.B.
Humanities	Humanities and Engineering	S.B.
	Humanities and Science	S.B.
Modern Languages		
SCHOOL OF INDUSTRIAL MANAGEMENT		
Industrial Management	Industrial Management	S.B.
Air Science		
Military Science		
Naval Science		

***Requires five years of study.

(*text continued from page 39*)

A brief account of the work of each undergraduate Course and the opportunities to which it leads appears in "Educational Opportunities". Here, too, are shown typical curricula for each of the eight or more semesters normally required for the bachelor's degree; these give the best "bird's-eye-view" of what each of M.I.T.'s undergraduate Courses really covers.

The section on "The First-Year Subjects" gives details of the first year of study at M.I.T.—including descriptions of the subjects from which first-year students normally make up their programs. Descriptions of the advanced subjects are in the General Catalogue.

Though there is much variety in M.I.T. curricula, there is a basic interrelationship between most fields of study here. This common meeting ground deeply influences the life of every undergraduate. In fraternity house and dormitory, at noon-time luncheon or evening bull session . . . everywhere, the naval architect and the biologist swap ideas, the thinking of the prospective metallurgist is stimulated by that of the future architect.

A technologist must, of course, be prepared to produce practical results: the bridges designed by a civil engineer must not fall down, and an oil refinery must do its work safely and efficiently. In this sense engineers must be conservative. But the scientist, on the other hand, must first of all be radical in his concepts; he must enter new fields of thought seeking new truths. "It is good for scientists, once their imaginations have been stretched," says Dean of Science George R. Harrison, "to be made more practical by working with engineers and more responsible by working with humanists." This kind of opportunity for understanding the problems of fields other than one's own and for contributing one's special view to a general discussion with keen minds from other fields is a valuable part of education at the Institute.

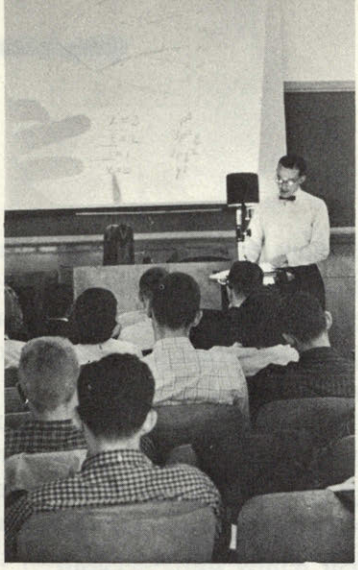
COMPETENCE AND VERSATILITY

This picture of M.I.T.'s education—each undergraduate Course apparently a separate, self-sufficient package—is misleading. Today's professional opportunities demand of *every* student the great competence in basic science and versatility in its exploitation which will enable him to move easily across the familiar fields of specialization. M.I.T. education is responding to this need by

providing deeper and more penetrating studies in the basic sciences and more emphasis on the scientific content of engineering. The boundaries between M.I.T. Courses are softening. Their similarities are far more important (if less obvious) than their differences.

You will find everywhere in all M.I.T. Courses the basic instead of the specific, the broad instead of the narrow. There are no subjects in highly specialized industrial practices. Because scientists and engineers, like administrators and managers, work with their brains rather than with their hands, the emphasis in professional Courses is on the larger aspects of subjects—the thermodynamics which makes a Diesel engine possible and the wave theory which lies behind a dish-shaped radar antenna.

Manual skill is near the bottom of the list of qualities a student should possess if he is to be successful in these fields. Dexterity in assembling a radio transmitter is a good thing, of course, but far more important than handiness with pliers and screw driver is the ability to master the theory of why the set works. More important still, and much rarer, is the quality of mind that can evolve new concepts out of which still other useful things can be developed, or that can administer large undertakings involving scientific processes and control. The number of M.I.T. graduates holding positions of major responsibility in industry and government evidences the soundness of the Institute's emphasis on breadth rather than on technical detail.

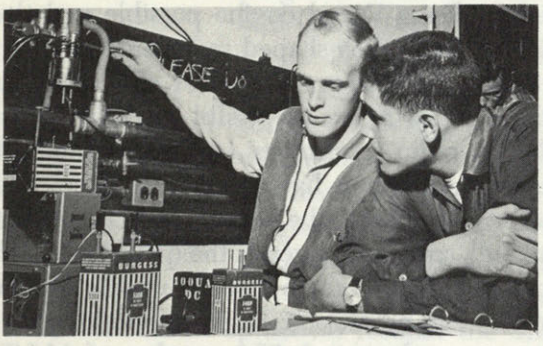


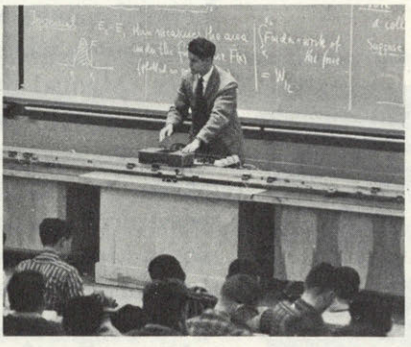
"BASIC INGREDIENTS OF ANY MODERN LIBERAL EDUCATION . . ."

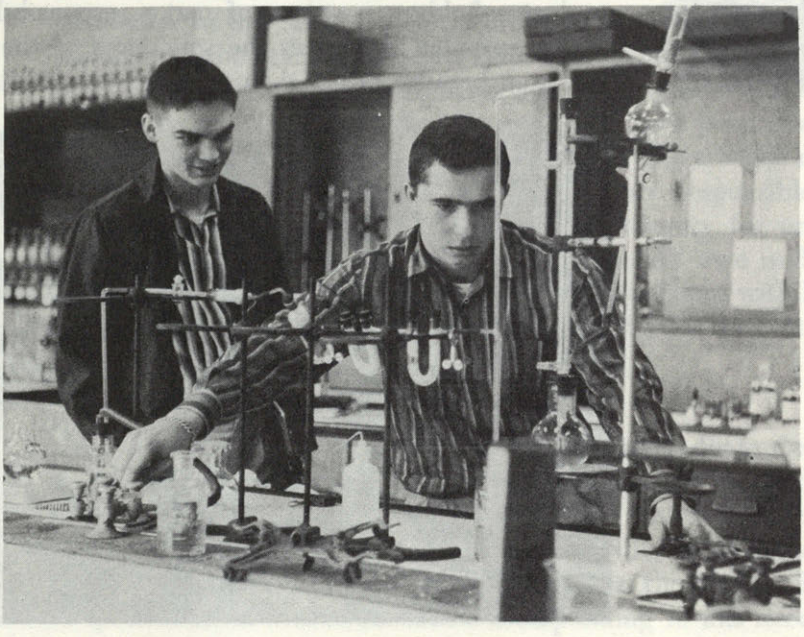
. . . mathematics

. . . physics

. . . chemistry







THE FOUR-YEAR PATTERN

Most Courses at M.I.T. follow a four-year pattern of professional development, beginning with a common stem of basic studies essential as a foundation for all advanced work.

Each student is asked to indicate his choice of Course by the beginning of the sophomore year.[1] But because curricula here follow this similar plan of development, a student is often able later to change his choice in accordance with his own increasing knowledge of himself and of the things he is studying.

Here is a generalized outline of the four years in most M.I.T. Courses:

The First Year

All freshmen (except those enrolled in the Course in Architecture) follow programs of study containing in common: humanities (Introduction to the Humanities), mathematics, physics, and chemistry. The Course in Architecture replaces chemistry with graphics. In addition, all students, except those in the N.R.O.T.C. Program, are required to earn 12 units of credit (22 units in Architecture)[2] during their freshman and sophomore years in elective subjects. Unusually qualified students may instead select upperclasss elective subjects. First-year elective subjects are described in detail at the end of this book.

Because of its general nature, the first-year curriculum is easily adapted to the requirements of any Course. But this adaptability does not prevent the basic program from being a rigorous and thorough foundation for later work.

In mathematics, first-year students build on their basic knowledge of algebra and trigonometry to master the calculus and pertinent portions of analytic geometry. One object of the calculus is to develop methods of studying rates of change, such as velocity and acceleration. Another goal is the study of the inverse problem—to find a function from its given rate of change. The climax comes in the discovery of the connection between these processes and the method of summation of many small bits (for example, of area, of volume, of arc length, or of work) to find

[1] Admission to certain Courses beyond the first year is limited when the demand exceeds the staff and facilities available.

[2] The system of credits at M.I.T. is described in Section 5.

an integrated whole. These ideas are basic to all science and engineering.

In physics, freshmen hear two lectures a week, illustrated with experiments and demonstrations. To supplement these, each student has two meetings with an instructor in a small section where he has ample opportunity for questions and discussion. Once every three weeks he spends half a day in the physics laboratory, performing experiments designed to acquaint him thoroughly with the experimental foundations of physics.

In chemistry, first-year students follow a similar program of two lectures and two section meetings each week, with a weekly laboratory period supervised by the section instructor and a laboratory assistant.

A first-year student spends about 20 hours per week in class and laboratory. If he plans his time well and utilizes free hours during the day, he will not find these first-year studies an over-powering burden. There is no conventional "cut system" at M.I.T. Occasional absences are assumed to be for valid reasons, and a student who is making satisfactory progress does not have to account for them. Freshmen soon learn that they are out of the schoolboy atmosphere of rigid restrictions. They respond quickly to the challenge of a mature university system, where students must take responsibility for planning their own time.

The Second Year

In the second year, all students begin their studies in the particular Course of their choice. This does not mean that they have begun to narrow their activities sharply, for all continue to study the fundamental subjects in science, mathematics, and humanities.

The Third Year

The professional subjects within each Course are introduced in the third year, and Course specialization begins.

The Fourth Year

In the fourth year, students concentrate upon the professional subjects within their Courses and choose electives which enable them to follow their own special interests within the broad field.

HUMANITIES AND ECONOMICS

This pattern is somewhat different in the case of M.I.T.'s Courses in Humanities and Engineering or Science and in Economics, Politics, and Engineering or Science; these are distinctly

less specialized than many of the professional curricula. In these Courses students devote 60 per cent of their time to basic work in one of the fields of science or engineering and 40 per cent to the humanities and social sciences. Students may, if they wish, use a fifth year to gain the Bachelor of Science degree in the science or engineering field of their earlier concentration.

These Courses are significant because, while they prepare a student to go on with work in the engineering or science field of his choice, they also give him ample background for further study in law, public administration, writing, personnel work, economics, or other humanities and social science fields, if he prefers to follow one of these directions.

THE UNDERGRADUATE THESIS

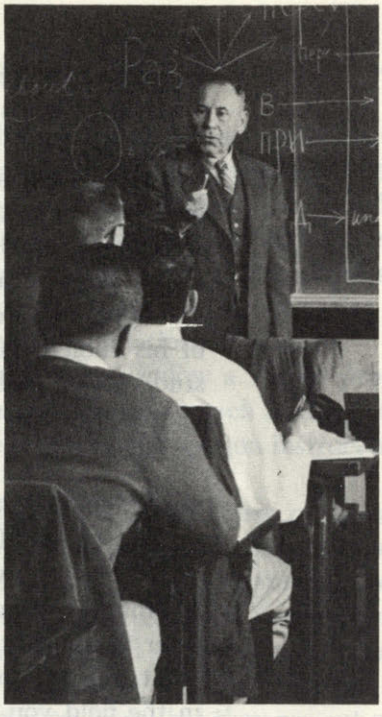
All M.I.T. seniors, as a graduation requirement, have the opportunity to write a thesis—a report on a special project or an original investigation. The booklet of instructions to seniors about their theses says, simply, "The thesis gives you a chance to show what you can do on your own with a genuine man-sized problem in the field you have chosen; instead of learning and practicing the basic principles of your chosen profession, you will now use your education to do a piece of real professional work. You are judged as the practicing engineer or architect or surgeon is judged —by how well you can do one complete job."

Each senior has a member of the faculty as a consultant for his thesis, and he picks his topic with the help of this adviser. But, say the instructions, "The initiative is yours throughout this project. You should come to your adviser with a well-formulated question or plan of action. You are in charge of this job yourself."

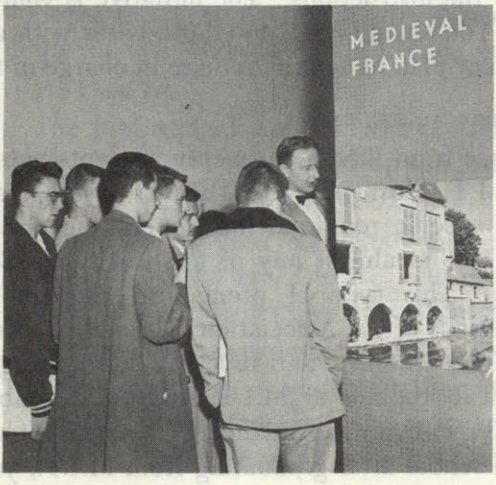
FOR PREMEDICAL STUDENTS

Each year from fifteen to twenty students enter medical school from M.I.T. Most premedical students take the Biology Course, but the specific requirements for entrance into medical school can be met in almost any of the Institute's Courses by proper planning. This type of premedical program fully meets the specifications of the Association of American Medical Colleges.

The flexibility and diversity of the programs available to premedical students at M.I.T. make it desirable that each student have individual guidance. If you are interested in entering medical school after graduating from M.I.T., you should consult



". . . SCHOLARS OF TALENTS UNUSUAL IN ENGINEERING EDUCATION"



Dr. James M. Faulkner, Medical Director, who is the official Adviser to Premedical Students.

HUMANITIES AT M.I.T.

As an undergraduate at M.I.T. you study the humanities, as do college students throughout the western world, primarily to explore such elusive topics as these: ethical, spiritual, and aesthetic values . . . the reconciliation between liberty and order in a free society . . . the temptations of complacency and conformity. You are encouraged to respond as you will to the past experiences about which you learn; you are required to think, talk, and write about those experiences. Indeed, the program continually provides exercises in expression, constructed to help you command and organize data; for the faculty knows that clear thinking must precede clear writing and that clear writing is at once the mark of the educated and the indispensable tool of the successful. The first- and second-year subjects have an additional purpose: to introduce you to the kinds of materials which you may choose for further study in upperclass subjects in the humanities and social studies.

The required first-year subject, Introduction to the Humanities, combines materials from history, literature, philosophy, and the arts in four topics, each requiring seven weeks, which focus successively upon Athens in the Fifth Century B.C., Western Christendom in the Middle Ages, Sixteenth Century Crises, and Science and the Secular State in the Seventeenth Century. Readings, selected for their significance and their interest, are from the writings of such men as Sophocles, Thucydides, and Plato; St. Augustine and Dante; Machiavelli, Calvin, and Shakespeare; Newton, Hobbes, and Locke.[1]

Sophomores may elect one of two subjects, either "Modern Western Ideas and Values" or "The United States: Men and Issues."

Then, familiar with the substance of these introductory subjects and practiced in oral and written expression, M.I.T. upperclassmen are prepared to begin more specialized and advanced

(text continues on page 52)

[1] Students who come to M.I.T. with sufficient background in French may enter a special group which studies the first- and second-year humanities subjects in the French language, using French-language source materials. If you are interested in this group, you should write to Professor William N. Locke, head of M.I.T.'s Modern Languages Department.

"... The vastness of man's experience and his limited knowledge of himself ..."

Dean John E. Burchard of the School of Humanities and Social Studies explains M.I.T.'s concern for helping its specialists develop a sense of proportion.

Specialization is here to stay. It is essential to our complex contemporary life. And for the individual there is a deep satisfaction in really knowing about something, in being able to deal with an explicit problem with force and elegance. So specialists are likely to be among the happiest of educated men.

Yet to have specialized competence today requires a formidable amount of specialized knowledge.

Needing to know so much about so little, there is always a risk that those who choose to be specialists may end by knowing—and caring—very little about anything else. In the long run the specialist will have to develop most of his sensitivities and his sense of proportion about the whole of society from a long experience in living. He will have to develop his own interest in and knowledge of the forest beyond the trees which he has been taught so sharply to identify. His undergraduate education can at best provide only a start.

By no means all of this start will come from his non-specialized subjects. Indeed, one of the largest forces for developing a sense of dignity and integrity will build up from within the specialty. Moral and ethical attitudes, for example, are rather more likely to develop from the codes of fellow scholars in the specialty than from sermons delivered in general courses.

The program of liberal education at M.I.T. has been arranged on the premise that specialists will not be made into men of wide vision through exhortation. Even a very learned modern man cannot hope in a lifetime to acquire a universal familiarity with all the fields of humanities and social sciences. Any undergraduate curriculum which undertakes to provide a comprehensive introduction to such a hope is bound to be inordinately superficial. We go at it differently. We look, for instance, at a few brief moments of time under a microscope rather than trying to run the course of history from Asoka to Eisenhower.

Every undergraduate at M.I.T. will study an average of at least one subject in this School during every semester of his residence with us. He may study more. An important part of the plan is that he does this study in all his years and not just his early ones.

We require our freshmen and sophomores to participate in two years of common experience in humanistic study. This part of the program tries to provide each student with some sense of the vastness of man's experience and some appreciation of the limited knowledge man has acquired about himself. It may lead our students to recall from time to time that there have been great nations before ours, that there have been great problems, great successes, and great failures, and to find some of the possible reasons for these successes and failures. It may influence them not to ignore their past on the silly premise that nothing that has ever happened to anyone before can be of any value to us now.

After this common experience, every upperclassman must elect a sequence of subjects in one or another field of concentration, a field of his choice. Here we are seeking to have him do a little "deep digging" in an area quite different from that of his specialty but one which has exerted some fascination on him. As the first part of the program tries to make him realize that there were great men before him, the second might show that there are great fields of current experience other than the one that he will follow, that there are great men in professions other than his own. This is more than a matter of creating an atmosphere of mutual tolerance and respect, although this is not a trivial objective. Once one can understand that there is a rigor in respectable study of history, though a different rigor from that of experimental physics, one is less likely to be taken in by shoddy history.

We must pay a great deal of attention, and do, to the quality of the works selected for study, to the nature of our library and our art exhibitions and our concerts. But we still could not succeed if we did not have a first-rate faculty, scholars of talents equal to those of their colleagues in science and engineering. We would not have such scholars unless their opportunities were in every direction equal to those enjoyed by their colleagues in their own fields in other universities. That this has been achieved at M.I.T. is symbolized by the fact that this faculty is assembled in a School. The existence of this effort as a School is unusual in engineering education and is of the utmost significance.

(text continued from page 49)
work in economics, psychology, political science, labor relations, history, literature, philosophy, music, modern languages, or the visual arts. And they have begun to understand something about the heritage and the shaping of their society, its present problems, and their future roles as decision-makers in it.

Upperclassmen in the professional Courses must choose at least four one-semester subjects in the School of Humanities and Social Studies during their junior and senior years. Three of these must be in one general area of study and the fourth must be outside this area. The list on the next pages shows the upperclass humanities subjects as they are divided into ten fields and indicates the usual sequence of three subjects within each field. Subjects which are marked by a dagger (†) may also be taken as the single "distributional" subject which is required in a different field.

Visiting Professor Ernst Levy, composer-pianist, holds open house.

Students who are interested in additional work in humanities and social sciences in the context of modern technology may wish to register in the Courses in Humanities and Engineering or Humanities and Science or in the Courses in Economics, Politics, and Engineering or Science.

OUTLINE OF HUMANITIES SUBJECTS

FIRST YEAR

First Term

21.01 Introduction to the Humanities

Second Term

21.02 Introduction to the Humanities

SECOND YEAR

First Term

21.03 Humanities

Option A: The United States: Men and Issues

Option B: Modern Western Ideas and Values

Second Term

21.04 Humanities

Option A: The United States: Men and Issues

Option B: Modern Western Ideas and Values

THIRD AND FOURTH YEARS

Any one of the following combinations of subjects may be taken without the approval of a humanities adviser. Other combinations are not prohibited but must be specifically approved by a humanities adviser. Subjects indicated by a dagger (†) may be taken as a single subject to satisfy the distributional requirement.

1. HISTORY

History and the Historian (21.41 *or* 21.42)†
plus any two of the following:
Growth of the American Industrial Economy (21.43)†
The Changing Role of the Industrial Leader (21.44)†
American Foreign Policy in Action (21.45)†
The American Mind (21.46)†
Technology and Economic Growth (21.48)†
Political Process in Industrial America (21.50)†
Europe—The Expansion of Europe (21.51)†
Modern Europe—War, Society and the State (21.52)†
The Russian Revolution and the Soviet Union (21.54)†
History of Engineering (21.55)†
History of Engineering (21.56)†
Special Topics in History (21.591)
Special Topics in History (21.592)

2. PHILOSOPHY

Any three subjects:
Philosophic Problems and Systems (21.61)†
Philosophic Problems and Systems (21.62)
Classical Philosophy (21.65)†
Philosophies and Religions of the East (21.67)†
Major Religions of the West (21.68)†
Problems in Contemporary Philosophy (21.69)†
Philosophy of History (21.71)
Philosophy in Literature (21.72)†
Nature of Man (21.73)†
Metaphysics (21.74)†
Ethical Theory (21.75)
Symbolic Logic (21.76)†
Social Ethics (21.77)†
Science and Philosophy from Antiquity to Copernicus (21.81)†
Science and Philosophy from Copernicus to the Present (21.82)
Philosophy of Science (21.83)
Topics in the History and Philosophy of Science (21.84)
Special Topics in Philosophy (21.891)
Special Topics in Philosophy (21.892)

(continued on the next page)

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3. LITERATURE

Introduction to Literature (21.11)†
plus any two of the following:
Literary Criticism (21.12)
The Epic (21.13)
Comedy in the Theatre (21.15)
Tragedy and Modern Drama (21.16)
Shakespeare (21.17)
Non-Western Literature (21.18)
Major British and Continental Writers of the 19th and Early 20th Centuries (21.19)
The Bible (21.20)
Dostoevsky, Tolstoi and Modern Russian Literature (21.21)
The Nature of Poetry (21.22)
The Comic Sensibility (21.24)
The Modern Novel (21.25)
Major Writers of the English Renaissance (21.26)
American Folkfore (21.31)
Nineteenth-Century American Literature (21.33)
Twentieth-Century American Literature (21.34)
Special Topics in Literature (21.391)
Special Topics in Literature (21.392)
Language and Society (L75)
Linguistic Structure (L78)

4. MODERN LANGUAGES

a. German:

Intermediate German (L14)
or
Introduction to Literature (21.11)†
plus any two of the following:
German Literature 1919-1933 (L15)†
Literature of Postwar Germany (L16)†
Great Books and Authors in German Literature (L20)†

b. French:

Intermediate French (L54)
or
Introduction to Literature (21.11)†
plus any two of the following:
Contemporary French Literature (L55)†
French Literature of the Third Republic (L56)†
Great Books and Authors in French Literature (L59)†

c. Russian:

Intermediate Russian (L94)
or
Introduction to Literature (21.11)†
and
Great Books and Authors in Russian Literature (L95)†
and
Modern Russian Literature (L96)†

d. Study of Languages:

Language and Society (L75)†
and
Problems of Phonology (L76)
and
Linguistic Structure (L78)

5. MUSIC

Introduction to Music (21.91)†
and
Western Music from the Middle Ages to the Baroque (21.92)
plus one of the following:
Western Music in the Classic and Romantic Eras (21.93)
The Opera (21.94)
Twentieth Century Music (21.95)
The String Quartets of Beethoven (21.96)
Seminar in Music (21.991)

6. ECONOMICS

Economic Principles I (14.01)†
and
Economic Principles II (14.02)
and one of the following:
Prices and Production (14.03)
Industrial Organization and Public Policy (14.04)
Economic Fluctuations and Growth (14.05)
Structure of the American Economy (14.06)
Comparative Economic Systems (14.07)
Economic Problems Seminar (14.09)
Economics of Innovation (14.21)
Monetary and Banking Policy (14.40)
Public Finance (14.43)
International Trade (14.54)
Labor Economics and Public Policy (14.64)

7. POLITICAL SCIENCE

Any three subjects in one of the following groups, or approved combinations of groups:

a.
Economic Principles I (14.01)†
The American Political Process (14.91)†
Seminar: Issues in Contemporary American Politics (14.93)
Government, Politics, and Technology (14.94)

b.
Personality and Social Structure (14.71)
Politics, Society, and Policy Making (14.95)
Influences on Policy Decisions (14.96)

c.
International Relations (14.51)†
Principles and Problems of American Diplomacy (14.52)
Seminar in International Politics (14.53)

d.
Basic Ideas of Western Politics and Ethics, 500 B.C.-1500 A.D. (14.55)
Rise of Modern Political and Social Science, 1500-1914 (14.56)
Contemporary Ideas on Political and Economic Development (14.57)
Nationalism and National Development (14.58)

8. LABOR RELATIONS

Economic Principles I (14.01)†
or
Organization and Communication in Groups (14.73)†
or
Personality and Social Structure (14.71)
and
Labor Relations (14.63)
and
Labor Economics and Public Policy (14.64)

9. PSYCHOLOGY

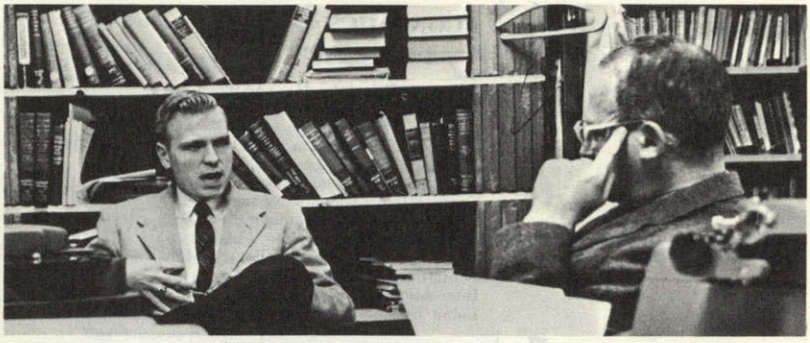
Introductory Psychology (14.70)†
plus any two subjects, at least one in Group A:

a.
Psychology of Language and Communication (14.77)
Learning (14.79)
Psychology of Perception (14.81)
Psychology of Motivation (14.82)

b.
Theories of Personality (14.84)
Social Psychology (14.85)
Behavior in Groups (14.86)
Mass Communication (14.87)

10. VISUAL ARTS

Any three of the following:
Visual Design Problems (4.031)†
Visual Design Projects (4.032)
Architecture of Cities (4.61)†
Introduction to Art and Architecture (4.65)†
Modern Art and Architecture (4.66)†



THE ADVISORY COUNCIL

When you come to M.I.T. for the Freshman Weekend preceding the beginning of classes, one of the first events of the program is a meeting with your faculty adviser. He will be one of seventy members of the M.I.T. faculty who comprise the Freshman Advisory Council.

The principal reason for having a Freshman Advisory Program is the sincere desire of the faculty to help make each student's career at M.I.T. interesting, enjoyable, and productive. The faculty is aware that an entering freshman may very well feel bewildered and somewhat lonely upon first coming to this new environment, and thus its members wish to extend a personal hand of welcome, to point out that the essence of M.I.T. is not the classrooms and buildings but the students and teachers who people them. The faculty wants to be on friendly terms with those with whom they associate and to establish this relationship as soon as possible. And—as do all members of this community—the faculty has a clear interest in working together with freshmen to develop their capabilities.

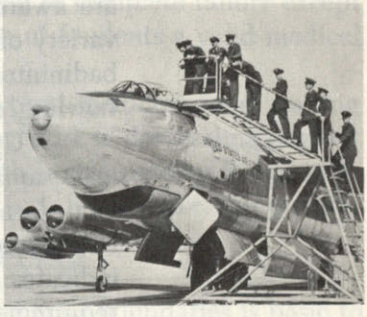
There will be some individual conferences with your adviser, since he will also be your registration officer—the person with whom you discuss your program of studies and who will approve any changes you may decide to make in your program. Your adviser will also undoubtedly try to see you under more informal circumstances, perhaps at his home, perhaps somewhere at M.I.T. Remember that half of the initiative for developing the relationship between student and adviser rests with each student; only when you contribute your share can a relationship of interesting substance develop.

AIR, MILITARY, AND NAVAL SCIENCE

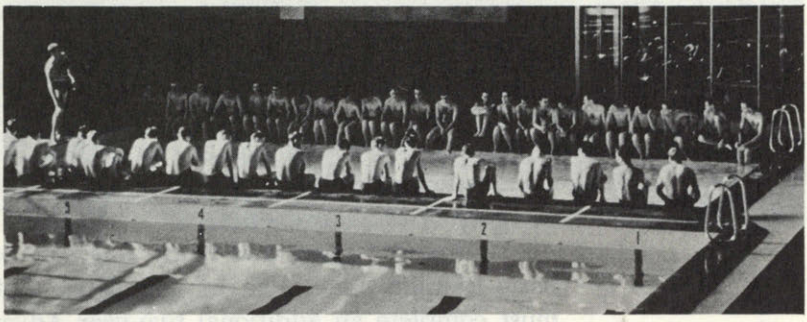
The Institute offers Air Force, Army, and Navy R.O.T.C. programs which lead upon graduation to commissions as reserve officers in the respective services. The Air Force program offers commissions in technical fields involving both flying and non-flying duties; the Army R.O.T.C. program offers commissions in the Corps of Engineers, Quartermaster Corps, Chemical Corps, Ordnance Corps, and Signal Corps. The Navy program offers commissions in the Restricted Line (engineering duty only) category of the Naval Reserve.

The Air Force and Army R.O.T.C. programs begin with basic training which can be completed in two years; students must complete an additional two-year Advanced Course to obtain commissions. In contrast, the Navy program consists of a four-year sequence, and students who enter it in the freshman year should be prepared to pursue it to completion.

The Navy program is open to students in all Institute Courses except Architecture, Biology, Chemical Engineering Practice, Economics, Food Technology, and Geology and Geophysics, and the Cooperative Courses in Aeronautical, Electrical, and Mechanical Engineering. The annual registration is limited to 40 freshmen, and applications should be made as early as possible—in no case after August 15 before the beginning of the fall term. Students electing either the Air Force or Army programs may usually expect to be accommodated in the program of their choice, and applications are accepted until Registration Day. For further information write directly to the professor in



charge of the appropriate department, as shown at the back of this book.



A swimming class in the Alumni Pool.

PHYSICAL EDUCATION REQUIREMENTS

The objective of M.I.T.'s physical education program is to develop good health through skill in physical activities which may be enjoyed both in college and in later life. The physical education requirements are based upon a point system, a flexible arrangement designed especially so that every student may satisfy his own personal preferences. Each male student must compile a minimum of eight points through some phase of the physical education program by the end of his second year. Points may be acquired by participating in any one of the eighteen freshman and varsity sports or in physical education classes. For example, members of intercollegiate teams acquire two points for fall or spring sports and four points for winter sports. Two points are awarded for each physical education class; there is a wide variety of such classes, including sailing, tennis, golf, basketball, badminton, squash, swimming, gymnastics, volleyball, skating, bowling, and archery.

Upon entering M.I.T., each student must complete a medical examination, swimming test, and a physical fitness test. Those who do not meet certain minimum standards are recommended for swimming or development classes. If the medical examination indicates any disability which might limit physical activities, the requirements are modified accordingly.

Although there are no specific requirements for women students, they are encouraged to participate in the class and intercollegiate programs suited to their abilities and interests.

ACADEMIC REGULATIONS

M.I.T.'s policy is to have as few rules and regulations as are consistent with its academic purposes. The day-to-day affairs of students are in general the responsibility of student government, and the following—which you should have in mind before you come to M.I.T.—are the only regulations which are of major concern.

The Institute expects regular and prompt attendance in classes.

M.I.T. reserves the right to dismiss at any time a student whom it deems unsatisfactory for any reason.

It is the aim of the faculty to maintain the highest standards of integrity. The attempt of any student to present as his own any work which he has not honestly performed or to pass any examination by improper means is regarded by the faculty as a most serious offense and renders the offender liable to immediate expulsion. The aiding or abetting of a student in any dishonesty is also held to be a grave breach of discipline.

Conduct inconsistent with general good order, wherever it may occur, is held to be grounds for dismissal.

Damage caused to any building, or to furniture, apparatus, or other property of the Institute, will be charged to the student or student group known to be immediately concerned; but if those who cause the damage are unknown, the cost of repairing it may be assessed equally upon all students.

Final examinations are held at the end of each term. No member of the faculty is empowered to grant excuse from a final examination, and absence is equivalent to complete failure except as a student may present to the Dean of Students a valid medical or other reason for not attending.

The Institute's grading system includes four passing grades—A, B, C, and D—representing work of descending degrees of quality. The last of these, although barely passing for an individual subject, is not regarded as of satisfactory average quality.

EDUCATION IS ALSO EXTRACURRICULAR

The concept that learning has no artificial boundaries is basic to education at M.I.T. Learning extends beyond the classroom walls to living and working in an environment which stimulates intellectual and extracurricular activities. M.I.T. has a full program

of such activities, managed (and we are very proud of this) with great independence by the students themselves. "Visitors to M.I.T. who are not acquainted with Institute life," says Dean Rule, "again and again express astonishment at the wealth of opportunities our students have—far beyond those offered not only by similar institutions but by most liberal arts colleges."

MUSIC AT M.I.T.

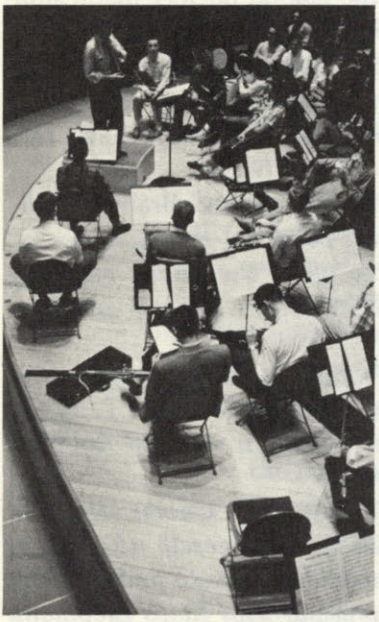
Musical events are a case in point. Klaus Liepmann, Professor of Music at M.I.T., calls special attention to the fact that students disciplined to concentration and conditioned to scientific thinking turn out to be ardent music lovers and music makers.

The subjects in music are among the most popular of the Department of Humanities' offerings; "Introduction to Music" is intended for those with little or no knowledge of music; "Western Music—Middle Ages to the Present" brings a detailed analysis of musical masterpieces by old and new composers; and several music seminars for a limited number of students draw on previous experiences to study in depth Beethoven's string quartets, for example, or twentieth century music, or the history of opera.

But where do these classrooms end? On this campus there are unusual opportunities for those who want to hear or help make fine music. The campus radio system, WTBS, carries music from the Music Library to all the dormitories and nearby fraternities throughout the day—and so successfully that the Radcliffe College radio has joined the network. Spontaneous barbershop singing and "jam sessions," hi-fi fans, serious music a best-seller at the campus record store . . . this is some of the evidence that M.I.T. is a musical community.

"You will never believe how much enthusiasm, talent, and skill exist among young Americans, especially among those whose mental curiosity and searching minds drive them to study science and engineering, until you have given them opportunities to make music in their free time."

PROFESSOR KLAUS LIEPMANN



Danny Kaye clowns with the Glee Club, Boston Pops, 1959

The Combined Musical Clubs include a Glee Club, Choral Society, Symphony Orchestra, Concert Band, and a Woodwind and Brass Ensemble—all out-of-classroom activities which draw a large following among the musicians in the student body. All of these organizations give public concerts in Boston and the neighboring communities—frequently in combination with musical groups of other colleges. The Choral Society joins with members of the Boston Symphony Orchestra for several major concerts; the Glee Club appears with the Boston Pops Orchestra in Symphony Hall. In 1956 and 1958 the Choral Society made summer tours in Europe, singing with European orchestras, including the Orchestra of the Darmstadt Technische Hochschule and of the Paris Conservatory. Many of these are concerts of highest professional standards. Here is what newspaper reviewers have said about some recent ones:

The Choral Society in a concert of Hindemith and Brahms: *"The Requiem was completely and utterly beautiful throughout. . . . In a city of fine choruses, none now offers the public anything better than does the M.I.T. Choral Society."*—THE JEWISH ADVOCATE (1956).

The M.I.T. Concert Band at Smith College: *"We were fortunate in having an organization of highest caliber; the M.I.T. group plays good music and plays it well."*—SMITH COLLEGE SOPHIAN (1953).

The Choral Society at the 1958 International Choral Week in Munich, Germany: *"One is inclined to ask oneself whether in this country technological students would be able to find as much enthusiasm for intensive work at choral music as Klaus Liepmann achieves with this layman's chorus. Intonation and discipline seem taken for granted."*—MUNCHNER MERKUR (1958).

A series of chamber music concerts and a concert by the Boston Symphony Orchestra in the Humanities Series—and additional recitals in the Music Library—bring to M.I.T. a variety of outstanding instrumentalists and singers.

PROFESSIONAL SOCIETIES

Professional activities, too, extend beyond the classroom at M.I.T. All the principal professional societies have student chapters here, and there are local professional clubs as well. The scientific and engineering honor societies are represented. (There is a full list

in the chart on the following page.) In lectures, plant trips, and general fellowship these groups bring to M.I.T. students professional experience of a vitality unusual to American undergraduates.

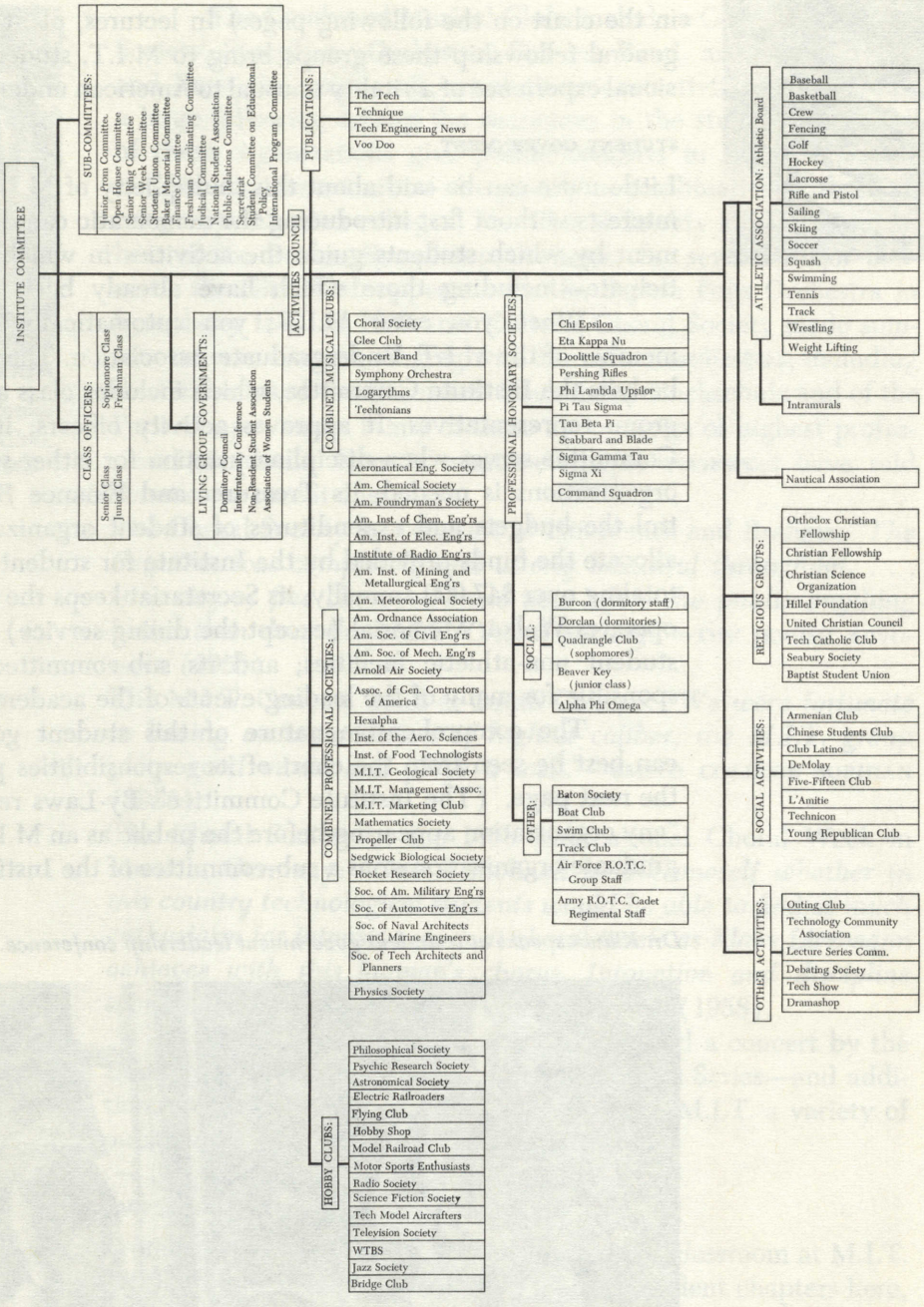
STUDENT GOVERNMENT

Little more can be said about this multiplicity of M.I.T. student interests without first introducing the democratic campus government by which students guide the activities in which they participate—including those which have already been described.

When you enter M.I.T., you automatically become a member of the M.I.T. Undergraduate Association. The legislative body is the Institute Committee, which includes class and living-group representatives. It approves activity officers; its Judicial Committee serves when disciplinary action for either students or organizations is needed; its Treasurer and Finance Board control the budgets and expenditures of student organizations and allocate the funds provided by the Institute for student activities, totaling over $47,000 annually; its Secretariat keeps the books and operates Walker Memorial (except the dining service) and other student non-athletic facilities; and its sub-committees are responsible for many of the leading events of the academic year.

The comprehensive nature of this student government can best be seen from the chart of its responsibilities printed on the next page. (The Institute Committee's By-Laws require that "any organization appearing before the public as an M.I.T. undergraduate organization or as a sub-committee of the Institute Com-

Dr. Killian speaks at a student government leadership conference.


INSTITUTE COMMITTEE
SUB-COMMITTEES:
Junior Prom Committee.
Open House Committee
Senior Ball Committee
Senior Week Committee
Student Union Committee
Baker Memorial Committee
Finance Committee
Freshman Coordinating Committee
Judicial Committee
National Student Association
Public Relations Committee
Secretariat
Student Committee on Educational Policy
International Program Committee
CLASS OFFICERS:
Senior Class
Junior Class
Sophomore Class
Freshman Class
LIVING GROUP GOVERNMENTS:
Dormitory Council
Interfraternity Conference
Non-Resident Student Association
Association of Women Students
ACTIVITIES COUNCIL
PUBLICATIONS:
The Tech
Technique
Tech Engineering News
Voo Doo
COMBINED MUSICAL CLUBS:
Choral Society
Glee Club
Concert Band
Symphony Orchestra
Logarythms
Techtonians
COMBINED PROFESSIONAL SOCIETIES:
Aeronautical Eng. Society
Am. Chemical Society
Am. Foundryman's Society
Am. Inst. of Chem. Eng'rs
Am. Inst. of Elec. Eng'rs
Institute of Radio Eng'rs
Am. Inst. of Mining and Metallurgical Eng'rs
Am. Meteorological Society
Am. Ordnance Association
Am. Soc. of Civil Eng'rs
Am. Soc. of Mech. Eng'rs
Arnold Air Society
Assoc. of Gen. Contractors of America
Hexalpha
Inst. of the Aero. Sciences
Inst. of Food Technologists
M.I.T. Geological Society
M.I.T. Management Assoc.
M.I.T. Marketing Club
Mathematics Society
Propeller Club
Sedgwick Biological Society
Rocket Research Society
Soc. of Am. Military Eng'rs
Soc. of Automotive Eng'rs
Soc. of Naval Architects and Marine Engineers
Soc. of Tech Architects and Planners
Physics Society
HOBBY CLUBS:
Philosophical Society
Psychic Research Society
Astronomical Society
Electric Railroaders
Flying Club
Hobby Shop
Model Railroad Club
Motor Sports Enthusiasts
Radio Society
Science Fiction Society
Tech Model Aircrafters
Television Society
WTBS
Jazz Society
Bridge Club
PROFESSIONAL HONORARY SOCIETIES:
Chi Epsilon
Eta Kappa Nu
Doolittle Squadron
Pershing Rifles
Phi Lambda Upsilon
Pi Tau Sigma
Tau Beta Pi
Scabbard and Blade
Sigma Gamma Tau
Sigma Xi
Command Squadron
SOCIAL:
Burton (dormitory staff)
Dorclan (dormitories)
Quadrangle Club (sophomores)
Beaver Key (junior class)
Alpha Phi Omega
OTHER:
Baton Society
Boat Club
Swim Club
Track Club
Air Force R.O.T.C. Group Staff
Army R.O.T.C. Cadet Regimental Staff
ATHLETIC ASSOCIATION: Athletic Board
Baseball
Basketball
Crew
Fencing
Golf
Hockey
Lacrosse
Rifle and Pistol
Sailing
Skiing
Soccer
Squash
Swimming
Tennis
Track
Wrestling
Weight Lifting
Intramurals
Nautical Association
RELIGIOUS GROUPS:
Orthodox Christian Fellowship
Christian Fellowship
Christian Science Organization
Hillel Foundation
United Christian Council
Tech Catholic Club
Seabury Society
Baptist Student Union
SOCIAL ACTIVITIES:
Armenian Club
Chinese Students Club
Club Latino
DeMolay
Five-Fifteen Club
L'Amitie
Technicon
Young Republican Club
OTHER ACTIVITIES:
Outing Club
Technology Community Association
Lecture Series Comm.
Debating Society
Tech Show
Dramashop

mittee must first be granted this privilege by the Committee.") In fact as well as theory, students run all their activities . . . including in a very large degree the management of athletics. There are advisers, coaches, and faculty and alumni committees, but these act at the request of the student government. To make all this more effective, there are each year a series of weekend off-campus conferences for detailed, relaxed study of the problems of student leadership.

The government of the dormitories is in the hands of a Dormitory Council, which promotes social and sports activities within the dormitories and administers rules of dormitory life. Interfraternity Conference, the central governing body of the fraternities, sets a general policy—social, scholastic, and administrative—which each fraternity may assume as a standard. The Non-Resident Student Association, with headquarters in a comfortable lounge, includes all students who do not live in dormitories or fraternities; and The Association of Women Students, of which all women students automatically become members when they enter the Institute, serves as their government association and as a center for their group social life.

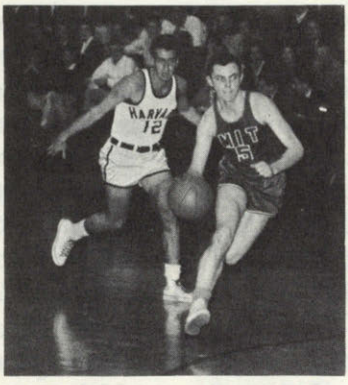
ATHLETICS AT M.I.T.

Athletics at M.I.T. demonstrate effectively the principles of M.I.T. student activities: the responsibility of students in student affairs, the intimate relation of the academic and extracurricular, and the value which M.I.T. students place on the diversity of a full college experience. The purpose, says Athletic Director Richard L. Balch, is "to provide individual opportunity to choose and participate in an athletic program designed to meet individual needs." Thus the program is based on the concept that athletic competition—competition to win—is good for everyone. You will never see a salaried athlete here, never hear of an athletic scholarship.

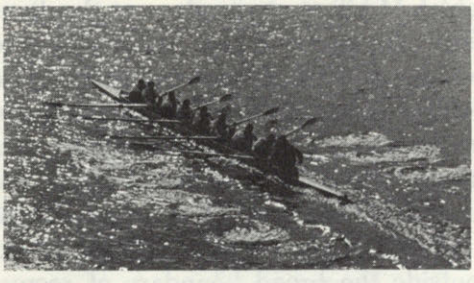
There is no room at M.I.T. for an athletic program that exists outside the broad boundary of recreation. This does not mean that we do without intercollegiate competition. But it does mean that all athletic activities—intercollegiate and intramural alike—serve the primary purpose of recreation. Winning the game is for this end only.

Here are the details of M.I.T.'s varsity and freshman intercollegiate teams:

BASEBALL ranks high, from the first crack of the bat early in March until the final inning, late in May. Rockwell Cage is used for practice in bad weather, and varsity and freshman teams play their home games on Briggs Field. The varsity squad participates in the strong Greater Boston Intercollegiate Baseball League; in addition, the schedule includes such teams as Bowdoin, Wesleyan, Colby, and Coast Guard.



BASKETBALL has always enjoyed a place of prominence at M.I.T. With the facilities of Rockwell Cage and the Armory M.I.T. teams now have ample practice space for the 16-game schedule. The varsity, junior varsity, and freshmen start work-outs early in November, finishing their season early in March.

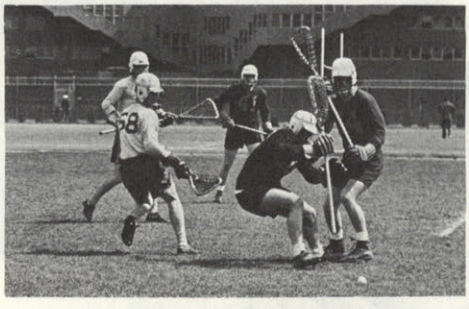


CREW brings out more than 100 men to compete with all the major college crews in the country. Six separate teams—"heavy" crews for varsity, junior varsity, and freshman teams, and "light" (or 150 pound) crews for varsity, junior varsity, and freshman teams—give plenty of opportunity for every candidate to have intercollegiate experience.

FENCING teams at M.I.T. have commanded respect in eastern fencing circles for years. The varsity participates against strong independent eastern college teams such as Cornell, Harvard, CCNY and Columbia.

GOLF offers opportunity for interested students to practice at a local golf course. There is a full varsity schedule, climaxed with the New England Collegiate Championships.

HOCKEY has been introduced in recent years to many students from all parts of the country. With our own rink, immediately adjacent to the new David Flett du Pont Athletic Center, interest in hockey increases each year.



LACROSSE, a sport only now growing into national popularity, has a long history at M.I.T. The game appeals especially because previous experience is not necessary. M.I.T. holds membership in the United State Intercollegiate Lacrosse Association. There is a spring schedule for varsity and freshmen, with the New England League and annual competition for the Briggs Cup highlighting the season.

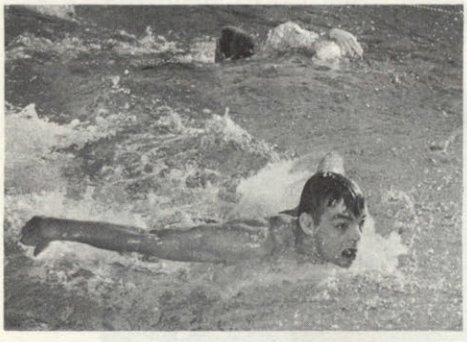
RIFLE AND PISTOL teams from M.I.T. traditionally contribute members to the annual All-American Rifle and Pistol teams. A well-balanced schedule of shoulder-to-shoulder and pistol matches starts in December and extends to April. Annual shoulder-to-shoulder competition is held with the three leading intercollegiate teams in the country—Army, Navy, and the Coast Guard Academy.

SAILING at M.I.T. offers a Sailing Pavilion fleet of Technology-designed dinghies, 110-class sloops, olympic fireflies, and olympic finns. Sailing, under the direction of the Nautical Association, can be for recreation as well as competition; informal racing goes on all week, and formal races are held regularly every weekend during the season. There are regular courses of instruction for beginners; some of M.I.T.'s most successful skippers never sailed a boat before they came to Cambridge.

SKIING is represented at M.I.T. by an intercollegiate ski team through the cooperation of the Athletic Association. Competition and competitive sites (including the Winter Carnivals of New England colleges) are close at hand, and the intercollegiate season extends from the middle of January to early April.

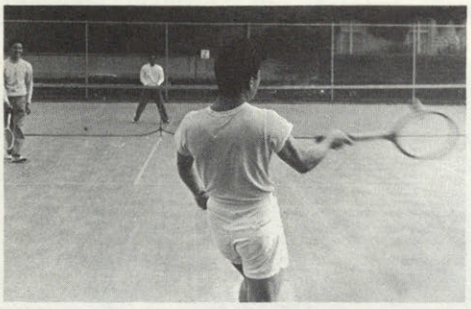
SOCCER has always been a favorite at M.I.T., and formidable teams are fielded by the Institute each year. The squad is a member of the New England Intercollegiate Soccer League and plays a full varsity and freshman schedule. Brown, Dartmouth, Springfield, Harvard, and Connecticut are among the annual competitors in a season extending through October and November.

SQUASH, a winter sport which requires no previous experience, provides excellent intercollegiate competition. The eight courts at M.I.T. are among the best in the area.



SWIMMING is high in the intercollegiate sports program. A normal schedule consists of eight or ten meets for the varsity team and six or eight for the freshman team between December and March, climaxed by the New England Intercollegiate Swimming Association Championships. M.I.T. has for years produced well-balanced teams, meeting some of the best competition in the East—Harvard, Brown, Bowdoin, Trinity, Springfield, R.P.I., Wesleyan, Tufts, and others.

TENNIS is part of the M.I.T. athletic program as a competitive and recreational sport. Varsity and freshman intercollegiate schedules include top teams from New England: Williams, Wesleyan, Harvard, Amherst, Dartmouth, and others.



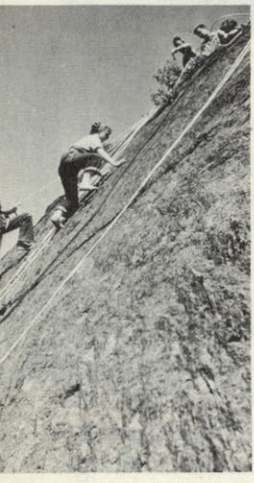
TRACK at M.I.T. includes cross-country and indoor and outdoor track. Practice sessions and intra-squad, inter-class, and intramural meets are scheduled throughout the school year. More than 125 men are usually on the roster; they practice and compete in the leading meets of the East. Briggs Field has an excellent quarter-mile outdoor track and a new portable wooden track; the Rockwell Cage has full indoor facilities.

WRESTLING is increasing in popularity, both from the participant and spectator point of view. Varsity and freshman teams compete in dual-meet schedules with Brown, Harvard, the Coast Guard Academy, Dartmouth, Tufts, Springfield, and others. The climax of the season is the New England Intercollegiate Wrestling Tournament.

INTRAMURAL ATHLETICS

Though you may not be a member of any of these intercollegiate teams, you are still part of the M.I.T. athletic picture. All the athletic facilities are available for recreational use, and experience proves that practically every M.I.T. student thus makes use of them.

For many M.I.T. men, intramurals are a fortunate combination of the competitive and recreational in sports. Intramurals at the Institute include touch football, basketball, volleyball, softball, swimming, tennis, track, table tennis, bowling, sailing, badminton, hockey, and golf. Students administer the program with a vice-president of the Athletic Association in charge. Intramural interest in these thirteen sports provides opportunity for 2,400 participants.



CLUBS AND ACTIVITIES

There is no need—and insufficient space—to describe here all the student clubs and activities which are shown on the chart. But a few need descriptions, which follow:

The weekend is rare when the OUTING CLUB is not conducting a rock-climbing or skiing expedition, a cycling trip to Walden in cooperation with Wellesley or Radcliffe, or an overnight camping trip to the White Mountains. The club is a member of the Intercollegiate Outing Club Association, which means that M.I.T. students are a part of many joint outings of New England colleges. Thanksgiving dinner on the slopes of Mount Katahdin, Maine's highest peak, is an M.I.T. Outing Club tradition; so is spring white-water canoeing, and so are the square dances with all the Boston members of the I.O.C.A.

The LECTURE SERIES COMMITTEE sponsors lectures, recitals, forums, and movies which are an important asset for the entire M.I.T. community. Recent guests under this sponsorship have included Mrs. Franklin D. Roosevelt, Captain Jacques-Yves Cousteau, Ogden Nash, Alistair Cooke, and Harold E. Stassen. There is a year-long program of foreign and special movies.

The Dramashop in the Elizabethan comedy, "The Alchemist."

DRAMASHOP is the organization of students interested in producing contemporary and classical plays. It also presents evenings of experimental and original plays on a workshop basis. There is a corresponding organization of faculty and staff—the M.I.T. Community Players—who present more traditional and tested productions. A separate student organization presents *Tech Show,* the annual student musical. As a result, there is an M.I.T. season of important dramatic productions each year using entirely "home talent."

STUDENT PUBLICATIONS at M.I.T. include *The Tech,* bi-weekly newspaper; *Technique,* yearbook; *Tech Engineering News,* the monthly of the engineering school students; and *Voo Doo,* the humor magazine. There are other outlets for journalism talents in the newspapers of the undergraduate houses and in departmental newsletters of many kinds.

The DEBATING SOCIETY takes part in many varsity intercollegiate debates, practice debates, special forums, and tournaments. An annual M.I.T. tournament attracts up to thirty leading college teams for its unique "M.I.T. style" of cross-examination rebuttals.

The MODEL RAILROAD CLUB builds and operates the Tech Nickel Plate, a complete and most elaborately controlled model railroad. There is a Christmas-season open house each year for faculty and their families.

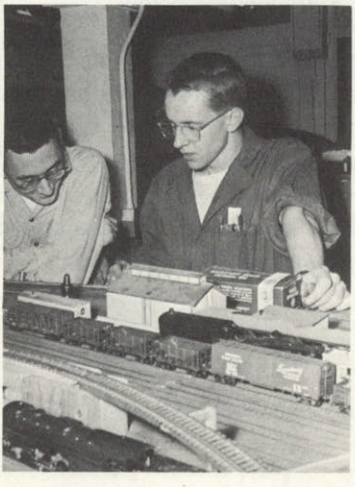
The ROCKET RESEARCH SOCIETY studies and builds rocket models, tests them in its own facilities, publishes results in its own quarterly journal, and cooperates with other amateur groups throughout the world.

The TECHNOLOGY COMMUNITY ASSOCIATION has a diversified program of service to the Institute community. With the help of a permanent staff, it conducts a book exchange and a travel and ticket service. Work with Boston boys' clubs, a handbook for new arrivals on the campus, Tech House for weekend outings, and annual blood donor and clothing drives are a few of the activities sponsored by the student members. The Technology Community Association maintains a circulating gallery of prints to brighten the rooms in M.I.T. dormitories.

Religious activities at M.I.T. center in many religious groups which have programs of worship and study. Chaplains from each denomination have regular office hours at the Institute and conduct services in the Chapel. Neighboring churches welcome student membership.

T.C.A. boys' club work.

". . . NEVER A DULL MOMENT ON THIS CAMPUS . . ."



. . . the Lecture Series chairman with Mrs. Eleanor Roosevelt.

. . . Tech Show on a spy chase.

. . . Open House visitors.

. . . operating the Tech Nickel Plate.

SOCIAL LIFE

"Numbers mean many things at M.I.T.," says the handbook for freshmen published by the Technology Community Association. "Besides the values of π and e," continues the editor, "you'll need to know the telephone numbers of Wellesley, Radcliffe, and Simmons." This quotation is one good way of suggesting the place of social life on this campus.

The social season begins each fall with a series of "acquaintance dances," at which M.I.T. is host to newcomers at all the women's schools in Greater Boston. From that time on things gain momentum; there are dances nearly every weekend, and some sequences of social activities are formed into a full weekend program to provide a special appeal for students' guests.

In winter comes the "All-Tech Sing"—a competition in barber-shop singing by all the dormitories, fraternities, and classes sponsored by the honorary music society—and in the spring the Carnival, where you can win prizes for marksmanship and strength while helping contribute to international student funds. There are "big name" dances in all the seasons: the Junior Prom and the Nautical Association Dance in the fall, Christmas Formal and Military Ball in the winter, Assemblies Ball and Senior Dance in the spring. The dormitories and fraternities have their own parties throughout the year.

Social activities for married students center in the organization of wives of M.I.T. students, called the Technology Dames.

NO DULL MOMENTS

The editor of the T.C.A.'s handbook for freshmen gives this advice: "Join some of the activities you have read about, be active in your living group, get a Saturday night date and talk about something besides engineering. You are going to be a lot happier." The opportunities to follow this advice (which everyone at M.I.T. thinks is excellent) are so manifold that truly "there is never a dull moment" on this campus.

. . . Dr. and Mrs. Stratton in the grand march.

. . . crowning the military queen.

. . . square dance has followers, too.

. . . fraternity costume party.

3 *Entering M.I.T.*

By now you have learned that the M.I.T. student body is made up of young men and women from many backgrounds and having many abilities, ideas, interests, and goals. There is no typical M.I.T. student; and even if there were, and even if you were just like him, no one could say that you would be interested in applying for admission to M.I.T. But if the description of the Institute in this catalogue—its ideas and purposes, its faculty, its students, its Courses, its student activities, its campus—has included concepts which are provocative and appealing to you, then it is likely that you may be interested in entering M.I.T.

If, furthermore, you possess a good basic intelligence, if you have taken subjects in secondary school which demonstrate that you are interested in science and mathematics—and also in the wide range of humanities,—if your marks indicate that you work consistently well and are seriously and conscientiously concerned with your studies, if your personal record shows that you are an active person whose interests and experiences include many aspects of living beyond the classroom and textbook . . . if these things are true, then M.I.T. invites you to apply for admission to this community.

In considering your application for admission, M.I.T. will try to study, insofar as possible, your entire record and personality. School marks, although important, are only a part of the things to be considered; a straight A average is *not* prerequisite.

HIGH SCHOOL BACKGROUND

Any good high school or preparatory school in the United States, and equivalent schools in other countries, will give you adequate preparation for entering M.I.T.—if you take full advantage of the opportunities before you. A broad secondary education—the kind of education that encourages you to think, to learn, and to express yourself clearly—is most desirable. M.I.T. does not recommend specialized technical perparation.

An interest in and an aptitude for mathematics and a general motivation to go further than a superficial introduction to the sciences are of primary importance; a familiarity with history and literature helps to achieve the understanding necessary for meeting the professional as well as the non-professional demands of modern citizenship.

Some suggestions to entering students are formalized in specific requirements established for all entering freshmen.[1] These specific requirements are:

English	three units
Algebra	two units
Plane Geometry	one unit
Physics	one unit
Trigonometry	one-half unit

By one "unit" is meant one full year's study—four or five times a week—in a high school subject (except for English, where four years of study are counted as only three units). In some states, algebra is completed in one and one-half years; this will satisfy the algebra requirement for candidates from those states. The plane geometry requirement may be met either by a course of the traditional type or by a one-year course which is mostly devoted to plane geometry but which includes some work in analytic geometry, solid geometry, or other fields, as suggested by the Commission on Mathematics of the College Entrance Examination Board. The inclusion of some topics from solid geometry is particularly recommended.

In addition to these subjects, M.I.T. recommends that among high school "electives" should be one year of chemistry

[1] If you have been unable to complete all these requirements but have an especially good record in those you have studied, special provisions can sometimes be made.

and one or more years' study of history. Although there is no language requirement for admission, the study of a modern foreign language in secondary school is desirable and is strongly recommended. No limitations are imposed with regard to languages, except that if a language is offered at all it should total at least two units. The choice of languages should be guided by the student's own interest, by the educational opportunities open to him, and by the nature of his probable future work. For example, those who expect to have contacts with Latin America may need Spanish or Portuguese. Those who look forward to advanced work in research or design in a scientific or engineering field may eventually need a knowledge of German, Russian, or French, since there is an extensive and important technical literature in each of these languages.

ENTRANCE EXAMINATIONS

All applicants are expected to take the test program of the College Entrance Examination Board, which is administered at various times each year in many centers in the United States and abroad. All candidates may obtain from this organization an *Information Bulletin* giving the test dates, locations, and fees for the current year.

If you are applying to M.I.T., you should take the following Board tests: in the morning, the Scholastic Aptitude Test; in the afternoon, three one-hour tests: Advanced Mathematics, English Composition, and either Physics or Chemistry. You may take the tests on any date you wish, or you may divide them among different dates, as you prefer. One or more College Board tests may be taken as early as the eleventh grade. These might well include the Scholastic Aptitude Test and one or two achievement tests. Any of these tests may be repeated in your senior year, if you wish.

To apply for the tests, write to the College Entrance Examination Board, Box 592, Princeton, New Jersey (or, in Western states, to the College Entrance Examination Board, P. O. Box 27896, Los Angeles 27, California). You should request that the College Entrance Examination Board send your test scores to M.I.T.

THE COST OF ATTENDING M.I.T.

The Institute is an independent, endowed institution. The tuition paid by each student, $1,500[1] per academic year, covers less than one-half of the costs to the Institute of providing its first-rate facilities and faculty; the difference is met by income from endowment and annual gifts of alumni and friends.

The following is an estimate of an average student's costs for an academic year of 33 weeks.

Tuition	$1,500.00[1]
Board	610.00[2]
Room	370.00
Books and materials	100.00
Health insurance	30.00
Total	$2,610.00

In addition to these costs, a reasonable allowance (probably $200 per academic year) should be made for personal expenditures which include personal necessities, laundry, clothes, and miscellaneous items. It should be understood that this total will vary according to individual tastes and requirements.

During the freshman year there are certain non-recurring expenses such as drawing equipment and slide rules, for which $40 should be allowed. Freshmen must make a deposit of $50 to cover breakage, repair of military uniforms, and laboratory equipment. Refunds on this deposit or bills for excess charges are mailed at the close of the year. Institute health insurance, $15 per term, is required unless a waiver is signed.

Here these items of expense are explained in detail:

ACADEMIC EXPENSES

The regular tuition fee, $750 per term,[1] is all-inclusive; there are no extra assessments such as matriculation fees, extra charges for extra subjects, or activity fees.

This tuition is the same for all years of all Courses, with the exception of certain terms during the Cooperative Courses, when students are working at industrial plants. If you find, after arriving at M.I.T., that you are interested in a Cooperative

[1]$1,300 ($650 per term) until the beginning of the 1960 Summer Session.
[2]This figure does not include the cost of board during vacation periods.

Course, you will want to consult with the Bursar for tuition information. Special tuition fees are established for subjects given during the Summer Session, and these figures are given in the Summer Session Catalogue each year.

LIVING COSTS (BOARD AND ROOM)

The rent for rooms in M.I.T. undergraduate houses ranges in 1958-59 from $150 to $215 per person per term, payable in advance. Freshmen—unless they commute to M.I.T. or live in fraternity houses—are required to live in the undergraduate houses up to the limit of accommodations available; a large number of upperclassmen also choose to live on the campus. All students living in Baker and Burton Houses are required to take their meals in the House dining rooms Mondays through Fridays. Similar service is available in Walker Memorial—on an optional basis—for residents of the East Campus. The present fee for these "commons meals" is $12.50 per week ($212.50 for the fall term and $200.00 for the spring term), providing three substantial meals each week day; similar dining facilities are available on a cash basis on Saturdays and Sundays and during vacations, but many students choose to explore the famous restaurants in Boston and the surrounding countryside for weekend meals.

HEALTH INSURANCE AND MEDICAL EXPENSES

A health insurance plan is available to students of the Institute for a premium of $15 per term. In return for this sum the insurance agency agrees, with certain limitations, to pay up to $1,500 toward meeting the cost of each injury or illness during the term. If any student does *not* wish to be enrolled in this plan, he must sign a waiver; insurance is not necessary for Army, Navy, or Air Force students or for those veterans enrolled under Public Law No. 894. Any student registering after the official Registration Day will be insured only from the date on which he files registration material.

Any student may receive routine medical care in the clinic without charge. The health insurance policy covers the fees charged for the special clinics; uninsured students are charged a moderate fee. The charges for students in the Infirmary are low. Food and nursing care in the wards cost $12 a day. For insured students the cost of these services, too, is borne by the insuring agency.

In cases of serious illness or contagious disease, students are sent for treatment and care to hospitals outside the Institute in the Boston area; fees at these hospitals, up to $15 per day, are paid by the insuring agency. If a student is not insured, these fees, of course, are the patient's responsibility.

PAYMENT OF BILLS

Registration instructions issued before the beginning of each term (and sent automatically to all admitted students) specify the date on which payments of tuition, board, room, and insurance premium are due. *No bills are sent;* meeting these deadlines is each student's responsibility.

BUDGET AND INSTALLMENT PLANS

Monthly budget payments of tuition and of room and board charges may be arranged with the Bursar; make your plans with him *before* the beginning of each term—not later than the Wednesday before Registration Day.

In addition, part of the tuition fee may be paid on a long-term installment plan. This plan requires a tuition down payment of $1,000 ($500 each term), payable either monthly or by terms, but permits the balance of the tuition fee to be met in long-term installments. A detailed description of this M.I.T. Installment Credit Plan is available from the Director of Student Aid.

FINANCIAL AID FOR STUDENTS

To help meet the cost of attending M.I.T. there are three types of financial aid available through the Institute—scholarships, loans, and part-time campus work. These are administered under a coordinated program of financial aids, the purpose of which is to assist well-qualified young people with limited funds and resources who wish to study at the Institute. In addition, there are liberal plans for budget and installment payments, described in the paragraph immediately above.

Each student should make an accurate estimate of his year's college expenses, including the basic expenses outlined in the previous pages, the variable personal expenses, and the needs for transportation. This estimate of expenses should be considered carefully in the light of the funds which he has available: the amounts he may expect to receive from his parents or guard-

ians, savings he may have accumulated, and earnings expected during the summer. His application for financial assistance from M.I.T. should be made only after his estimate is complete.

SCHOLARSHIPS

Approximately one-quarter of the members of M.I.T.'s entering class receive scholarship grants ranging from $300 to $2,200 for the academic year. Although most of these scholarship grants are for the first year only, the Student Financial Aid Committee has funds for the renewal of grants in succeeding years to those who show academic and extra-curricular achievement during the freshman year and who demonstrate continued financial need.

The principal four-year scholarships—the William Barton Rogers Scholarships, the Alumni Fund National Scholarships, the Sloan National Scholarships, and others, including industrial grants—are open to all entering freshmen. In addition, there are a substantial number of Freshman Competitive Scholarships for the first year only, with stipends varying according to need. Other scholarship awards depend upon a candidate's meeting some special qualifications in addition to showing evidence of scholastic ability, such as that he come from a particular locality or be a graduate of a certain school. For instance, Alumni Regional Scholarships, for the first year only, are limited to students from 19 metropolitan areas. A full list of the Freshman scholarships available at M.I.T. appears on the next pages; when you apply for scholarship aid, you should indicate on the application *all* the scholarships for which you believe you may be qualified. Full information, applications, and instructions for the various scholarships may be obtained from the Director of Student Aid, Student Aid Center, Room 5-119, Massachusetts Institute of Technology, Cambridge 39. Completed application forms must be filed early in February preceding the fall term in which the scholarship is to be effective.

Most of these scholarships specify that they be awarded on the basis of achievement and financial need. Selection is made by the Student Financial Aid Committee, on the evaluation of such factors as your secondary school record, College Board test scores, qualities of character and personal bearing, professional promise, participation in school and community affairs, and need as demonstrated by statements supplied through the College Scholarship Service. *(text continues on page 88)*

SCHOLARSHIPS FOR FRESHMEN

Alumni Regional Scholarships, carrying an award based on demonstrated ability and need for the freshman year, are offered in Chicago, Denver, Detroit, District of Columbia, Kansas City, Los Angeles, New York City, New Jersey, Northern Ohio, Philadelphia, Pittsburgh, Portland (Oregon), Rochester (New York), San Francisco, St. Louis, Seattle, Schenectady, Southern Ohio, and Westchester County (New York).

Army and Navy Scholarships are for sons of regular Army, Navy, Air Force, Marine Corps, or Coast Guard officers, who may receive up to one-half tuition, throughout their undergraduate years, depending upon need. (Applications should be accompanied by documentary evidence that the applicant's father is a commissioned officer in the *regular* Army, Navy, Air Force, Marine Corps, or Coast Guard.)

Bridgeport Scholarship (the Horace T. Smith Scholarship Fund), carrying a stipend based on demonstrated need with a maximum of full tuition for the freshman year, is annually offered to a graduate of the high schools of Bridgeport, Connecticut.

Cabot Foundation Scholarships provide funds for children (sons *and* daughters) of employees of Godfrey L. Cabot, Inc., and its subsidiary and associated companies. (Candidates must establish their eligibility by first applying to the Personnel Office of Godfrey L. Cabot, Inc.)

Cambridge Scholarships are granted to graduates of schools in Cambridge and children of legal residents of that city. These scholarships carry a stipend up to full tuition and may be continued in the second, third, and fourth years.

Class of 1895 Scholarship is for qualified descendants of members of the Class of 1895, donors of the fund.

Class of 1922 Scholarship provides awards with preference given to children of members of the Class. (Beneficiaries are expected to issue notes agreeing to repay the face value, without interest, of amounts received.)

Class of 1931 Compton Memorial Freshman Scholarship, a memorial to Dr. Karl Taylor Compton, is open to all freshmen applicants.

Class of 1938 Scholarship, made possible by gifts from the Class of 1938, is open to all freshmen.

W. A. Conant Scholarship is intended for native-born Protestant graduates of New England schools, with first preference to graduates of schools in Brookline, Massachusetts. It is a four-year grant, offered annually to an entering freshman.

Thomas C. Desmond Scholarship for the freshman year is available to a student who plans to study civil engineering.

Development Fund Scholarships consist of four-year grants to students who maintain academic ranking in the top quarter of the class and demonstrate continued need for financial assistance.

William H. Donner Prize Scholarships are prize awards for the freshman year, carrying a stipend of $2,200, limited to students who are planning to study aeronautical engineering.

East Bridgewater Scholarship (Horace T. Smith Scholarship Fund) is annually offered to a graduate of the high school of East Bridgewater, Massachusetts; the maximum award is full tuition.

Elks Scholarship for a student who plans to study in science or engineering, resident of Massachusetts, American citizen, is a grant of up to $2,500 renewable each year for four years.

Fall River and Swansea Scholarships (the Albert G. Boyden Fund), for the freshman year only, are annually offered to qualified applicants residing in Fall River or Swansea, Massachusetts.

Francis Morgan Frasher, Jr., Memorial Scholarship, tuition for the freshman year only, is for graduates of high schools in San Antonio, Alamo Heights, or Bexar County, Texas, who will study in science.

Freshman Competitive Scholarships vary according to need, cover the first year, and are awarded without geographical restrictions of eligibility.

General Motors Scholarships are four-year grants, established under the General Motors College Scholarship Plan, intended for outstanding entering students.

Humphrey M. Haley Scholarship is awarded with first preference to students from St. James Parish, Salem, Massachusetts.

Charles Hayden Memorial Scholarships are given in memory of the late Charles Hayden, '90.

Jakobson Scholarship carries a grant of $1,000, for which first preference is to a son of an employee of Jakobson Shipyard, Inc.; second preference to graduates of high schools in Glen Cove, Huntington, Manhasset, Oyster Bay, Port Washington, Roslyn, or Sea Cliff, New York; and third preference to entering students from elsewhere on Long Island, excepting the counties of Kings or Queens.

Knapp Memorial Scholarships are for students entering M.I.T. from the Buffalo area and Erie County.

Amelia S. Kneisner Scholarship is awarded with preference to graduates of the high schools of Danbury, Connecticut.

Jacob and Jennie Lichter Fund is "for the aid of students who shall satisfy all entrance requirements of the Institute and be endorsed as to character and personality."

Charles E. Locke Memorial Fund provides grants with preference to descendants of members of the Class of 1896, including freshmen.

Lockheed Leadership Fund Scholarships are for United States citizens under 25 years of age who plan to major in a field of engineering applicable to the aircraft industry. Grants are for full tuition plus $500 toward living expenses, renewable for the total undergraduate period.

H. W. McCurdy Scholarship (Puget Sound Foundation) is for an entering freshman who plans to follow a career in naval architecture or mechanical engineering, with preference to a student from the Seattle area.

Martin Aircraft Scholarships are for male students planning to pursue Courses most applicable to the activities of The Martin Company, with preference to residents of Maryland (including the District of Columbia) and especially to sons of employees of The Martin Company.

Waldo A. Martin Scholarship, for the freshman year only, is awarded with first preference to friends or relatives of Waldo A. and Eleanor P. Martin and second preference to graduates of Milton High School, Milton Academy, or residents of Milton.

M.I.T. Alumni Fund National Scholarships were established by the M.I.T. Alumni Fund Board to give opportunity to well-qualified young people from throughout the United States to come to the Institute; continued awards depend upon achievement and need.

M.I.T. Boston Stein Club—New England Scholarships provide one or more awards for the freshman year only to New England residents.

M.I.T. Club of Chicago Scholarships are restricted to entering men who reside in the area of the club membership.

George H. May Fund provides a scholarship to assist graduates of the Newton High School. (Beneficiaries under this fund are expected to issue notes agreeing to repay, without interest, the amounts received.)

Milton High School Fund, founded by the Institute in recognition of contributions from residents of Milton, provides a scholarship for former students of the Milton High School.

Joseph R. Minevitch Memorial Scholarship is to assist public high school graduates, with first preference to graduates of the Boston English High School and second preference to graduates of any other Boston public high school.

Naval Architecture and Marine Engineering Scholarship, established by the Society of Naval Architects and Marine Engineers, is given each year to a secondary school graduate who plans to enter the field of naval architecture and marine engineering; each grant may be renewed for three additional years.

Niarchos Scholarships provide opportunities for higher education to the sons of merchant seamen. Holders of these scholarships are given opportunities to work in the marine field during summer vacations.

Pittsburgh Consolidation Coal Company Scholarship is a four-year grant open to male residents of the northeastern United States who wish to study chemical engineering or chemistry; recipients may be considered for summer employment by the Company.

Procter and Gamble Scholarships are four-year grants open to entering students who plan to study engineering or science; they cover tuition plus an added amount for books and supplies.

Willis Ward Reeves, Jr., Fund provides scholarship aid with preference to undergraduate students from Kentucky.

William Barton Rogers Scholarships are four-year grants established in honor of the founder of the Institute, providing full tuition plus $300 for the first year and full-tuition awards for the remaining undergraduate years.

Frederick J. Shepard, Jr., Fund (Lewis-Shepard Fund) is used to assist needy and worthy young men from New Hampshire with first preference to graduates of Pinkerton Academy, Derry Village, New Hampshire.

Frank Arnold Sherman Scholarship. The income from this bequest is awarded with first preference to a male graduate of Westerly High School, Rhode Island, or of other Rhode Island high schools.

Sloan National Scholarships provide aid for outstanding students in science and engineering. Sloan National Scholars hold positions of academic honor at the Institute. Grants range from a $200 prize scholarship to $2,000 and are renewable each year.

G. H. Miller Smith Fund provides scholarship aid with preference to undergraduates from Tennessee.

Albert F. Sulzer Scholarship is designated for first-year students who are non-residents of Massachusetts.

Vermont Scholarships are given with first preference to residents of Vermont.

Granger Whitney Fund provides scholarship aid with first preference to students nominated by the Detroit M.I.T. alumni club.

Arthur Williams Scholarship is used to assist men studying in the engineering professions or business administration.

(text continued from page 85)

In granting scholarships the Committee expects that holders will qualify through achievement for continuing assistance beyond the freshman year if needed.

There are often individual problems in connection with scholarships which are best discussed as such. The Director of Student Aid will be pleased to hear from you. Your questions should be sent as soon as possible, since the final date for scholarship applications is quite early.

LOAN FUNDS

The Technology Loan Fund, one of the largest college loan funds in the nation, is available for entering freshmen in amounts less than full tuition for the first year, as a supplement to scholarship awards. After one year of residence, any undergraduate with a satisfactory record may apply for direct grants up to the amount of tuition or to supplement scholarship awards. These loans bear interest at one per cent per year during enrollment and are repayable in semi-annual installments of $150 beginning six months after graduation; the interest rate after graduation increases to two per cent per annum. The maximum loan to an individual may not exceed $5,000 during his undergraduate period or $6,000 during his undergraduate and graduate periods.

The Boston Stein Club Loan Fund, established by alumni members of the M.I.T. Boston Stein Club to help students from Greater Boston, is available only to first-year students who show good promise. Grants, in general, are for less than full tuition. Recipients will be required to sign notes to repay the amounts granted, without interest, after graduation.

STUDENT EMPLOYMENT

Through the Office of Student Personnel, M.I.T. stands ready to help and encourage students who must earn part of their expenses during the college year. Although a new student should not commit himself too heavily until he has fully adapted to his academic program, experience has shown that young people of good ambition can do a reasonable amount of outside work without detracting from their total education. It is not advisable nor practicable for a new student to anticipate that he may earn *all* of his living expenses during his first college year.

Positions are available in the dormitories, dining services, and other divisions of the Institute. The time that may be de-

voted to these positions is limited, with slight variations, to between ten and twelve hours per week as a maximum, and income may be somewhat more than $175 per term and more than $350 for the academic year.

BANKING FACILITIES

Students are encouraged to maintain their own checking accounts in commercial banks, either in their home communities or in the Boston area. The Institute maintains a Personal Deposit Office where students may deposit their personal funds in amounts up to $1,000 and draw upon them without charge or interest.

DORMITORIES AND FRATERNITIES

Freshmen may live in any of the Institute's undergraduate houses. As soon as you are admitted to M.I.T. you go on a list to receive, when it is ready in mid-summer, complete information about the facilities available, the rates which apply to each room, the equipment and service offered, and the regulations which apply to dormitory residents. In general, rooms in the houses are provided with the furniture needed for a comfortable year, and there is telephone service. Residents supply their own blankets, bed linen, soap, and towels. There are attractive lounge rooms in each house, and an active social life centers around each of the Institute's dormitories. Many of the rooms overlook the Charles

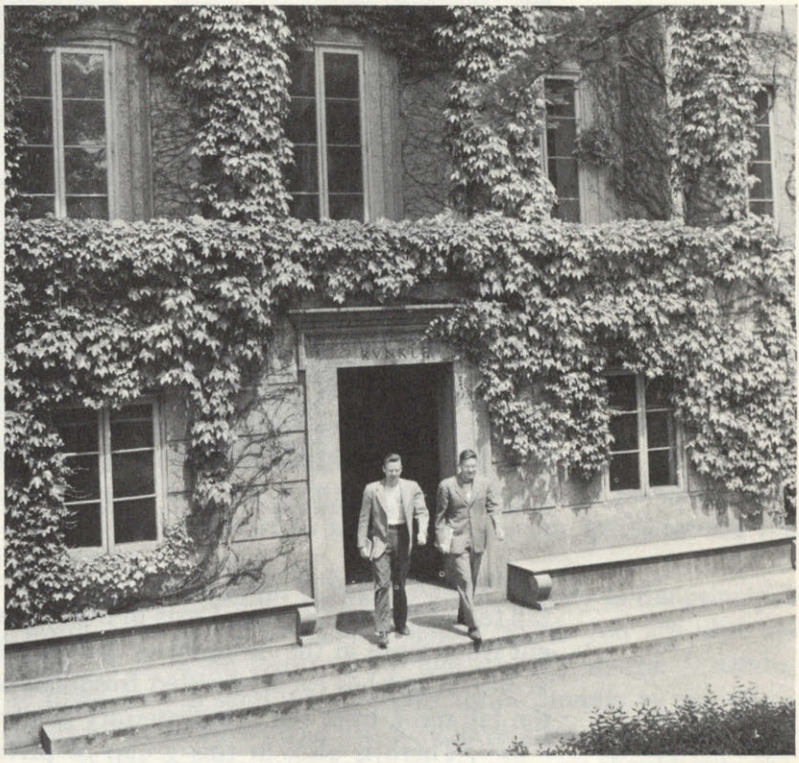
Burton House entrance

River, giving attractive views of the basin and the Boston skyline beyond. Faculty residents in each of the houses welcome informal and friendly discussions with students and their friends.

You may wish to consider joining one of the 28 fraternities which have active chapters at M.I.T. But whether or not you expect to join a fraternity, you should apply for accommodations in the undergraduate houses. When you are accepted for fraternity membership you can withdraw your dormitory application without penalty—if you do it promptly. Fraternity membership is by

The Everett Moore Baker House

Theta Delta Chi

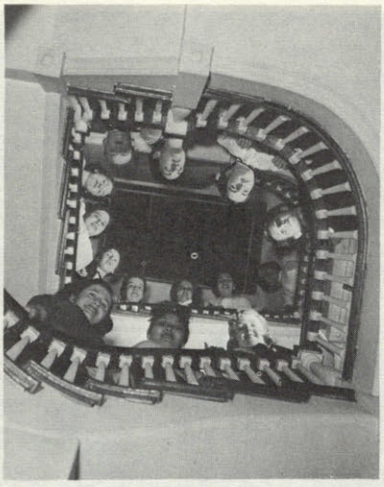


Runkle, on the East Campus

Hobbies in the dormitories.

A Christmas party for underprivileged children.

Fraternity Stairway.



In the Women's Dormitory

Bexley Hall apartment

invitation only, after the formalities of a Rush Week before the fall term begins each year. Costs in fraternities are not very different from those in the dormitories. Information about fraternities at M.I.T. reaches each admitted freshman several months before the fall term, from the Interfraternity Conference.

There is also, in this group of private accommodations, the M.I.T. Student House, organized by a group of alumni to provide attractive and unusually economical living arrangements. Students living here operate the house themselves and do much of their own work—aside from cooking and certain items of maintenance—thus reducing the total of board and room expense by as much as $250 a year. For information about membership in this group you should write directly to the President of the House at 111 Bay State Road, Boston 15.

The Women's Dormitory, at 120 Bay State Road in Boston, accommodates 17 freshmen in an attractively furnished house with a home-like atmosphere. Residence here is required for first-year women who do not live at home. There is a House Mother in residence, and breakfast and dinner are served by the residents of the house in accordance with a schedule planned in advance. The girls also have the privilege of preparing their lunches with food provided by the house. Bexley Hall, in Cambridge, is an apartment dormitory for upperclass and graduate women, with a Faculty Resident and his family.

HOW TO APPLY TO M.I.T.

As soon as you know that you may be interested in coming to M.I.T., you should file with the Director of Admissions (Room 3-108, Massachusetts Institute of Technology, Cambridge 39) a preliminary application. This will put you on the mailing list for all current information about M.I.T.—including new editions of this catalogue. With a preliminary application on file, you will also automatically receive your final application material in the fall preceding the year you wish to enter.

You should complete and return the final application form and coded information sheet, and send with them a non-returnable application fee of $10. (A check or money order is preferred.) The endorsement forms included should be given to two of your teachers who are in a position to tell us of your personal characteristics and interests as they relate to your qualifications for the Institute.

The school report should be given directly to the principal or headmaster of the secondary school which you are now attending; it is to be returned by him directly to the Institute. The Institute will send school report forms directly to any other high or preparatory schools you may have attended.

If you are applying for financial aid, you should note the directions for obtaining application forms as well as the deadline for filing applications—these are given earlier in this section, under "Financial Aid for Students."

INTERVIEWS

Each applicant for admission to the freshman class is expected to have a personal conference either with a member of the Admissions Office staff or with a designated member of the M.I.T. Educational Council who is near his home.

Council members are alumni who have been selected for their ability to represent M.I.T. and for their interest in and liking for young people. These men welcome the opportunity to meet students interested in M.I.T. and to help them with their educational plans.

Each applicant will be referred to a member of the Council at the time of his Preliminary Application for admission. The conference should take place not later than mid-February of the senior year and preferably early in the fall.

President's reception

Applicants and other interested students and their parents will be welcome at the Admissions Office on Mondays through Fridays between 9 and 5; an appointment is not necessary. Visitors may wish to include a student-guided tour of the campus, available at 10 and 2 o'clock each day that the Admissions Office is open.

ADMISSION

Early in May of each year the Admissions Office reports on their status to most applicants for the class entering the following fall. During the summer, after you have an official admission statement, will come information about registration, dormitory room selection, and Rush Week and fraternities—and a medical form for your family doctor. Dormitory room assignments are completed only after admission has been secured.

ADVANCED PLACEMENT

College-level courses designed for selected groups of students of better-than-average ability are offered in the eleventh and twelfth grades of many secondary schools. M.I.T. has traditionally encouraged students to move ahead academically according to their capabilities, and we are anxious to cooperate with these plans for talented students. There are now two procedures by which entering high school graduates may establish their readiness to pursue advanced subjects here.

If you take college-level courses offered in high school in conjunction with the Advanced Placement Program sponsored by the College Entrance Examination Board, you should plan to take the appropriate subject matter tests given by the Board each year in May. The results of these three-hour examinations will be sent to M.I.T. by the Board, and when you arrive here to begin your first term the amount of credit for advanced subject placement which fits your scholastic development will be determined in consultation with the appropriate subject examiner and with the approval of your faculty adviser.

If you are unable to take the College Board Advanced Placement Tests you may, with permission of the Director of Admissions, take Advanced Standing Examinations given by the Institute. Examinations for advanced standing in subjects having laboratory work or in languages and the humanities may be taken only with the additional consent of the instructor in charge of

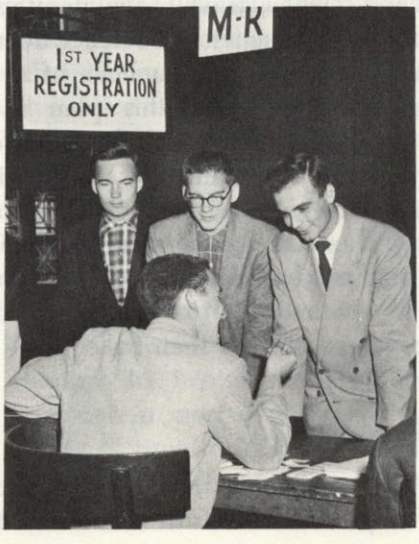
FRESHMAN WEEKEND . . . *the Dean's welcome*

the subject. The examinations are given during the week prior to registration for the fall term; students who plan to enroll for the first time in September should write to the Director of Admissions about these tests before August 1.

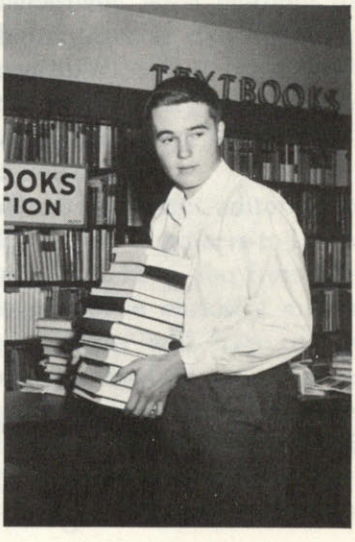
COLLEGE TRANSFERS

Most M.I.T. students enter the Institute directly after graduation from high or preparatory school. Each year, however, a few

. . . *signing in*



. . . *bookstore patrol*



enter as "college transfers," following one or more years of college elsewhere. The Committee on Admissions reviews the records of such applicants just as they do those of prospective freshmen. Transfer students are expected in every case to have completed the academic preparation required for admission directly from secondary schools, and their college records should give evidence of ability in higher-level studies. Detailed information about transfer students' admission is available from the Director of Admissions.

ADVANCED ACADEMIC CREDIT

Students admitted by transfer may expect to receive advanced credit for subjects completed at other colleges which are substantially equivalent to M.I.T. subjects; a grade above the lowest passing grade is the minimum necessary for the transfer of credits.

A student who contemplates transfer to M.I.T. from another college should plan his program of study so that he covers the basic subjects of the Course he expects to enter. At least one year each of college mathematics and physics should be included.

THE TWO-DEGREE PLAN

A number of liberal arts colleges grant their bachelor's degrees to students who have attended for three years and who have then gone on to qualify for bachelor's degrees in engineering, science, or architecture at M.I.T. or a similar institution. A student who plans his three college years carefully to include the requisite mathematics and science, as well as humanities and social studies, can usually obtain the Bachelor of Science degree at M.I.T. in two additional years (three for the Bachelor of Architecture).

Students interested in this plan should communicate directly with the college they wish first to attend and secure admission there. Later acceptance at M.I.T. will depend, as with all transfer applicants, on the quality of the college record.

College transfers are, in general, not eligible for financial aid during their first year of attendance. Exceptions may be made for students of outstanding promise who are designated as members of a two-degree plan by their college and are already receiving financial aid there.

HOW TO BEGIN AT M.I.T.

The fall term begins for freshmen on the Thursday before Registration Day—which in turn is the next to the last Monday

Registration Day

in September. (First-year students are not admitted at other times of the year.) Dormitory rooms for entering students are ready on Wednesday afternoon. Upperclassmen are not due before Registration Day; this means that first-year students arrive on the campus in time for four days of special programs which are designed to help them get acquainted with their classmates and with M.I.T. There are general introductions by members of the faculty, administration, and student organizations; there are social activities so that you may get acquainted with your classmates; there are tours and visits to introduce you to the campus; and there are conferences with faculty advisers to help you plan your program.

You will have further information about registration itself during the summer before you arrive at M.I.T.

Every entering student is required to be immunized against tetanus and smallpox before he arrives at M.I.T. Soon after you register you will have a complete physical and dental examination, including a chest x-ray.

Your registration is not considered complete until you have paid the tuition, board, room, and other fees at the times specified in the registration instructions. Since no bills are sent by M.I.T., this is a matter of your own personal responsibility; a charge of $5.00 is made if any one of these payments is late.

WHAT TO BRING

The Institute doubts the need of telling you what clothing to bring to M.I.T. (this is a pretty informal place in that respect), what decorations you will want for your room, and to bring your skis or ice skates. But some other things that may not at once occur to you are even more important. Here are a few suggestions:

Bring an open mind. A dormitory newsletter editor once warned new arrivals here, "Some of the best engineers-to-be in the world are your buddies, but they cannot keep you from falling into a rut." If you arrive with an active curiosity and a determination to discover for yourself, you will have many chances to investigate all these things; and if you are a beginner in most of them, as you probably are, you will have plenty of time to look around and to learn the fundamentals of any new field of activity in which you decide to take part.

(*text continues on page 100*)

". . . choose the important aspects of life and live in accord with them."

Bostwick F. Wyman of Columbia, South Carolina, reports on his first year as a member of M.I.T.'s Class of 1962.

I first reached Boston late one afternoon, at the beginning of Rush Week. Although I didn't join a fraternity, I'm still glad I came then, because everyone was very helpful, and I was pretty well fixed by the beginning of Freshman Orientation Week.

The Orientation Week helped, though. I saw more of the Institute than I've seen since—the reactor, out-of-the-way research labs, the little back alleys. Gradually I learned which way is up.

Two things about M.I.T. impressed me most. First, the people, millions and millions of them (it seemed) from all over. Variety of personalities is evident in classes, in the halls, and in the dormitories. Second was the lack of rules and regulations. It's advisable not to have a hot plate in the dorms; otherwise, only you, and perhaps your roommate, care how you live. You must choose the important aspects of life and live in accord with them. I find I'm a harder taskmaster than my family ever was.

Don't believe anyone who tells you that M.I.T. men are illiterate engineers. Courses here are such that one can take almost anything he wants; the choice is tremendous. Freshman advisers are nice to have around, since they know more about available courses than we benighted freshmen. When I needed an extra course in the second term, my adviser suggested 14.01, Economics—normally a sophomore subject. I like the course a lot, but I probably would not have taken it on my own, mainly because I had just barely heard of it.

It's hard to really judge how much homework one is doing. I have the general impression that I'm working hard, but I get bogged down when I try to count hours. About 20 hours a week, according to the Institute, and slightly more than this by my stopwatch. Institute work will be quite a bit more than high school for most people; but I don't think homework would really bother anyone, unless he has a long-standing "I don't need to study" complex. The important thing is to keep up: most of the courses require absorption of material, and it's difficult to learn a month's work in one night.

Concerning sports and extracurricular activities—the trouble is staying out, not getting in. Name it; we've got it. If you're very imagina-

tive and think of something that isn't available, start it yourself. It's easy to do.

My two activities are writing and chess. There are three regular publications on campus and several annual literary magazines and competitions. The M.I.T. Chess Club is fairly strong, despite the fact that the Institute is more of a bridge-playing school.

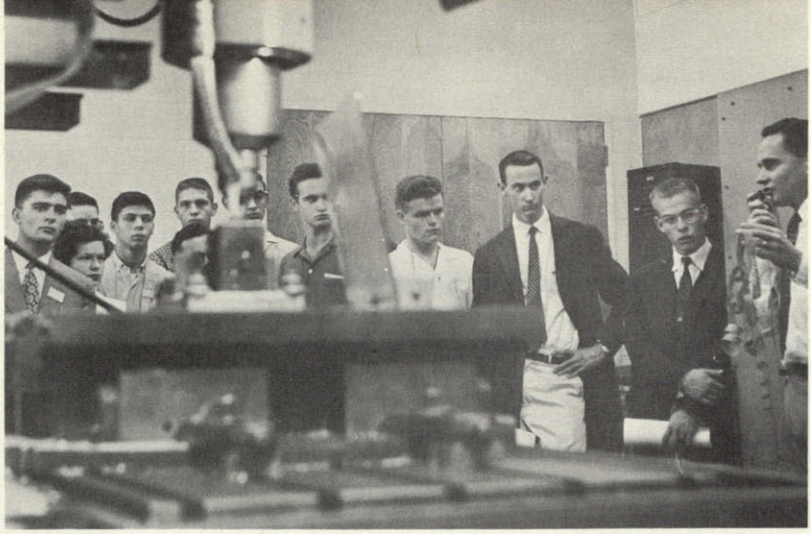
Statistics say that girls in Boston outnumber the boys. This is easy to believe, since there are many small girls' schools around as well as the big-name colleges, and the M.I.T. man is in a pretty sound position socially. There are dances about once a week during the year, with flurries of acquaintance dances in the fall and spring. Once you meet a girl there is never any problem: Boston reeks of cultured (and uncultured) night life.

Sports are varied and a lot of fun. There is room in the system for Tarzan of the Apes, but in general it is set up for the average player. The point is to enjoy yourself. I did, and I had undisputed possession of the cellar position on the squash ladder.

When one applies to M.I.T., he is requested to choose a Course of study. Don't think you are bound by your choice; there's nothing holy about it. Courses aren't even punched on freshman roll cards (the I.B.M. 704 is supreme here), and one may change conveniently up to the end of the sophomore year.

If you expect to do basic research with expensive equipment, you may be temporarily disappointed. A special program was started this year to give freshmen a chance to work on research with a faculty member in a field of their choice; but mostly the emphasis in the first year is on the necessary fundamentals.

Success at M.I.T. probably depends on the ability to make valid, independent decisions. One whose ambition is to escape as much work as possible will probably conclude that "Tech is hell." My guess is that a student who comes here to learn, and keeps that goal throughout his stay at M.I.T., will develop an approach to things that will stand by him all his life.



"Bring an open mind . . . an active curiosity . . ."

(*text continued from page 97*)

You may gain perspective by exploring your own particular aptitudes as they are revealed by your progress during the first year. You will have time to learn which fields at M.I.T. most closely satisfy your own abilities. You will have a chance to discuss these matters with your fellow students, with your instructors, and often with men in industry; you may be able to find out what specific opportunities exist for the combination of ability and application you have discovered in yourself. The initiative is your own.

Self-confidence is important. You will find yourself a beginner in the midst of many people at various stages of progress in learning and research. There is nothing wrong with being a beginner; and a beginner who shows enthusiasm and eagerness to learn, who demonstrates his good attitudes by hard and careful work, and who rewards friendship with an interested and interesting personality . . . such a freshman earns as much respect here as an expert in research or an established leader in campus activities.

A sense of responsibility is essential. As a freshman you will probably have more freedom in managing your own affairs and in making your own decisions than you are used to. There are few rules at the Institute. The key to freedom for everyone lies in the limitations each individual places upon himself in order not to infringe on the freedom of others. At M.I.T. you can establish a foundation for good citizenship throughout your life.

Be assured that everyone at M.I.T. is looking forward to meeting you and to hearing what you have to say. Friendship is one of the cornerstones of the Institute; even before you arrive, you have friends here waiting for you.

4 *Educational Opportunities at M.I.T.*

The chart in Section 2 listing M.I.T.'s professional Courses shows that an M.I.T. education may focus on any of a large number of fields which lie within the general influence of science, engineering, architecture, and management. You may learn more about each of these fields as they are presented at M.I.T. by studying, on the following pages, the statements prepared by the heads of each Course. Here, too, you will find the "curriculum" for each Course, showing all the required subjects in the order in which they are best taken, as well as the various choices by which undergraduates may fulfill their special interests within the field.

There are certain fundamentals common to all the fields of science, engineering, architecture, and management. Subjects in these common fundamentals are the principal content of the first year at M.I.T. Thus the first year gives each M.I.T. student an opportunity to gain perspective and to judge his own aptitudes. There is time to learn which phases of science or engineering most closely match your own abilities. You will be able, through discussion with fellow students, through conference with your instructors and advisers—whom you will be seeing frequently,—and

perhaps through direct contacts with industry and business, to find what specific opportunities exist for you at M.I.T.

In the last analysis, the responsibility for choosing a curriculum to follow after the first year will be your own; no one else can make it for you. You should be aggressive in seeking the knowledge on which to base this choice. Go to your instructors in their offices; visit plants; accumulate experience through summer jobs; talk with those who are experienced in fields which interest you. Then, when you enter your profession, you will be equipped to find your place in the new environment quickly and effectively.

FLEXIBILITY WITHIN THE COURSES

Flexibility in planning a program within each Course is provided by electives, by the possibility of substituting other subjects for certain of those specified in the Course, and by the Institute's plan for examinations for advanced standing; such examinations enable students of superior ability or unusual experience to progress more rapidly or to include extra elective subjects in a four-year program. Indeed, while the sequences of subjects shown on the following pages indicate a normal four-year program in each field, the student who follows this program literally is definitely in the minority.

You will notice that, although most curricula include study only in the two regular terms of the school year, the three Cooperative Courses, the Course in Geology and Geophysics, and the Course in Metallurgy have scheduled activities during one or more of M.I.T.'s summer sessions. The calendar at the front of this book gives the dates involved.

Dean Belluschi

"The architect must be a competent technician. He must also be a man to whom people and life in all its facets and mysteries are objects of fascination, delight, and concern. His task in society, therefore, is no longer to follow old styles or merely to create new ones but to give meaningful interpretation in physical terms of our complex civilization, to reflect our way of life and the substance of our culture."

—Dean of Architecture and Planning Pietro Belluschi, March, 1957.

ARCHITECTURE

Professor Lawrence B. Anderson

Architecture today, as always in history, is the art of creating structures and spaces that can enhance the dignity and meaning of human life.

The architect is trained to provide his community with the physical environment that fosters more orderly and creative civic life. Towards that end, leading citizens throughout the community—in industry, education, finance, religion, medicine, law, and government—require the services of the architect. He works with energetic, practical, and imaginative designers; he integrates the work of many specialists; and his colleagues are members of a dynamic profession which promotes urban, national, and international exchanges of ideas about techniques and social objectives of architecture.

In working towards the constructive, humanitarian goals of his profession, the architect must rely both on craftsmanship and theory. He uses his technical skill to make protective shelters perform well, to design buildings that will be safe, convenient, comfortable, durable, economical, in visual harmony with their surroundings, and esthetically satisfying. He uses his understanding of people and institutions to develop cultural aspirations in visual form, to analyze and interpret the needs of his clients, to imagine arrangements in space that will translate these needs into structural form, to develop his concepts verbally and graphically, and to win their acceptance.

Consequently, the architect who has been educated both in engineering technology and in broadly scientific and humanistic ideas will best solve architectural problems. Only then will he be prepared to coordinate effectively the work of the special design consultants upon whom he relies for detailed analyses, to instruct the contractors in the execution of his designs, and to represent and guide his clients until the work is completed.

At M.I.T. the Department of Architecture offers an education in both the craftsmanship and theory of architecture. The general subjects in the humanities and in the pure sciences provide a foundation in history, in ideas and verbal expression, in people and social structure, and in methods of scientific investigation. To this is added the special contribution of the Institute: technological training in related engineering fields such as structures, materials, heating, lighting, and acoustics. Another branch of studies, visual design, encourages students to develop their visual experience by learning to think in three dimensions; to investigate the vast resources in the organization of lines, planes, textures and colors; and to bring visual order to their structural inventions. Throughout the Course these specialized fields are coordinated in the design classes where the students, with the aid of instructors, solve modern, realistic architectural problems of many kinds.

This five-year program emphasizes the processes and the educational climate that develop in the student the techniques and goals of the professional architect. The internationally recognized achievements of alumni indicate the scope of the architectural education that has been developing for almost a century at M.I.T. In each drafting room students work individually upon a whole problem; each is assisted by instructors and distinguished visiting architects; and each discusses his drawings or models before a group of critics. This experimentation with solutions proposed by individual students from differing backgrounds encourages vigorous, productive thinking.

The graduate is equipped to perform a supporting role in an architectural office, where experience accumulates the practical skills that lead to professional licensing. Later he will decide whether to seek independent commissions in order to be more free to develop his personal design signature or to remain as part of the team, where he can also, in a different way, learn excellence in the task that best suits his talents. He may choose to become a specialist or to enter teaching or research.

In the United States today, architects capable of imaginative innovation and leadership form a small group with great responsibilities. In twenty-five years, expanding population and industry will require a great building program; this larger responsibility will be that of the architectural graduates of the next few years.

Architecture (Course IV-A)

FIRST YEAR

First Term

Engineering Drawing (2.721)
Physics (8.01, Mechanics)
Calculus (18.01)
Introduction to the Humanities (21.01)

Second Term

Descriptive Geometry (2.722)
Physics (8.02, Mechanics, Kinetics)
Calculus (18.02)
Introduction to the Humanities (21.02)

In his first two years each Architecture student is expected to take at least 22 elective units. Elective subjects normally chosen during the first year include: Astronomy, General Chemistry, Earth Science, Elementary Meteorology, Graphics Laboratory, Graphical Processes, Elementary Nomography, Philosophy and Scientific Methodology, Topics in Discrete Mathematics, Basic Machine Drawing, Structure of the City, Man's Food, Perspectives in Life Science, English Composition, Public Speaking, Elementary Number Theory, Air Science, Military Science, Introduction to Automatic Computation, *and any French, German, or Russian subject for which the student is prepared*

SECOND YEAR

First Term

Form and Design
Architectural Form and Structure
Physics (Electricity, Magnetism)
Humanities

Second Term

Applied Mechanics
Architectural Design
Physics (Optics, Atomic Physics)
Humanities

THIRD YEAR

First Term

Architectural Design
Structural Analysis
Introduction to Art and Architecture
one elective subject
and one elective in Humanities

Second Term

Architectural Design
Structural Analysis
City Planning Principles
Modern Art and Architecture
and one elective in Humanities

FOURTH YEAR

First Term

Heating and Ventilation
Architectural Design
Materials—Masonry and Metals
one elective subject (see right)
and one elective in Humanities

Second Term

Heating and Ventilation
Architectural Design
Materials—Wood, Plastics, and Fabrics
one elective subject (see right)
and one elective in Humanities

FIFTH YEAR

First Term

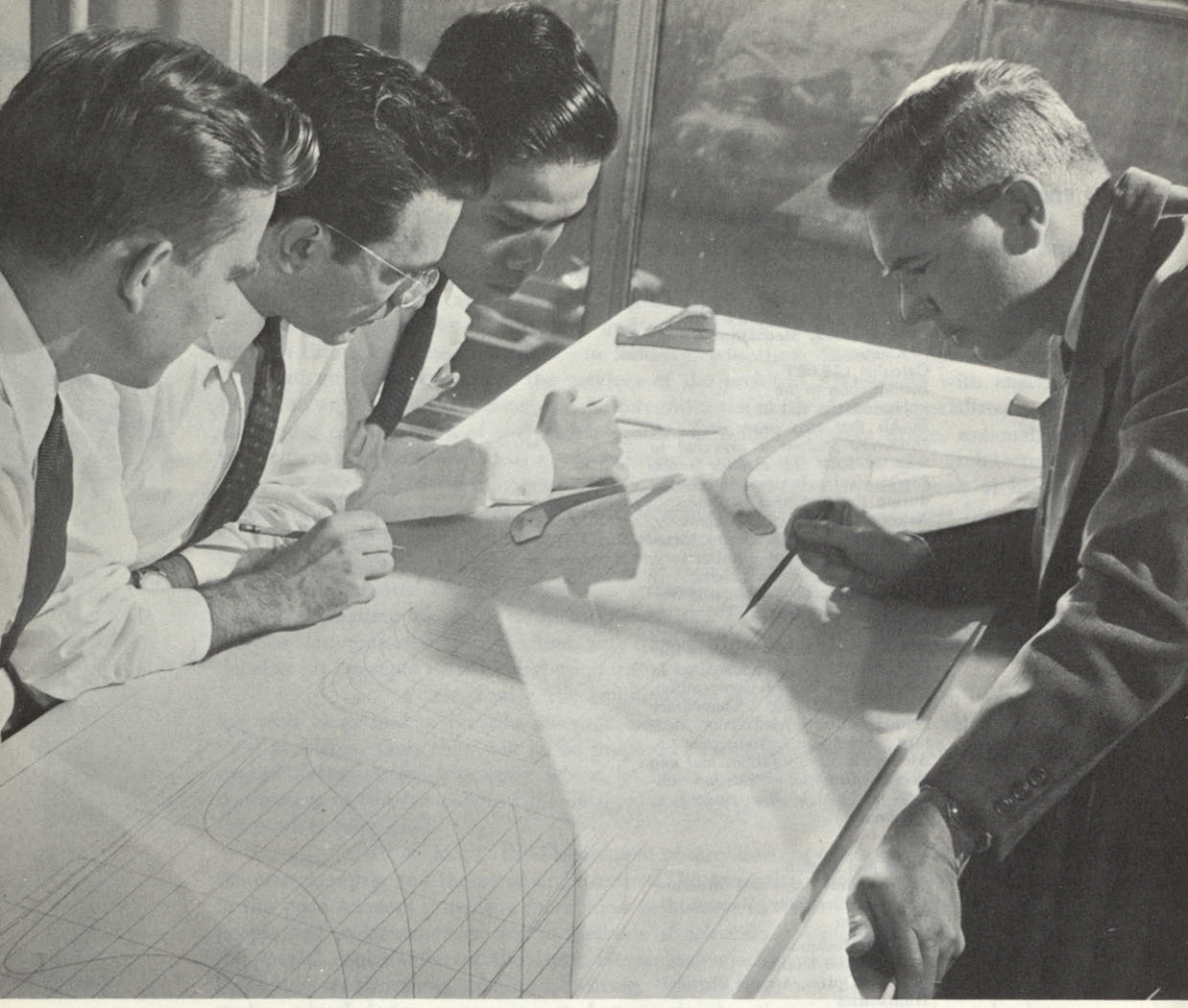
Light and Color
Architectural Design
and one elective subject (see right)

Second Term

Thesis
and several elective subjects (see right)

Each student is expected to plan with his Registration Officer an elective program for the fourth and fifth years based primarily on the subjects listed below. He may include additional subjects in the Humanities, *and he may propose appropriate graduate subjects or subjects from other departments if he is properly qualified.*

Structures Seminar, Architectural Acoustics, Industrialized House, Architecture of Cities, Architecture in the Contemporary City, Theories of Architecture, Architectural Criticism, People in the Urban Environment, City Structure and Economic Development, Real Estate Economics, Electricity, *and* Illumination



Dean Brown

The engineer is the revolutionist in today's revolution in technology. Increasingly, his achievements derive more from a mature shaping of today's scientific knowledge than from skillful backyard invention. And while he is the instigator of change in his own profession, he is the efficient cause of rapid change in the economic, social, and cultural environment of the world in which he lives.

—Dean of Engineering Gordon S. Brown, June, 1959.

AERONAUTICS AND ASTRONAUTICS

Professor Charles S. Draper

Flight is a word which means passing above or beyond ordinary bounds. It is only recently that these bounds have been extended toward their ultimate limits, now that long-range ballistic missiles and earth satellites are accomplished facts, and interplanetary trips are in the stage of active planning. Astronautics, a name which implies travel among the stars, where effects due to the earth's atmosphere have disappeared, is certain to be an important field of technology in the future. It is in fact a normal development from aeronautics, which is concerned with vehicles that fly within the atmosphere. The solid background in science, mathematics, and the humanities which is essential for aeronautical engineers is equally important for men who are to be leaders in the field of astronautics. In addition, the mental attitude of accepting the responsibility for conceiving, designing, building, and operating complete aircraft—characteristic of education in aeronautics—is ideally suited for astronautical developments. The career of any aeronautics and astronautics student is certain to be stimulating and his work exciting; he can be sure of high rewards in personal satisfaction and professional achievement.

Aeronautics as a field of technology began just over fifty years ago, when Wilbur and Orville Wright's plane flew at Kitty Hawk. Today aircraft carry man over the face of the earth at twice the speed of sound, and we predict without hesitation their penetration of space. No other field of technology has ever before progressed so far, so fast.

Aeronautical and astronautical engineers are called upon to take charge of developing, manufacturing, and operating many vehicles, including helicopters; subsonic, transonic, and supersonic aircraft; air-supported guided missiles; ballistic missiles; earth satellites; and interplanetary vehicles. At M.I.T., education for these exacting and complex tasks is based on knowledge of science and ability to use mathematics, combined with judgment developed by personal contacts with faculty members who are experienced engineers.

In order to distinguish clearly between basic principles and special applications, the professional work in the aeronautics and astronautics curriculum is divided into four major areas: aerodynamics, structures, propulsion, and control. These fields, which naturally overlap to a considerable extent, are coordinated in both theory and practice by means of comprehensive projects which the individual student chooses from the wide range of important problems in aeronautics and astronautics. Each student has considerable freedom to direct his attention toward research, toward engineering applications, or toward any intermediate combination of these fields. We hope that the undergraduate work will give each student a sound knowledge of each of the four basic fields and an opportunity for professional specialization under the guidance of a faculty adviser.

Beyond the four-year programs that lead to the bachelor's degree, properly qualified students may continue studies in master's degree or professional engineer degree programs or may plan a longer period of graduate study leading to the doctorate. Because this education provides a wide range of knowledge and abilities, men holding degrees in aeronautics and astronautics often find that they are well qualified to work in many other fields. Aeronautics and astronautics is especially recommended for individuals who want to play important roles in the very exciting period of technology that lies just ahead.

FIRST YEAR

First Term	General Chemistry (5.01) Physics (8.01, Mechanics) Calculus (18.01) Introduction to the Humanities (21.01) *and at least 12 units of elective subjects during the first two years; first-year electives are described in Section 5.* A Graphics *subject is recommended*	*Second Term*	General Chemistry (5.02) Physics (8.02, Heat, Kinetic Theory) Calculus (18.02) Introduction to the Humanities (21.02) *and at least 12 units of elective subjects during the first two years; first-year electives are described in Section 5.* A Graphics *subject is recommended*

	Aeronautics and Astronautics (Course XVI)		**Cooperative Course (Course XVI-B)**
SECOND YEAR			
First Term	Applied Mechanics I Physics (Electricity, Magnetism) Aircraft Detail Design Introductory Aeronautical Engineering Calculus Humanities	*First Term*	Applied Mechanics I Physics (Electricity, Magnetism) Aircraft Detail Design Introductory Aeronautical Engineering Calculus Humanities
Second Term	Heat Engineering Physics (Optics, Atomic Physics) Flight Dynamics Differential Equations Humanities	*Second Term*	Mechanical Behavior of Materials Physics (Optics, Atomic Physics) Flight Dynamics Differential Equations Humanities
THIRD YEAR			
		Summer	*At M.I.T. (first six weeks):* Heat Engineering Flight Dynamics *Vacation (two weeks)* *At plant (remainder of summer):* Industrial Practice
First Term	Mechanical Behavior of Materials Fundamentals of Electrical Engineering Flight Dynamics Aerodynamics *and one elective in* Humanities	*First Term*	*At plants:* Industrial Practice
Second Term	Aircraft Performance and Stability Structures Principles of Automatic Control Aircraft Propulsion *and one elective in* Humanities	*Second Term*	*At M.I.T.:* Fundamentals of Electrical Engineering Aerodynamics Structures Principles of Automatic Control *and one elective in* Humanities
		Summer	*At M.I.T.:* Aircraft Performance and Stability Aircraft Propulsion *and one elective in* Humanities

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FOURTH YEAR			
First Term	Aeronautical Systems Aeronautical Engineering *one elective laboratory subject* *one elective subject in* Humanities *and one professional or* Humanities *elective subject*	*Second Term*	Aeronautical Engineering Thesis or Project *and three elective subjects, of which one must be in* Humanities *and one in* Aeronautical Engineering

CHEMICAL ENGINEERING

Professor Walter G. Whitman

Applying the principles and theories of chemistry to meet great human needs is the job of chemical engineers: to utilize physics and chemistry in mass production, to improve on nature with synthetics, and to process raw materials for highest yields of chemical products.

The chemical and petroleum industries start with coal, petroleum, natural gas, salt, sulfur, limestone, and other raw materials and convert them by chemical reactions into a wide variety of useful things: synthetic polymers and fibers, fuels, drugs, detergents, synthetic rubber, surface coatings . . . The chemical industry supplies fertilizer and insecticides to the farmer; synthetic fibers to the textile industry; and fuels for automobiles, aircraft, and rockets. The synthesis of giant molecules of increasingly precise structure is leading to the manufacture of plastics of such strength, toughness, and long life as to become formidable competition to such conventional materials as wood, metal, and glass.

The early college training of chemical engineers is similar to that of chemists, since both must have a thorough knowledge of chemistry as well as of physics and mathematics. The chemist and chemical engineer are close partners in industry, too, but the engineer is concerned with large-scale and expensive equipment; he must carry out with larger quantities the chemical reactions and separations which the chemist has pioneered on a small scale. The chemical engineer is usually more closely associated with the business operations of his company than the chemist, and he must be constantly aware of costs and economics.

The chemical industries as a group are growing three times as rapidly as the rest of U. S. industry. They spend large amounts of money on new products and new manufacturing processes. Chemical engineering education must therefore prepare its students to handle competently the new and unfamiliar situations they will constantly face in this kind of industry. Chemical engineering students at M.I.T. must learn to think for themselves. Since their opportunities will be so varied and changing, the undergraduate program of studies is along fundamental lines without emphasis on any particular field or any one special group of chemical problems. However, the flexibility of the chemical engineering curriculum allows students, if they wish, to pursue special interests in depth in this or some other department.

America's first curriculum in chemical engineering was organized here at M.I.T. in 1888; since then, members of this faculty have been responsible for many of the basic concepts of chemical engineering, and graduates of the course have become leaders in the chemical industries.

The Course in Chemical Engineering Practice gives M.I.T. chemical engineering students a unique opportunity to spend the second half of the senior year at two practice schools which M.I.T. maintains in the plants of two companies. Here they can learn to apply principles toward improving equipment under actual industrial conditions, with the guidance of members of the M.I.T. academic staff who are in residence at the plants.

Most chemical engineers are employed by industry, although a few are teachers, consultants, or operators of their own businesses. Some supervise production, some develop ways of making new chemicals or better ways of making present products, some design plants, some are technical salesmen. Many chemical engineers have advanced to positions in administration and management. Because of their technological background, many chemical engineers have become effective administrators and managers in these technically-complex industries. The rapid and continuing growth of the chemical process industries assures challenging problems and good opportunities.

FIRST YEAR

First Term

General Chemistry (5.01)
Physics (8.01, Mechanics)
Calculus (18.01)
Introduction to the Humanities (21.01)
and at least 12 units of elective subjects during the first two years; first-year electives are described in Section 5. A Graphics *subject is recommended*

Second Term

General Chemistry (5.02)
Physics (8.02, Heat, Kinetic Theory)
Calculus (18.02)
Introduction to the Humanities (21.02)
and at least 12 units of elective subjects during the first two years; first-year electives are described in Section 5. A Graphics *subject is recommended*

SECOND YEAR

First Term

Organic Chemistry I
Organic Preparations I
Physics (Electricity, Magnetism)
Chemical Engineering
Calculus
Humanities

Second Term

Physics (Optics, Atomic Physics)
Differential Equations
Humanities
and two elective subjects

THIRD AND FOURTH YEARS

Chemical Engineering (Course X)

The third and fourth year programs are entirely elective, but the subjects chosen must include at least 35 units of Chemistry, *at least 60 units of* Chemical Engineering, *at least 25 units of an integrated professional minor in a field other than these, and at least four subjects in* Humanities. *There must be at least 23 units of laboratory work. The undergraduate* thesis *is a fourth-year requirement.*

Chemical Engineering Practice (Course X-B)

The third and fourth year programs are entirely elective, but the subjects chosen must include at least 35 units of Chemistry, *at least 45 units of* Chemical Engineering, *at least 15 units of an integrated professional minor in a field other than these, and at least four subjects in* Humanities. *There must be at least 13 units of laboratory work. The undergraduate* thesis *is a fourth-year requirement.*

Each student in the Chemical Engineering Practice *program spends the second semester of the fourth year at the field stations:*
Bayway (New Jersey) Station
Bound Brook (New Jersey) Station

CIVIL ENGINEERING

Professor John B. Wilbur

Civil engineering has been called the foundation of modern civilization. You need only think of the modern city of today to see why this is true. Can you imagine a city without its transportation systems—without highways, expressways, and parking facilities—without railways and rapid-transit facilities—without airports—without transmission systems and pipelines—and without sanitary facilities—without a water-supply system with its dams, aqueducts, and treatment plants that bring water from distant points and purify it for domestic and industrial use—and without a disposal system that collects, treats and disposes of the industrial and domestic wastes of the city? Can you imagine a city without large structures such as skyscrapers and industrial buildings? These things are all built by civil engineers, and without them cities—as we know them today—could not exist.

Civil engineering is the planning, design, and construction of the fixed structures and ground facilities that provide the arteries of transportation, that control the use of water, and that provide protection against the elements of nature. The reference to *fixed* structures is important; it means structures that do not move. For example, the civil engineer builds the superhighways with bridges and tunnels but not the automobiles that are driven over them; he builds powerhouses but not the power generating equipment that they shelter.

The civil engineer deals with things that are big in stature. He truly changes the landscape when he builds a Boulder Dam to create a new lake miles in length, when he builds a George Washington Bridge that spans a great river, when he builds an aerial expressway such as the Boston Central Artery through the heart of a metropolitan area, or when he builds the framework of an Empire State Building.

These and similar projects cost vast sums of money, often running into millions or even hundreds of millions of dollars. Planning, designing, and constructing such ventures is a great responsibility. It requires not only technical knowledge of a high order but great personal character and integrity as well. The civil engineer probably spends more money than any other kind of engineer; but in the main he is spending other people's money, and he must always strive to get full value for every dollar spent.

Because these large projects have such major effects on the lives of so many people, they are frequently built for some branch of the government—either city, state, or federal. For this reason some civil engineers are employed by government. Others, however, work for private organizations such as railroad or power companies. They may work in the offices of consulting engineers and eventually become engineering consultants themselves. They may work for construction companies and later operate their own contracting businesses. Throughout this whole range of employment opportunities there is a distinct shortage of civil engineers that shows no sign of lessening.

Perhaps our greatest asset in the Civil Engineering Department at M.I.T. is our faculty of men who are themselves leaders in the field—men who combine teaching ability with engineering achievement—who themselves have planned and designed great highway systems, for example, or major hydroelectric plants, or important sanitary projects. Equally important is the fact that among these are many men leading the way to new developments in civil engineering through research . . . . in our structures laboratories, hydraulics laboratory, soil mechanics laboratory, sanitary engineering laboratory, highway and traffic center, and aerial surveying laboratory.

For those who are challenged by outdoor life and the romance of far-away places, civil engineering in the many under-developed portions of the world may be appealing. But even greater opportunities lie in our own country—and, in fact, in our own cities—where slum areas, building shortages, water shortages, industrial waste pollution, and traffic congestion are all demanding attention.

Expenditures for construction represent one-tenth of our total national income. To spend this money wisely is the challenge to the civil engineer.

Civil Engineering (Course I)

FIRST YEAR

First Term

General Chemistry (5.01)
Physics (8.01, Mechanics)
Calculus (18.01)
Introduction to the Humanities (21.01)
and at least 12 units of elective subjects during the first two years; first-year electives are described in Section 5. A Graphics *subject is recommended*

Second Term

General Chemistry (5.02)
Physics (8.02, Heat, Kinetic Theory)
Calculus (18.02)
Introduction to the Humanities (21.02)
and at least 12 units of elective subjects during the first two years; first-year electives are described in Section 5. A Graphics *subject is recommended*

SECOND YEAR

First Term

Surveying I
Civil Engineering Projects I
Physics (Electricity, Magnetism)
Calculus
Humanities

Second Term

Surveying II
Statics and Dynamics
Civil Engineering Projects II
Physics (Optics, Atomic Physics)
Differential Equations
Humanities

THIRD YEAR

First Term

Materials and Mechanics
Fluid Mechanics
Engineering Construction
Fundamentals of Electrical Engineering
Engineering Geology
and one elective in Humanities

Second Term

Soil Mechanics
Materials and Mechanics
Elementary Structural Engineering
Fluid Mechanics
and one elective in Humanities

FOURTH YEAR

First Term

Structural Design
Structural Analysis
Thesis
four of the following (those recommended for special fields are indicated):

CONSTRUCTION ENGINEERING:
Advanced Materials, Building Construction, Dwelling House Construction, Structural Design

HYDRAULIC ENGINEERING:
Fluid Mechanics Laboratory, Hydrology and Hydraulic Engineering

SANITARY ENGINEERING:
Fluid Mechanics Laboratory, Hydrology and Hydraulic Engineering, Sanitary Science

STRUCTURAL AND FOUNDATION ENGINEERING:
Structural Design, Advanced Soil Mechanics

TRANSPORTATION ENGINEERING:
Transportation Planning, Advanced Soil Mechanics

OTHER ELECTIVES:
Photogrammetric Engineering, Introduction to Industrial Management, Financial Management, Accounting, Business Law
and one elective in Humanities

Second Term

Reinforced Concrete Design
Heat Engineering
Thesis
three of the following (those recommended for special fields are indicated):

CONSTRUCTION ENGINEERING:
Construction Management, Reinforced Concrete Design, Structural Analysis

HYDRAULIC ENGINEERING:
Hydrology and Hydraulic Engineering

SANITARY ENGINEERING:
Hydrology and Hydraulic Engineering, Sanitary Engineering

STRUCTURAL AND FOUNDATION ENGINEERING:
Reinforced Concrete Design, Structural Analysis

TRANSPORTATION ENGINEERING:
Applied Surveying, Transportation Engineering

OTHER ELECTIVES:
Introduction to Industrial Management, Financial Management, Business Law
and one elective in Humanities

ELECTRICAL ENGINEERING

Professor Gordon S. Brown

The field of electrical engineering has become one of great variety and scope. Its products and services influence the daily living and business of most of the world's population. Much of its growth has been compressed into such a short period of time that the changes appear almost revolutionary. The growth and change that will prevail for many years to come offer young men a wide range of interesting and expanding professional careers with rich intellectual and spiritual rewards.

Electrical engineering at M.I.T. supports two major human motivations: to transmit and process information; and to convert, control, and utilize energy. The former involves such things as radar, radio and wire telephony, measurement, electronics, computation, and control. The latter furnishes the means to substitute machines for human muscle and to keep the wheels of industry turning—power, light, heat, and control—and so provides the basis of our modern civilization; here the issue is to exploit energy for energy's sake. This barely suggests the widely diversified areas with which M.I.T. electrical engineering students are familiar.

To provide an *enduring* basis upon which to establish successful careers in any of the rapidly changing professional, industrial, or business areas which depend upon electrical technology, students in electrical engineering must first develop a working mastery of the basic sciences of mathematics and physics. On these is built study of the principles of electrical engineering and their applications.

An electrical engineer's career is influenced quite as much by his understanding of people, his judgment, his sense of values, and his breadth and responsibility of outlook as by his technical competence. The humanities and social studies therefore form an important and integral part of our program.

A major feature of the professional studies of the second, third, and fourth years is the group of eight classroom-laboratory subjects which are required for all students. In the classroom we emphasize basic principles and methods of analysis; then we consider their applications to a broad range of specific electrical processes and equipment. Students discover that these principles and applications form a closely integrated body of electrical science. By applying it in elective subjects and thesis research, they achieve a still deeper understanding of that basic science.

While the laboratory program is coordinated with the work of the classroom, its objectives go beyond the mere mastery of experimental facts, methods, and techniques. Here students encounter the need for engineering judgment, team work, and careful planning. The major objective is to develop independent, creative thought and initiative through a program which requires students to assume progressively increased responsibility for the planning and execution of their work.

The four-year program, Course VI, leading to the degree of Bachelor of Science, is believed best suited to the student who desires to defer the decision on graduate study until late in his program. This Course permits the student to choose free elective subjects in his senior year and hence to prepare for many different careers.

For a selected group of students who feel relatively confident at the sophomore level that their interest will lead them to go on to graduate school and who wish to take advantage of an early opportunity to build up the required background in the engineering sciences, we offer Course VI-B in Electrical Science and Engineering. Students may apply for admission to this Course up to the first term of the junior year and as early as the beginning of the sophomore year. The Course spans five years, after which we award both Bachelor of Science and Master of Science degrees.

For another selected group of students who want to combine industrial or research experience with education in electrical engineering, we offer Cooperative Course VI-A—an interlinking of classroom and laboratory work with sixty weeks of experience in one of nine industrial organizations. Selection for this Cooperative Course comes at the end of the sophomore year; the industrial experience extends this cooperative curriculum to five years instead of four, after which we award both the Bachelor of Science and the Master of Science degrees.

FIRST YEAR

First Term

General Chemistry (5.01)
Physics (8.01, Mechanics)
Calculus (18.01)
Introduction to the Humanities (21.01)
and at least 12 units of elective subjects during the first two years (one subject in Graphics *is recommended); the first-year electives are described in Section 5*

Second Term

General Chemistry (5.02)
Physics (8.02, Heat, Kinetic Theory)
Calculus (18.02)
Introduction to the Humanities (21.02)
and at least 12 units of elective subjects during the first two years (one subject in Graphics *is recommended); the first-year electives are described in Section 5*

SECOND YEAR

First Term

Applied Mechanics I
Introductory Circuit Theory
Physics (Electromagnetism)
Calculus
Humanities

Second Term

Applied Mechanics II
Structural Chemistry (Course VI-B *only*)
Introductory Circuit Theory
Physics (Electromagnetism)
Differential Equations
Humanities

	Electrical Engineering (Course VI)	**Cooperative Course (Course VI-A)**	**Electrical Science and Engineering (Course VI-B)**
Summer		*At M.I.T.:* Electronic Devices and Circuits Fields, Energy, and Forces *and one elective subject*	
THIRD YEAR			
First Term	Electronic Devices and Circuits Fields, Energy, and Forces Advanced Calculus for Engineers Atomic and Nuclear Physics *(or in the first term, fourth year)* *and one elective in* Humanities	*At Plants:* Advanced Calculus for Engineers Industrial Practice	Electronic Circuit Theory Fields, Energy, and Forces Atomic and Nuclear Physics Advanced Calculus for Engineers *and one elective in* Humanities
Second Term	Electronic Circuits and Signals Electromechanical Energy Conversion *two electives in such subjects as:* Dynamics, Heat Engineering, Thermodynamics I, Advanced Calculus for Engineers, *and* Introduction to Solid-State and Molecular Physics *and one elective in* Humanities	*At M.I.T.:* Electronic Circuits and Signals Electromechanical Energy Conversion Economic Principles I *one elective in such subjects as:* Dynamics, Heat Engineering, Thermodynamics, *or* Introduction to Solid-State and Molecular Physics *and one elective in* Humanities	Electronic Circuits, Signals, and Systems Electrical Energy Conversion Introduction to Solid-State and Molecular Physics Probability *and one elective in* Humanities
Summer		*At Plants:* Advanced Calculus for Engineers Industrial Practice	
FOURTH YEAR			
First Term	Energy Transmission and Radiation Molecular Engineering Thesis *one or two professional electives* *and one elective in* Humanities	*At M.I.T.:* Energy Transmission and Radiation Molecular Engineering Atomic and Nuclear Physics *two electives in* Humanities	Energy Transmission and Radiation Seminar *one elective in* Mathematics *one elective in* Humanities *and one or two professional electives*
Second Term	Thesis *and four or five elective subjects, at least one in* Humanities	*At Plants:* Industrial Practice *and one elective subject*	Molecular Science and Engineering Seminar Statistical Mechanics and Thermodynamics
Summer		*At Plants:* Industrial Practice *and one elective subject*	*one elective in* Humanities *and one professional elective*
FIFTH YEAR		*During the fifth year, each student must register for* Thesis *and for* graduate study	*During the fifth year, each student must register for* Thesis *and for* graduate study

MECHANICAL ENGINEERING

Professor Joseph H. Keenan

The expansion of the interests of the mechanical engineer has left very little of applied science and technology outside his sphere of activity. Traditionally, mechanical engineering has been differentiated from civil engineering in that it deals with moving machines rather than standing structures, and from electrical engineering in that it emphasizes materials, processes, and design rather than electrical circuits and electronics. As he looks into the future, however, the mechanical engineer sees as his province essentially all of industry and all of science as it is applied to man's purposes. He must play a leading part, not only in the perfection of the older aspects of engineering, but also in developing nuclear power, high-speed transport, missiles, and travel in space.

Undergraduate study in mechanical engineering at M.I.T. is planned with all these objectives in mind, because the student of today will be doing the as-yet-unthought-of engineering tasks of tomorrow. He works in an atmosphere peculiar to mechanical engineering, however, because it is created by a group of faculty members who are leaders in the profession of mechanical engineering. They and their students carry on research and design on a wide range of basic subjects such as thermodynamics, heat transfer, refrigeration and cryogenics, fluid and gas dynamics, magnetohydrodynamics, lubrication, properties of materials, metal processing, automatic control, elasticity, plasticity, and dynamics. The applications of these subjects to the machines and devices of the foreseeable future are limitless.

Engineers differ from scientists not so much in their knowledge of science as in their reasons for knowing about science. The engineer uses science to make or devise something that somebody wants; the scientist uses science to learn more about nature. The engineer aims to satisfy social needs, the scientist to understand.

In addition, therefore, to learning science, the engineer must learn how to bridge the gap between science on the one hand and its applications on the other. This is the art of engineering. To teach the art is the primary object of our subjects in laboratory and in engineering design, in which students work under the critical and sympathetic eyes of men skilled in the art. Laboratory experience, which takes many forms, is intended to show how the experimental method is used in the solution of engineering problems. Design experience includes the devising of means to perform certain specified tasks. It may be the design of a device or the synthesis of a system made up of parts having known characteristics. Either experience may culminate in a senior thesis.

The Department encourages each student to propose a program of studies to suit his own tastes. Such a program may be heavily weighted toward science or toward the arts of engineering, as long as it satisfies the registration officer that for the student in question it is a sound educational program.

Suggested programs have been prepared by the Department which have essentially a common second year but which diverge in the third year. They are entitled Power and Propulsion; Design, Manufacturing, and Controls; Materials (including Textiles); and Engineering Science. Of these, the Engineering Science program is intended for students with greater-than-average aptitude for mathematics and the analytical method; it will normally lead to graduate study. The other three proceed further into the arts and practices of engineering at the expense of some depth in the sciences, though many students from these programs will also continue with graduate study. The Course based on any one of these four programs, or any other program approved by the registration officers of the Department, leads to the degree of Bachelor of Science in Mechanical Engineering.

A cooperative program (Course II-B) offers the same curriculum and includes in addition some six months of actual plant experience, mostly during the summer. This Course is especially valuable for students who would otherwise have no first-hand experience in industry before they graduate.

FIRST YEAR

First Term

General Chemistry (5.01)
Physics (8.01, Mechanics)
Calculus (18.01)
Introduction to the Humanities (21.01)
and at least 12 units of elective subjects during the first two years; first-year electives are described in Section 5. A Graphics *subject is recommended*

Second Term

General Chemistry (5.02)
Physics (8.02, Heat, Kinetic Theory)
Calculus (18.02)
Introduction to the Humanities (21.02)
and at least 12 units of elective subjects during the first two years; first-year electives are described in Section 5. A Graphics *subject is recommended*

SECOND YEAR

First Term

Applied Mechanics I
Engineering Design and Manufacture
Physics (Electricity, Magnetism)
Calculus
Humanities

Second Term

Applied Mechanics II
Thermodynamics I
Physics (Optics, Atomic Physics)
Differential Equations
Humanities

THIRD AND FOURTH YEAR

Mechanical Engineering (Course II)

Each student is required to complete four terms of Humanities *and a* Thesis *in his third and fourth years. In addition, he must complete a professional program in one of the following four fields. The recommended programs listed may be modified.*

Power and Propulsion

Third Year

First Term: Fluid Mechanics, Thermodynamics II, Experimental Engineering, Engineering Materials, *and* Fundamentals of Electrical Engineering.

Second Term: Gas Dynamics, Mechanical Behavior of Materials, Experimental Engineering, Engineering Design, *and* Machine Tool Fundamentals.

Fourth Year

First Term: Dynamics, Fluid Machinery, Cycles and Processes, Thesis, *and one elective subject.*

Second Term: Engineering Projects, Heat Engineering, Thesis, *and one or two elective subjects.*

Design Manufacturing, and Controls

Third Year

First Term: Fluid Mechanics, Engineering Thermodynamics, Experimental Engineering, Engineering Materials, *and* Fundamentals of Electrical Engineering.

Second Term: Dynamics, Mechanical Behavior of Materials, Experimental Engineering, Engineering Design, *and* Machine Tool Fundamentals.

Fourth Year

First Term: Thesis *and four to six elective subjects.*

Second Term: Engineering Projects, Thesis, *and three or four elective subjects.*

Materials (including Textiles)

Third Year

First Term: Fluid Mechanics, Engineering Thermodynamics, Experimental Engineering, Engineering Materials, *and* Fundamentals of Electrical Engineering.

Second Term: Dynamics, Mechanical Behavior of Materials, Experimental Engineering, Engineering Design, *and* Machine Tool Fundamentals.

Fourth Year

First Term: Strength of Materials, Thesis, *and three or four elective subjects.*

Second Term: Non-Metallic Materials, Engineering Projects, Thesis, *and two elective subjects.*

Engineering Science

Third Year

First Term: Thermodynamics II, Experimental Engineering, Engineering Materials, Atomic and Nuclear Physics, *and* Advanced Calculus for Engineers.

Second Term: Mechanical Behavior of Materials, Experimental Engineering, Elementary Electric Circuit Theory, Introduction to Solid-State and Molecular Physics, *and* Advanced Calculus for Engineers.

Fourth Year

First Term: Fluid Dynamics, Fields, Energy, and Forces, Thesis, *and one elective subject.*

Second Term: Dynamics, Fluid Dynamics, Engineering Projects, Thesis, *and one elective subject.*

Cooperative Course[1] (Course II-B)

THIRD YEAR

Summer:

Vacation (approximately seven weeks)

At plants (remainder of summer):
Industrial Practice

First Term (at plants):
Industrial Practice

Second Term (at M.I.T.):
Fluid Mechanics
Engineering Design
Engineering Materials
Fundamentals of Electrical Engineering
and one elective in Humanities

FOURTH YEAR

Summer (at M.I.T.):
Dynamics
Thermodynamics II
Experimental Engineering
Economic Principles I

First Term (at M.I.T.):
Gas Dynamics
Fluid Machinery
Heat Engineering
Cycles and Processes
Experimental Engineering
and one elective in Humanities

Second Term (at M.I.T.):
Mechanical Behavior of Materials
Machine Tool Fundamentals
Thesis
two elective subjects
and one elective in Humanities

[1]The program shown is for study in Power and Propulsion. Similar programs are available in Design, Manufacturing, and Controls; Materials (including Textiles); and Engineering Science

METALLURGY

Professor John Chipman

Metallurgy is an engineering science that deals with the production, utilization, and behavior of metals and their alloys. The field is quite broad because it is based on physics and chemistry which are necessary for an understanding of the metallic state; it also relates to chemical engineering in the extraction of metals from their ores, and to mechanical engineering in the fabrication of metals into useful forms for ultimate service. There are three main reasons for focussing these disciplines on metals: metals comprise about three-fourths of the elements in the periodic system, and thus are of immense scientific interest as fundamental matter of the universe; metals have remarkable properties as a class of materials that make them particularly useful to mankind; and many metals are available in nature in such quantity and form that they can be produced at reasonable cost in pure or alloyed condition. Accordingly, to a large extent, metals have become the "working substance" of modern industry; it has been estimated that forty per cent of all the jobs in America are connected directly or indirectly with the manufacture and use of steel alone. Moreover, the field is a lively one in research and development because it is now clear that the efficient operation of such complex devices as gas turbines, jet engines, guided missiles, and nuclear reactors will depend not only on the design but also on the materials of construction.

The Course in Metallurgy offers opportunity for the study of other engineering materials as well as metals. Instruction in ceramics including glasses, porcelains, and refractory oxide materials is available within the Department. The curriculum also provides a wide choice among elective subjects.

The curriculum is based upon a core of science and engineering subjects including mathematics, physics, chemistry, and the humanities, along with an introduction to metal science and the engineering principles involved in the extraction and application of metals. The student learns the basic thermodynamics, unit processes, and mechanical operations which underlie the making and shaping of metals; the inner structure of metals as a foundation for understanding their properties and for selecting the right materials for a certain job; and the principles for developing alloys of metals.

The large block of elective time permits the student to direct his metallurgical studies according to his interests, or to take additional subjects in metallurgical engineering, metal processing, and physical metallurgy. For example, students who are interested in ores and their beneficiation will elect subjects in mineral engineering and geology. A combined program of metallurgical and chemical engineering is feasible for those who wish to concentrate more on the production of metals. Students who are mechanically inclined can elect sequences of subjects leading to machine design, stress analysis, and metal forming. Students who wish to become materials engineers will include studies of ceramics, plastics, and electrical materials. Opportunities are also afforded for combining metallurgy with other disciplines, such as nuclear engineering, the humanities, or business administration. For students who lean toward science, the curriculum may include many subjects in mathematics and physics.

Graduates in metallurgy find many kinds of jobs. Some enter the metal-producing field in companies that make copper, brass, aluminum, titanium, special alloys, or that giant among industries, steel. Many metallurgists are active in selecting, testing, and supervising the application of metals; the automotive and aircraft industries, for example, employ many metallurgists and wish they could find more. Every atomic energy project in the country depends on metallurgists and needs more. The principal challenges in jet engine manufacture and in developing nuclear power are metallurgical problems. And in the immediate future the demand for mineral engineers will continue to exceed the supply as our higher-grade ores are depleted.

The world needs more metallurgists. It is difficult to name one modern product that does not contain metal or that does not require the help of metal. Yet only half the known metals are in commercial use today. Truly the horizon is a wide one.

Metallurgy (Course III)

FIRST YEAR

First Term	General Chemistry (5.01) Physics (8.01, Mechanics) Calculus (18.01) Introduction to the Humanities (21.01) *and at least 12 units of elective subjects during the first two years; subjects in* Graphics *are especially recommended. First-year electives are described in Section 5*	*Second Term*	General Chemistry (5.02) Physics (8.02, Heat, Kinetic Theory) Calculus (18.02) Introduction to the Humanities (21.02) *and at least 12 units of elective subjects during the first two years; subjects in* Graphics *are especially recommended. First-year electives are described in Section 5*

SECOND YEAR

First Term	Applied Mechanics I Engineering Materials Physics (Electricity, Magnetism) Calculus Humanities	*Second Term*	Applied Mechanics II Extractive Metallurgy Physics (Optics, Atomic Physics) Differential Equations Humanities

THIRD YEAR

First Term	Physical Metallurgy I Physical Chemistry I *three or four elective subjects in* Metallurgy *and other related fields (see the list of* Metallurgy *subjects below)* *and one elective in* Humanities	*Second Term*	Metallurgical Engineering I Metallurgical Engineering Laboratory I Physical Chemistry II *or* Statistical Mechanics and Thermodynamics *three elective subjects in* Metallurgy *and other related fields (see the list of* Metallurgy *subjects below)* *and one elective in* Humanities
Summer	Metallurgical Plant Visits		

FOURTH YEAR

First Term	Metallurgical Thermodynamics X-ray Metallurgy Thesis *three or four elective subjects in* Metallurgy *and other related fields (see the list of* Metallurgy *subjects below)* *and one elective in* Humanities	*Second Term*	Thesis *three or four elective subjects in* Metallurgy *and other related fields (see the list of* Metallurgy *subjects below)* *and one elective in* Humanities

The following subjects within the Department of Metallurgy are among the recommended electives for the third and fourth years: Metallurgical Engineering, Foundry Engineering, Welding Engineering, Powder Metallurgy, Plastic Working of Metals, Physical Metallurgy, Electrochemistry, Physics of Metals, Electric and Magnetic Materials, Ceramics, Mineral Engineering, Quantitative Mineragraphy, *and* Ore Testing. *Students are expected also to choose subjects from other departments.*

NAVAL ARCHITECTURE AND MARINE ENGINEERING

Professor Laurens Troost

The ship is the biggest moving object that man has devised. Its design and construction is a problem without parallel in modern engineering: ships must move efficiently through water; they must be structural entities capable of taking on severe forces at sea; they must perform their transportation service with unmatched efficiency; they must provide such diverse services as water supply, refrigeration, ventilation, sewage disposal, communications, and cargo handling; they must contain specially designed power plants, often of hundreds of thousands of horsepower. This power must be produced and transmitted efficiently with regard to cost of construction, space, weight and fuel consumption.

Designing a ship is indeed a demanding profession—yet one as fascinating as the stories and folklore of the men and ships that sail the sea.

At M.I.T., we begin education in naval architecture and marine engineering with the fundamentals of basic subjects including applied mechanics, fluid mechanics, heat engineering, and structural theory. The emphasis on fundamentals in a deliberately broad area is continued throughout the four years. This is accompanied by an application to problems pertinent to ships and their machinery. In the latter part of the curriculum the ship as a complete entity is examined, bringing together all the technical and professional background of the previous subjects. In this manner the ability to apply the formal disciplines of the classroom to the diverse and as yet unthought-of problems of the future is developed.

Business management and economics play a very important role in all phases of the shipbuilding and maritime industry, and there is a need for competent men with a basic knowledge of naval architecture and marine engineering as well as the fundamentals of various areas of business management and economics. To provide this background for students interested in the business phases of shipbuilding and shipping, we offer a five-year course in Shipping and Shipbuilding Management, numbered XIII-B, in association with M.I.T.'s Departments of Economics and Engineering, and Business and Engineering Administration. This course in shipping management begins to differ from the naval architecture and marine engineering course only in the senior year, when students enter subjects that are necessary for advanced study in business management and economics. The fifth year of work in these fields and in Naval Architecture and Marine Engineering leads to both S.B. and S.M. degrees.

The Department's laboratory facilities are an important factor in both these courses, and there are excellent opportunities for theses and research. These facilities include the Ship Model Towing Tank, for studies of the hydrodynamics of ships' hulls; the Propeller Tunnel, for controlled underwater tests of model ships' propellers under simulated ship conditions; and the Ship Structures Laboratory, for research in structural arrangements for ships.

Modern ships are large and fast. New ship construction materials are being used for strength and lightness. Seagoing nuclear power plants are already afloat. The S. S. *United States* represents a triumph in modern naval architecture and marine engineering. Today there are serious studies in progress on submarine tankers, semi-submerged hulls, and hydrofoil boats. All these things suggest the creativeness which will be demanded of tomorrow's ship designers, builders, and managers; they further indicate the breadth of interest and ability required in this field. M.I.T. is one of a handful of American universities preparing men for the future of this profession.

FIRST YEAR

First Term

General Chemistry (5.01)
Physics (8.01, Mechanics)
Calculus (18.01)
Introduction to the Humanities (21.01)
and at least 12 units of elective subjects (first-year electives are described in Section 5) during the first two years; subjects in Graphics *are especially recommended*

Second Term

General Chemistry (5.02)
Physics (8.02, Heat, Kinetic Theory)
Calculus (18.02)
Introduction to the Humanities (21.02)
and at least 12 units of elective subjects (first-year electives are described in Section 5) during the first two years; subjects in Graphics *are especially recommended*

SECOND YEAR

First Term

Applied Mechanics I
Engineering Design and Manufacture
Physics (Electricity, Magnetism)
Calculus
Humanities

Second Term

Applied Mechanics II
Engineering Materials
Physics (Optics, Atomic Physics)
Differential Equations
Humanities

THIRD YEAR

First Term

Fluid Mechanics
Thermodynamics I
Naval Architecture I
Marine Engineering Design III
and one elective in Humanities

Second Term

Mechanical Behavior of Materials
Heat Engineering
Naval Architecture II
Ship Structures
Marine Engineering I
and one elective in Humanities

Naval Architecture and Marine Engineering (Course XIII)

Shipping and Shipbuilding Management (Course XIII-B)

FOURTH YEAR

First Term

Fundamentals of Electrical Engineering
Ship Structural Drawing
Marine Engineering II
Thesis
three electives, at least one in Humanities *and one professional elective*

Fundamentals of Electrical Engineering
Ship Structural Drawing
Marine Engineering II
three electives, at least one in Humanities *and one professional elective*

Second Term

Ship Design
Marine Engineering Dynamics
Marine Engineering Design IV
Thesis
one elective subject
and one elective in Humanities

Ship Design
Marine Engineering Dynamics
Marine Engineering Design IV
three electives, at least one in Humanities *and one professional elective*

FIFTH YEAR

First Term

Thesis
Graduate study

Second Term

Thesis
Graduate study


Paris
AIR FRANCE

Dean Burchard

". . . again and again in the Bible, we are enjoined to love our neighbors as ourselves. To make love for our neighbor effective, perhaps even to make it possible, we must first know our neighbor. To gain this knowledge in a large and restless world will be extremely difficult. But the search is all-important."

—Dean of Humanities John E. Burchard in *The Saturday Review*, November 3, 1951.

ECONOMICS, POLITICS, AND ENGINEERING OR SCIENCE

Professor Robert L. Bishop

The Courses in Economics, Politics, and Engineering or Science are another evidence of M.I.T.'s pioneering role among technological institutions. These two new Courses were designed to combine study in the social sciences with concentrated work in a selected field of engineering or science . . . once more emphasizing the Institute's interest in developing graduates who can help effect a melding of technology with the human environment in which it operates.

These are the essential features which we think distinguish these Courses from other offerings at the Institute—and from offerings at other schools:

1. Our students in these Courses are ordinarily those who have innate curiosity both about technical and scientific matters and about social problems. They ask, for instance, questions like this: "What are the probable consequences of the automation of a factory in terms of the economic position of the firm *and* the well-being of the employees involved?"

2. Our students in the Economics option are typically interested in going into industry after graduation, because they are aware of the particular challenge to be found there for the man who understands technical processes and who can also think along the broadest analytical lines in seeking to understand social processes.

3. Students taking the Political Science option are trained broadly on policy matters, to fit them for work in government or in professional careers associated with public issues.

4. While at M.I.T., students choose one engineering or science field in which to major. Whatever field is chosen, we adhere to this one general rule: this technical work will involve the fundamental subjects included in the curriculum of students taking their degrees in that field. There are no special "watered-down" subjects for Course XIV students.

5. Approximately 40 per cent of our students' course work is done in social science. This includes certain required work in economics, humanities, and political science. In addition, there is a wide choice of electives in economics and political science—dealing with economics, the structure in which business is conducted and technologic change takes place; and, in political science, the increasing range of problems arising in connection with government which are of direct concern to scientists and engineers. We do not encourage narrow specialization but we do permit some degree of concentration along the lines of quantitative methods, industrial economics, labor relations, or political science.

M.I.T. does not claim to have found the best way to bridge what is often a wide gap between technology and the social sciences. But our experience in these Courses suggests that all concerned—students, teachers, and employers—can afford to be very optimistic. Industry in particular has watched the program develop with special interest: this synthesis of economics and technology promises to be a valuable one for the training of future executives. Similarly, high governmental officials are looking for men in public life who have both the capacity to understand scientific developments and the political knowledge necessary to use those developments in the public interest.

Perhaps one recent comment from an employer will best describe the need which the Courses seek to meet: "We can hire good engineers when we need them. We can also get special help on our financial or personnel problems when we need that. But what we can really use now for top-level jobs are a few men who don't think in terms of separate pigeon-holes but think instead in analytical terms about all the problems we face that are *both* engineering and social science problems."

Economics, Politics, and Engineering (Course XIV-A) or Science (Course XIV-B)

FIRST YEAR

First Term	General Chemistry (5.01) Physics (8.01, Mechanics) Calculus (18.01) Introduction to the Humanities (21.01) *and at least 12 units of elective subjects during the first two years; first-year electives are described in Section 5*	*Second Term*	General Chemistry (5.02) Physics (8.02, Heat, Kinetic Theory) Calculus (18.02) Introduction to the Humanities (21.02) *and at least 12 units of elective subjects during the first two years; first-year electives are described in Section 5*

SECOND YEAR

First Term	Physics (Electricity, Magnetism) Economic Principles I Calculus Humanities *and one elective in* Language, Engineering, *or* Science*	*Second Term*	Physics (Optics, Atomic Physics Electromagnetism, *or* Electromagnetic Theory of Light Economic Principles II *or* American Political Process Differential Equations Humanities *and one elective in* Language, Engineering, *or* Science*

THIRD YEAR *Students specializing in economics take the subjects marked (a); those in political science take those marked (b).*

First Term	(a) Prices and Production (a) Economic Fluctuations and Growth (a) Elementary Statistics *or* Statistical Theory (b) *elective subjects in* Economics *or* Political Science *(see below)* *two elective subjects in* Engineering *or* Science* *and one elective in* Humanities	*Second Term*	(a) Structure of the American Economy *elective subjects in* Economics *or* Political Science *(see below)* *one elective subject in* Engineering *or* Science* *and one elective in* Humanities

FOURTH YEAR

First Term	(a) Economic Research Seminar (b) Political Science Seminar *elective subjects in* Economics *or* Political Science *(see below)* *one elective subject in* Engineering *or* Science* *and one or more additional electives*	*Second Term*	(b) Political Science Seminar Thesis *elective subjects in* Economics *or* Political Science *(see below)* *and one elective subject in* Engineering *or* Science*

The following are among the recommended elective subjects in Economics:

GENERAL ECONOMICS: Industrial Organization and Public Policy, Comparative Economic Systems, Monetary and Banking Policy, Public Finance, International Trade, Labor Economics and Public Policy, *and* Growth of the American Industrial Economy.

INDUSTRIAL AND LABOR ECONOMICS: Industrial Organization and Public Policy, Linear and Nonlinear Programming, Economics of Innovation, Economics of Particular Industries, Labor Relations, Labor Economics and Public Policy, Labor Problems Seminar, Collective Bargaining and Union-Management Cooperation, Personnel Administration, Financial Management, Accounting, *and* Industrial Accounting.

QUANTITATIVE ECONOMICS AND METHOD: Statistical Theory, Advanced Calculus for Engineers, Methods of Applied Mathematics, Statistical Quality Control, Introduction to Econometrics, Design and Analysis of Scientific Experiments, Economic Statistics, Sampling of Human Populations, Advanced Treatment of Techniques in Scientific Management, Demand Analysis and Marketing Research, Operations Research, Theory of Games, *and* Probability.

The following are among the recommended elective subjects in Political Science:

Comparative Political Systems, Seminar on Issues in Contemporary American Politics, Government Politics and Technology, Basic Ideas of Western Politics and Ethics–500 B.C. to 1500 A.D., Rise of Modern Political and Social Science–1500 to 1914, Contemporary Ideas on Political and Economic Development, International Relations, Principles and Problems in American Diplomacy, Seminar in International Politics, Politics, Society, and Policy Making, Influences on Policy Decisions, *and* Nationalism and National Development.

*Students will take science or engineering subjects in accordance with their interests and as recommended in consultation with the Economics Department and the science or engineering department concerned.

HUMANITIES AND ENGINEERING OR SCIENCE

Professor Howard R. Bartlett

The broad objective of M.I.T.'s Courses in Humanities and Engineering and Humanities and Science is to provide a general education firmly based on science or engineering. At the same time, either Course provides the foundation for graduate work in science or engineering, in medicine, law, business, or public administration, and even in some fields of the humanities.

Dean John E. Burchard of the School of Humanities has written, "Surely many American citizens are becoming aware of the dilemma of a democracy which is more and more dependent upon a technology which in turn is more and more specialized and intricate. We can foresee a day when policy problems can hardly be trusted to the intuitions of those whose knowledge of the modern technological world is limited. The nation can clearly benefit from the services of men who have solid training in specialties other than science but whose understanding and grasp of science is real. It is on this basis that we believe these undergraduate Courses provide an unusual opportunity for some thoughtful young Americans."

Each Course consists of about 60 per cent basic science or engineering and about 40 per cent humanities and social science. The work in science or engineering is concentrated in one area; it includes the core subjects and other subjects recommended by one department in the School of Science or the School of Engineering. The subjects in humanities are combined to make up programs emphasizing such fields as history, literature, philosophy, and the history and philosophy of science.

Both curricula lead in four years to the Bachelor or Science degree in the School of Humanities and Social Studies, without specification of science or engineering department. In a fifth year any graduate of this Course may complete the requirements for an additional S.B. degree (and in some cases an S.M. degree) in the engineering or science department in which he has concentrated his technical studies. Or, after his four years at M.I.T., any graduate of this Course should be able to enter liberal arts graduate study in the area of his humanities concentration.

This Course appeals to undergraduates who want a broader education than is possible when one is concentrating in one technical or scientific field. The Course is unique, for example, as preparation for law school; there are very few attorneys who have the background for dealing with the complex legal matters touching upon science in industry. It is consonant in purpose and rigor with all M.I.T. traditions.

In the first two years come the basic subjects in both humanities and science which are familiar to all M.I.T. students. In the last two years come the specialized work in the science or engineering of each student's choice and a series of subjects in one or more fields of the humanities. In the final year each student does a special project—a thesis on an interdisciplinary topic designed to assist him to correlate his undergraduate studies and to bring into focus the insights and techniques developed in his professional and humanistic studies.

We speak of this Course as a "double major", because it includes concentrated studies in one field of humanities *and* one field of technology. As such, it encourages students to probe deeply in two fields. Under the rigorous standards characteristic of M.I.T., students in this Course acquire a thorough grounding in science and technology, and a knowledge of humanities commensurate with that required of students in a liberal arts college.

For students who are interested in careers in teaching high school science and mathematics, five-year programs combining studies at the Institute and at the Harvard Graduate School of Education may be arranged. Work at the Institute typically follows the curriculum in Humanities and Science, but the arrangement may also be made for students in other Courses; education subjects at Harvard begin in the third year, and the fifth year includes practice teaching. Such programs usually lead to the Bachelor of Science degree from M.I.T. and the Master of Arts in Teaching degree from Harvard.

FIRST YEAR

First Term
General Chemistry (5.01)
Physics (8.01, Mechanics)
Calculus (18.01)
Introduction to the Humanities (21.01)
and at least 12 units of elective subjects during the first two years; first-year electives are described in Section 5

Second Term
General Chemistry (5.02)
Physics (8.02, Heat, Kinetic Theory)
Calculus (18.02)
Introduction to the Humanities (21.02)
and at least 12 units of elective subjects during the first two years; first-year electives are described in Section 5

SECOND YEAR

First Term
Physics (Electricity, Magnetism)
Calculus
Humanities
Introduction to Literature
or
History and the Historian
or
Philosophic Problems and Systems
or
Science and Philosophy from Antiquity to Copernicus
and one elective subject in Engineering, Science, or Language*

Second Term
Physics (Optics, Atomic Physics *or* Electromagnetism, Electromagnetic Theory of Light)
Differential Equations
Humanities
Literary Criticism
or
History and the Historian
or
Philosophic Problems and Systems
or
Science and Philosophy from Copernicus to the Present
and one elective subject in Engineering, Science, *or* Language*

THIRD YEAR

First Term
three elective subjects in Humanities
three elective subjects in Science *or* Engineering*

Second Term
three elective subjects in Humanities
three elective subjects in Science *or* Engineering*

FOURTH YEAR

First Term
Humanities Seminar
four or five elective subjects, of which two must be in Humanities *and one or two in* Engineering *or* Science*

Second Term
Humanities Seminar
Thesis
three or four elective subjects, of which one must be in Humanities *and one or two in* Engineering *or* Science*

*Students enrolled in Humanities and Science will choose science subjects and those in Humanities and Engineering will choose engineering subjects—in both cases as recommended in consultation with the Humanities Department and the science or enigneering department concerned.

Dean Johnson

"Our future prosperity and happiness as a free people will rest heavily on our ability to manage successfully our expanding American industrial enterprise system which will become increasingly dependent on the technological advancements of science and engineering."

—Former Dean of Industrial Management, E. P. Brooks.
before the Dallas Management Association, May 12, 1958.

INDUSTRIAL MANAGEMENT

Professor David Durand

The dominant characteristic of our society is rapid change. Among those chiefly responsible are the scientist, the engineer, and the manager. Today, the manager of both private and public enterprise plays a major role in making effective the work of scientists and engineers.

M.I.T.'s undergraduate Course in Industrial Management is specifically designed for the student who wishes to make his contribution to society as a manager of people rather than of things. Dealing with people as a variety of interested groups—owners, employees, customers, and the "body politic"—and acting effectively through people are the essential, fascinating, and demanding elements of administration. And while much is known about a theory of administration, the fact that so much of management rests upon many as-yet-unknown elements of human behavior makes it certain that management should still be classed among the "lively arts".

This program in management might be called a "breadth" program. It requires a grounding in basic physics, chemistry, and mathematics. Furthermore, it demands a rigorous exposure to the fundamentals of technical application in a chosen field (for example, the field of chemical sciences). It demands an investigation of a field of humanities. Finally, it calls for a study of both the analytical aspects of management decision-making and the practical or human problems of administration.

Although the mathematics, science, and engineering subjects which together make up about one-half of the content of the undergraduate program provide in themselves a basic education in today's technology, they have a more important purpose. They are crucial for the sound administrator who would manage today's industry; this administrator need not know a great deal about the specific engineering involved, but he should have studied enough in some area of technology to have an understanding of the needs of the engineer and the scientist.

There is a further purpose in the engineering and science base in this Course. Much has been learned about mathematically oriented decision-making techniques in many areas of business. Our students are peculiarly qualified to learn about the use of statistics, mathematical models, and modern data-processing concepts. Men who know these fields will increasingly be among those who contribute to the development of scientific methods of administration.

We think it especially important that our students approach problems from a point of view which takes into account social forces and individual human impulses as well as economic and engineering considerations. Our students are expected to develop an appreciation of the intangibles of modern industry while they are learning to reduce the number of these intangibles. They are expected to recognize the shortcomings of many business practices as well as their uses. To the fullest extent possible, Industrial Management undergraduates come into contact with experimental administrative techniques and methods of analysis which are advanced well beyond the current practice of industry.

We emphasize contacts with experienced management people. Students typically spend a good portion of their time in our advanced courses studying live problems in cooperating industrial plants, and they must work with the men actually responsible for the operations of these firms. We have many seminars, most of which are organized by the undergraduate professional society, with special visitors who bring a particular competence or problem to us.

As in any other profession, the possibilities for individual growth are determined primarily by the growth of the field as a whole. The phenomenal past and projected growth of the national economy, especially in its technologically dominated sectors, will create an even faster-growing demand for technologically oriented managerial talents.

Industrial Management (Course XV)

FIRST YEAR

First Term

General Chemistry (5.01)
Physics (8.01, Mechanics)
Calculus (18.01)
Introduction to the Humanities (21.01)
and at least 12 units of elective subjects during the first two years; first-year electives are described in Section 5

Second Term

General Chemistry (5.02)
Physics (8.02, Heat, Kinetic Theory)
Calculus (18.02)
Introduction to the Humanities (21.02)
and at least 12 units of elective subjects during the first two years; first-year electives are described in Section 5

SECOND YEAR

First Term

Physics (Electricity, Magnetism)
Economic Principles I
Calculus
Humanities
and one elective subject in Engineering *or* Science

Second Term

Physics (Optics, Atomic Physics)
Industrial Management I
Differential Equations
Humanities
and one elective subject in Engineering *or* Science

Recommended during Summer

Industrial practice

THIRD YEAR

First Term

Industrial Management II
Accounting
Marketing
and two elective subjects (see below)

Second Term

Personnel Administration
Financial Management
Production Management
and three elective subjects (see below)

FOURTH YEAR

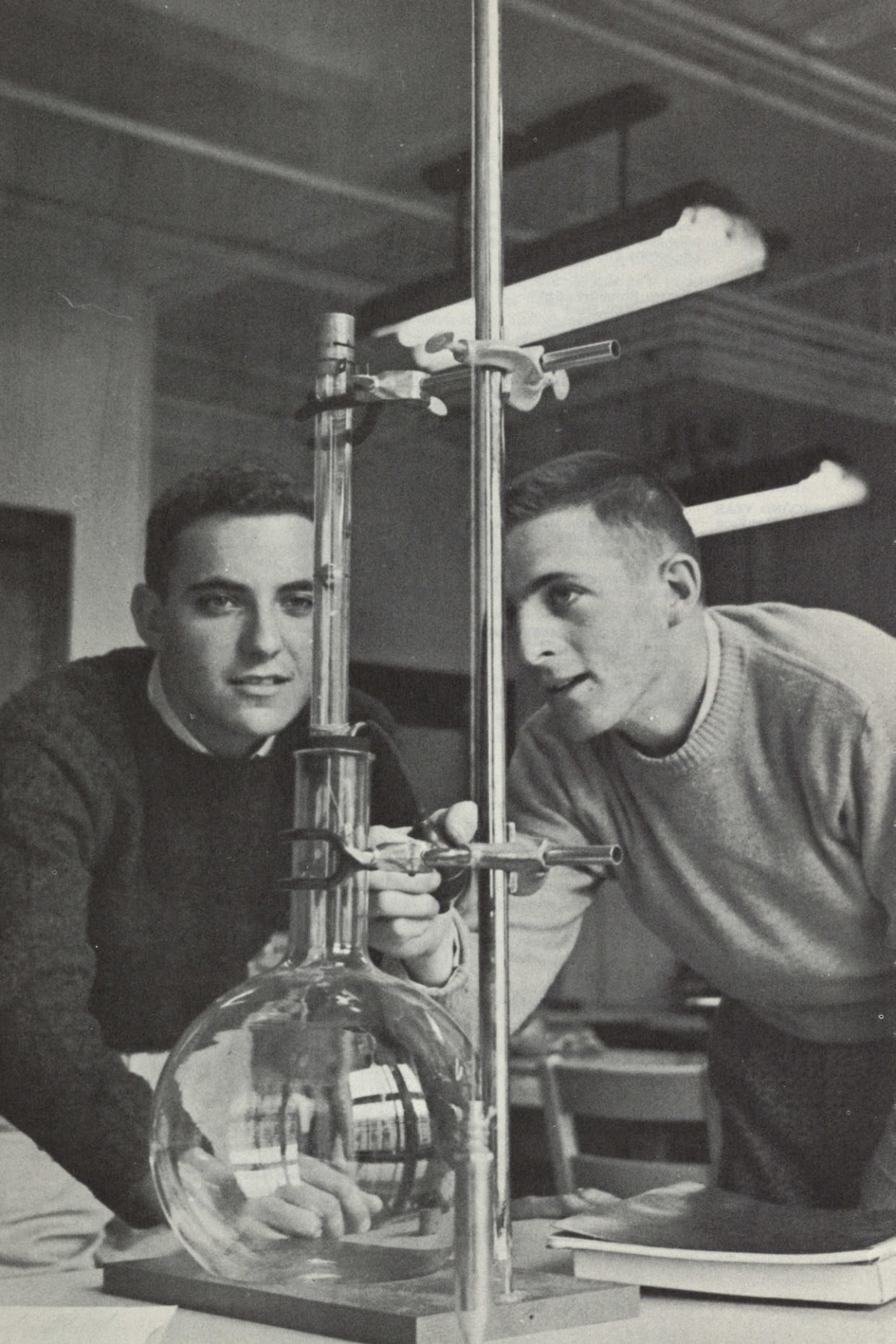
First Term

Thesis
and four or five elective subjects

Second Term

Thesis
and three or four elective subjects

The elective subjects must include four subjects in Humanities *and an approved program of subjects in* Engineering *or* Science.



Dean Harrison

"To a considerable degree, our form of government is determined by our economics, our economics by our industry, our industry by our technology, and our technology by our science."

—Dean of Science George R. Harrison, in *Life,* January 4, 1954.

BIOLOGY

Professor Irwin W. Sizer

Biology is the science of *life*—of all living organisms from the smallest microorganism (we still do not know whether the tiny viruses are "alive" in the usual sense!) to the giant trees and the large mammals and fish. The subject matter has been conveniently divided into these five categories:

1. Molecular biology—a study of the molecules which make up living things, what they do in life and how they do it. Included in this category are biophysics and biochemistry.

2. Genetic biology—including genetics, evolution, and all the aspects of reproduction of the countless forms which life displays in our world.

3. Developmental biology—the science of individual development from embryo to death—through growth, maturity, and aging.

4. Regulatory biology—how organisms regulate themselves, including, indeed, such apparently simple phenomena as how humans feel hunger and so are lead to periodically replenish their energy.

5. Environmental and group biology—the mutual relations among organisms, and between organisms and their environment.

The undergraduate curriculum in Biology (Course VII) provides an introduction to all of these fields in the subjects taken in the sophomore and junior years. We at M.I.T. have chosen to lay special emphasis on the physics and chemistry of living organisms—molecular biology. This is a natural emphasis in the M.I.T. environment, where the skills of chemistry, physics, and instrumentation are the special concern of many of our colleagues. This emphasis is reflected in the senior course in general biochemistry, physiology, and microbiology and in the elective courses which we offer.

From the standpoint of its contribution to the welfare of man, this analytical approach is richly justified. Experimental biology of this sort provides the basis of modern medicine and man's attempt to adapt more successfully to his environment. So it is that this kind of undergraduate experience is the most popular selection of premedical students who come to M.I.T.—although they may also fulfill premedical requirements in many of the other subjects here. From one-half to two-thirds of the undergraduates who major in biology are premedical students; the record of our alumni in the medical field is an impressive one.

With advancing knowledge of tissues and microorganisms, biological scientists are making discoveries of ever-increasing importance in fighting disease, in understanding fermentation and in providing new sources of food. The keys to this kingdom—the key molecules in living organisms—are the proteins and nucleic acids which form the basis of the genes which determine heredity, the enzymes which catalyze all energy-giving reactions in the body, and the structural proteins which make up the machinery of such tissues as muscle, skin, and tendon. So it is most important that we discover the intimate structure of the proteins and nucleic acids; and to do this we are applying the full armamentarium of biophysics, using electron microscopy, X-ray diffraction, polarization optics, ultracentrifugation, and other physical chemical tools as well as advanced analytical biochemistry. Biology seeks to become an exact science devoted to learning about living things in terms of the basic processes which occur in their most elementary units.

The Biology Department at M.I.T. is a world center for this type of work. Graduates occupy key positions in these fields in universities, research institutions, and in industry. It is this combination of biophysics, biochemistry, cell physiology, and microbiology which gives the Department its particular stamp and reputation.

Quantitative Biology (Course VII)

FIRST YEAR

First Term

General Chemistry (5.01)
Physics (8.01, Mechanics)
Calculus (18.01)
Introduction to the Humanities (21.01)
and at least 12 units of elective subjects (first-year electives are described in Section 5) in the first two years

Second Term

General Chemistry (5.02)
Physics (8.02, Heat, Kinetic Theory)
Calculus (18.02)
Introduction to the Humanities (21.02)
and at least 12 units of elective subjects (first year electives are described in Section 5) in the first two years)

SECOND YEAR

First Term

General Biology I
General Biology Laboratory I
Physics (Electricity, Magnetism)
Calculus
Humanities
one elective subject

Second Term

General Biology II
General Biology Laboratory II
Physics (Optics, Atomic Physics)
Differential Equations
Humanities
and one elective subject

THIRD YEAR

First Term

Organic Chemistry I
Organic Preparations I
Physical Chemistry I
Physical Chemistry Laboratory I
Genetics and Cytology
and one elective in Humanities

Second Term

Analytical Chemistry I
Analytical Chemistry Laboratory I
Physical Chemistry II
Physical Chemistry Laboratory II
Developmental Biology
and two elective subjects, including at least one in Humanities

FOURTH YEAR

First Term

General Biochemistry and Physiology I
General Biochemistry and Physiology Laboratory I
Thesis
two or three elective subjects, including at least one in Humanities

Second Term

General Biochemistry and Physiology II
General Biochemistry and Physiology Laboratory II
Thesis
and three elective subjects including at least one in Humanities

CHEMISTRY

Professor Arthur C. Cope

There are approximately one hundred chemical elements and several hundred thousand known chemical compounds. The elements vary in properties from the light gases, hydrogen and helium, through the metals such as iron and nickel and non-metals such as chlorine and sulfur to the currently important uranium and trans-uranic elements. The compounds have infinite variety—from the familiar table salt and sugar to recently discovered things that have reshaped our lives and economy within the past few years. Included in the products of recent research are the life-saving antibiotic "wonder drugs" such as penicillin, streptomycin, terramycin, aureomycin and tetracycline; the sulfa drugs; new textile fibers, plastics, dyes, fuels, explosives—things unknown a decade ago, commonplace today, and apt to be superseded by still greater discoveries of the chemical research of tomorrow.

Chemistry deals with the properties and reactions of these elements and compounds—the study of those which are known, and the search for others remaining to be discovered. The chemistry curriculum at M.I.T. begins with an introduction to the subject in first-year general chemistry, followed by work in the four major branches of the science: organic chemistry, which concerns the limitless number of compounds of carbon; inorganic chemistry, concerned primarily with all of the elements except carbon; physical chemistry, dealing quantitatively with the principles governing the behavior of chemical substances; and analytical chemistry, based on inorganic, organic, and physical chemistry and including modern instrumental methods of analysis.

The undergraduate chemistry curriculum at M.I.T. includes work in mathematics, physics, the humanities, languages, and allows considerable time for electives which provide an opportunity to extend knowledge in fields of special interest. An experimental senior thesis which constitutes an introduction to chemical research is a most important and interesting part of the senior year; it helps seniors to decide whether they want to pursue chemical research as candidates for advanced degrees or enter industry immediately after receiving the S.B. degree.

Some students completing degrees in chemistry take positions in chemical research in the constantly growing chemical industry; others continue in universities, or go to research foundations or government laboratories. The job of the chemist in such employment is that of the original investigator or inventor, as distinguished from the chemical engineer who works with the chemist and then takes over in process design, pilot-plant, and eventual production of useful products.

Chemists not primarily interested in research usually find employment in the production, business, or sales activities of the chemical industries, in which a demand for competent chemists at all levels will exceed the supply for years to come.

Chemistry (Course V)

FIRST YEAR

First Term

General Chemistry (5.01)
Physics (8.01, Mechanics)
Calculus (18.01)
Introduction to the Humanities (21.01)
and at least 12 units of elective subjects (first-year electives are described in Section 5) during the first two years

Second Term

General Chemistry (5.02)
Physics (8.02, Heat, Kinetic Theory)
Calculus (18.02)
Introduction to the Humanities (21.02)
and at least 12 units of elective subjects (first-year electives are described in Section 5) during the first two years

SECOND YEAR

First Term

Organic Chemistry I
Organic Preparations I
Physics (Electricity, Magnetism)
Calculus
Humanities
Language

Second Term

Organic Chemistry II
Organic Preparations II
Physics (Optics, Atomic Physics)
Differential Equations
Humanities

THIRD YEAR

First Term

Principles of Inorganic Chemistry
Qualitative Organic Analysis
Physical Chemistry I
Physical Chemistry Laboratory I
one elective subject (see below)
and one elective in Humanities

Second Term

Analytical Chemistry I
Analytical Chemistry Laboratory I
Physical Chemistry II
Physical Chemistry Laboratory II
one elective subject (see below)
and one elective in Humanities

FOURTH YEAR

First Term

Analytical Chemistry II
Analytical Chemistry Laboratory II
Thesis
two elective subjects (see below)
and one elective in Humanities

Second Term

Thesis
two elective subjects (see below)
and one elective in Humanities

Among their electives students are expected to take at least one subject in advanced inorganic chemistry, organic chemistry, *and* physical chemistry.

FOOD TECHNOLOGY

Professor Bernard E. Proctor

The food industry is at present the largest single industry in the United States, accounting for over 26 per cent of our national income. Its present magnitude may be attributed in part to our increase in population and our increasing longevity. Most important, however, is the general increase in our living standards, resulting in increased expenditures for foods and particularly in the popularity of "convenience foods." Food processing today demands greatly increased numbers of young men scientifically trained in food technology to undertake research, quality control, production, and management in the food industries.

In fact, there are but few foods now on the market that need no processing to improve their quality, preserve their value, or expedite their distribution. Refrigeration, canning, packaging, drying, and freezing are every-day processes which affect most of what we eat. They are basic processes of the vast food industry, which is only now coming to apply scientific knowledge to its many different problems and procedures.

Bringing science to food—chemical science to find the reactions and mechanisms that make better flavor, color, and nutrition; biological science to discover spoilage mechanisms; biochemical science to improve the nutritional values of food; engineering to improve food machinery, packaging, and handling; psychology to analyze public preferences for flavors and colors, business to administer the vast food industry . . . . all these are part of food technology.

Our undergraduate studies in food technology at M.I.T. are planned to lay a sound foundation in these many sciences upon which food technologists rely for basic concepts. The specific information on applying these concepts to food problems is presented in the second year of the curriculum, in such subjects as bacteriology, food production, food engineering, chemistry and technology of food supplies, technology of food products, and chemical engineering food applications. Studies in nutrition show the elements that human beings require in their foods, how foods may be analyzed to show their content of these elements, and how food processes may preserve and enrich these essentials. Pioneering studies on new ways of preserving foods by ionizing radiations suggest a potentially important use of atomic energy. New electronic techniques are being applied to evaluating the physical properties of foods.

The student who follows this basic Course in Food Technology can look forward to an interesting and satisfying career in an industry concerned with vital human needs and on which rests marked social responsibility. Positions of executive as well as technical responsibility are waiting.

The course in Biochemical Engineering, XX-B, is basically the undergraduate curriculum in chemical engineering, modified to include studies of biology, bacteriology, microbiology, and biochemistry, particularly as they relate to the beneficial uses of microorganisms for producing antibiotics and other important chemicals. The result is an unusual program for those interested in industries based on the antibiotics and vitamins, where microscopic plants and animals are made to do so much for us.

The food industry is the largest manufacturing enterprise in the United States, with more individual processing companies than in any other field of industrial activity. It gathers raw materials from farms throughout the world and by processing converts these to thousands of products. The total value of these products is greater than for any other industry, and so is the increase in their dollar value during the processing.

For every four hungry Americans sitting down to a meal this year there will be a fifth citizen to satisfy twenty years hence. The nutritional standards of vast areas of the world suggest that the science of food technology has barely begun to meet even our current needs. Who can doubt the opportunities ahead in this new science?

FIRST YEAR

First Term

General Chemistry (5.01)
Physics (8.01, Mechanics)
Calculus (18.01)
Introduction to the Humanities (21.01)
and at least 12 units of elective subjects during the first two years; first-year electives are described in Section 5

Second Term

General Chemistry (5.02)
Physics (8.02, Heat, Kinetic Theory)
Calculus (18.02)
Introduction to the Humanities (21.02)
and at least 12 units of elective subjects during the first two years; first-year electives are described in Section 5

	Food Technology (Course XX)	**Biochemical Engineering (Course XX-B)**
SECOND YEAR		
First Term	Organic Chemistry I Organic Preparations I General Biology I Physics (Electricity, Magnetism) Calculus Humanities	Organic Chemistry I Organic Preparations I General Biology I Physics (Electricity, Magnetism) Calculus Humanities
Second Term	Physics (Optics, Atomic Physics) Differential Equations Chemistry and Technology of Food Supplies I Bacteriology I Humanities	Organic Chemistry II Physics (Optics, Atomic Physics) Differential Equations Bacteriology I Humanities
THIRD YEAR		
First Term	Food Engineering Physical Chemistry I Chemistry and Technology of Food Supplies II Chemical Engineering Food Applications *and one elective in* Humanities	Food Engineering Physical Chemistry I Chemical Engineering Food Applications Industrial Microbiology *and two elective subjects, one of which must be in* Humanities
Second Term	Food Engineering Analytical Chemistry I Analytical Chemistry Laboratory I Physical Chemistry II Technology of Food Products Chemical Engineering Food Applications *and one elective in* Humanities	Analytical Chemistry I Analytical Chemistry Laboratory I Physical Chemistry II Chemical Engineering Thermodynamics Chemical Engineering Food Applications *and one elective in* Humanities
FOURTH YEAR		
First Term	General Biochemistry and Physiology I Technology of Food Products Chemistry of Nutrition Thesis *and two elective subjects, one of which must be in* Humanities	Analytical Chemistry II Analytical Chemistry Laboratory II General Biochemistry and Physiology I Chemistry of Nutrition Biochemical Engineering *and one elective in* Humanities
Second Term	Bacteriology II Thesis *and three or four elective subjects, at least one of which must be in* Humanities	Bacteriology II Biochemical Engineering Thesis *and two or three elective subjects, at least one of which must be in* Humanities

GEOLOGY AND GEOPHYSICS

Professor Robert R. Shrock

The origin, age, and composition of the earth, the physical state of the earth's interior, and the origin of the oceans and atmosphere are among the most challenging and perplexing problems of science. They all lie within the domain of the earth scientists—geologists, geochemists, geophysicists, meteorologists, and oceanographers —but they can be successfully attacked only by using the latest contributions from the physical and engineering sciences.

Graduates from M.I.T.'s Course in Geology and Geophysics are in great demand because their specialized training in geology rests on a broad foundation of the basic sciences, and they have many opportunities to tackle difficult geological problems involving the use of these basic sciences.

Geology is concerned mainly with the study of minerals, rocks, and earth structures as they are found in the field; geologists spend much of their time determining the geologic history of the earth as a basis for locating all kinds of raw materials for industry—petroleum and natural gas, metals, nuclear fuels, and building and construction materials. Laboratory geologists investigate the physical and chemical properties of earth materials by many techniques, using the most modern equipment and instruments that can be obtained.

Geophysicists are interested in the physical characteristics of the earth—magnetism, gravity, electrical conductivity, elasticity and radioactivity—and in measuring these in the field and in the laboratory. Anyone interested in applied mathematics, physics or electrical engineering will find geophysics a challenging profession, but it is only for the well-trained scientist who wants to tackle difficult problems. So our curriculum at M.I.T. is heavily weighted in mathematics and physics in order to give interested students the fundamentals they will need for professional practice. Most geophysicists have traveled widely over the earth by the time they have reached middle age, and they have had to solve a wide variety of problems involving mathematics, physics, electrical engineering, and geology.

Modern earth scientists need to be able to work in the field as well as in the laboratory. M.I.T. requires, after the sophomore year, a summer's work in the well-equipped field camp which we share with the Nova Scotian Universities near Antigonish, Nova Scotia. Here students learn surveying, mapping, and geological field methods during a ten-week period.

An optional cooperative program of geophysical field training has been arranged with Geophysical Service, Inc., of Dallas, Texas, for the summer following the third year. During this summer, students who participate in the program are employed by the company; and after a week of orientation lectures in Dallas, they join field parties engaged in seismic exploration in a part of the continent where active petroleum search is going on. Other juniors may find summer work with petroleum and mining companies and may go to areas as distant as Mexico, California, British Columbia, New Brunswick, and Newfoundland.

The nation's expanding industrial economy is making heavy demands on the petroleum and mineral industries and on the companies that find and develop the raw materials for these industries. Reserves of petroleum and natural gas, of metallic ores, and of many non-metallic substances—even water supplies—are increasingly difficult to maintain; likewise, reserves of nuclear fuels are now being sought everywhere. The easy discoveries have been made, the low-cost deposits have been exhausted, and we now are dependent on improvements and new developments in geological, geochemical, and geophysical methods.

Geological science is young; it dates from about 1800, but its growth to national prominence is much more recent. A current survey shows that 70 per cent of those in the profession are between 25 and 45 years of age. The number of trained geologists almost doubled between 1940 and 1950; we expect it to double again by 1970. This young profession has plenty of room for promising graduates.

FIRST YEAR

First Term

General Chemistry (5.01)
Physics (8.01, Mechanics)
Calculus (18.01)
Introduction to the Humanities (21.01)
and at least 12 units of elective subjects during the first two years; first-year electives are described in Section 5

Second Term

General Chemistry (5.02)
Physics (8.02, Heat, Kinetic Theory)
Calculus (18.02)
Introduction to the Humanities (21.02)
and at least 12 units of elective subjects during the first two years; first-year electives are described in Section 5

SECOND YEAR

First Term

Physics (Electromagnetism)
Mineralogy I
Physical Geology
Calculus
Humanities

Second Term

Physics (Optics, Atomic Physics)
Historical Geology
Differential Equations
Humanities
and one elective subject

Summer

At the Nova Scotia Centre for Geological Sciences:
Geological Surveying
Field Investigations and Reports

Four-Year Course (Course XII)

THIRD AND FOURTH YEARS

In consultation with registration advisers, students plan individual programs of elective subjects for both the third and fourth years. Each student must register for Thesis *during the fourth year. In addition, during the third and fourth years, each must register for four subjects in* Humanities; *four to six subjects in* Mathematics, Physics, Chemistry, *and* Electrical Engineering; *and five to seven subjects in* Geology. *Other electives (three or four subjects) may be chosen from any department at the Institute.*

Five-Year Course (Course XII-A)

THIRD, FOURTH, AND FIFTH YEARS

In consultation with registration advisers, students plan individual programs of elective subjects for the third, fourth, and fifth years. Each student must register for Thesis *work during the fifth year. In addition, during the three years each student must register for four subjects in* Humanities, *four to six subjects in* Mathematics, Physics, Chemistry, *and* Electrical Engineering; *and eight to ten subjects in* Geology *(including graduate subjects). Other electives (six to eight subjects) may be chosen from any department at the Institute.*

This wide choice of electives makes it possible for students to concentrate their work in one or a combination of these fields: Basic Geology, Crystallography, Engineering Geology, Geochemistry, Geophysics, Mineralogy, Mineral Industry, Mineral Deposits, Mineral Fuels (Petroleum and Natural Gas), Petrology, Sedimentation, Stratigraphy and Paleontology, Structural Geology, *and* Theoretical Geology.

MATHEMATICS

Professor William T. Martin

The study of mathematics as a professional major may have as its goal some or all of the following objectives:

1. The creation of new mathematics;
2. The application of mathematics in engineering, science, or industry;
3. Preparation for teaching mathematics.

One of the postulates underlying scientific research is the assumption of the existence of "laws of nature." We assume that effect follows cause, that nature is not capricious and chaotic but possesses an inherent harmony and beauty. Mathematics has played a significant role in the discovery of physical laws, and it has provided a simple language for expressing them. But beyond this, mathematics provides what is probably the most economical tool for exploring the consequences of these laws and for predicting the outcome of experiments. For example, the planet Pluto was discovered after mathematical calculations showed that there was a discrepancy between the observed position of Neptune and the position predicted for it on the basis of the laws of gravitation. Similarly, one of the crucial tests of Einstein's theory of relativity (the bending of light rays under gravitational attraction) was first worked out mathematically, then verified experimentally. More dramatic, of course, has been the development of atomic energy, first predicted by mathematical calculations applied to basic physical laws expressed in mathematical language.

One of the noticeable trends during the past decade has been the increasing demand from industry and from governmental research organizations for persons trained in mathematics. These jobs range over such fields as communications, aeronautics and astronautics, atomic energy, oil exploration, missile control and instrumentation, and design and operation of high-speed computers. No longer is it true (if indeed it ever was) that the only careers to which a mathematics major can look forward are in statistics or in teaching, though these fields are also expanding and are calling for more qualified people.

Some people are surprised to learn that mathematics is a living, growing science in its own right and not just a collection of formulas discovered long ago and passed on from generation to generation. To the student who finds that mathematics has its own fascination, quite apart from its function as "handmaiden of the sciences," we especially offer a word of encouragement. If you can see beauty in, and feel a glow of satisfaction from understanding, a mathematical theorem—or if you have been lucky enough to discover some interesting mathematical facts for yourself—you may be one of those destined to become a mathematician in the true sense of the word—namely, a creative scientist who discovers or invents new mathematics. There is no guarantee of success, for there can never be such a guarantee in acts of discovery or invention, but you will surely derive a great deal of pleasure from the process of trying.

Only a brief word about the M.I.T. Course in Mathematics need be added: as you can see, it provides in the junior and senior years a very wide choice of subjects. This means that the Course can fulfill the needs of all who are interested in mathematics; we work with each student to develop his program to meet his special requirements.

Mathematics (Course XVIII)

FIRST YEAR

First Term

General Chemistry (5.01)
Physics (8.01, Mechanics)
Calculus (18.01)
Introduction to the Humanities (21.01)
and at least 12 units of elective subjects during the first two years; first-year electives are described in Section 5

Second Term

General Chemistry (5.02)
Physics (8.02, Heat, Kinetic Theory)
Calculus (18.02)
Introduction to the Humanities (21.02)
and at least 12 units of elective subjects during the first two years; first-year electives are described in Section 5

SECOND YEAR

First Term

Physics (Electromagnetism)
Calculus
Humanities
Language
and one elective in Engineering *or* Science (*not* Mathematics)

Second Term

Physics (Electromagnetism, Electromagnetic Theory of Light)
Differential Equations
Humanities
Language
and one elective in Engineering *or* Science

THIRD YEAR

First Term

Linear Algebra
Analysis
and three elective subjects, of which one must be in Mathematics (*or* Engineering *or* Science) *and one in* Humanities

Second Term

Analysis
and four elective subjects, of which one must be in Mathematics (*or* Engineering *or* Science) *and one in* Humanities

FOURTH YEAR

First Term

Thesis
and five elective subjects, of which three must be in Mathematics (*or* Engineering *or* Science) *and one in* Humanities

Second Term

Elementary Differential Geometry
Thesis
and three or four elective subjects, of which one or two must be in Mathematics (*or* Engineering *or* Science) *and one in* Humanities

PHYSICS

Professor Nathaniel H. Frank

Understanding of the quantitative description of our physical environment—for example, of the laws of dynamics or of the structure of matter—is essential for proper education in pure or applied physical science. The rapidly evolving nature of standard engineering practice and especially its application to unusual and novel situations can be grasped more effectively by the man capable of relating it to a basic picture of the physical world. In its undergraduate curriculum the Physics Department attempts to develop the necessary insight through rigorous subjects encompassing not only the fields of classical physics but also the many ideas of modern physics. This physical picture relates such diverse things as individual atoms to chemistry or metallurgy and the nucleus of the atom to the intense energy radiated by stars.

The physics subjects in the first two years at M.I.T. provide thorough grounding in Newtonian mechanics and its range of applicability; then in electromagnetism, not only for its application to electrical circuits but also for its interaction with matter and the radiation of electromagnetic waves. Such wave motions give useful insight into optics and acoustics. They also lead into the modern conceptions of the wave nature of matter. An important role of these physics subjects is to supply a sound scientific foundation on which each student can build his own professional career.

In the last two years of the physics undergraduate curriculum, students are able to satisfy their individual interests by choosing from a great number of more advanced and more specialized subjects. The curriculum for those who major in physics is flexible. Opportunity exists to delve into one subject deeply, and the possible choices are many. The Department provides opportunities to see how physics research is really done, and, indeed, to participate in it in one of many active laboratories.

Both prospective physicists and those who will use their knowledge of physics for application in other fields benefit from the Physics Department's two closely interrelated objectives—good teaching and good research. The research program guarantees contact with current problems of physics and with the growth of the science. Here research groups in solid state, low temperature, nuclear, high energy, and theoretical physics, optics, spectroscopy, electronics, and many other fields of physics attack the current problems. Furthermore, physics at M.I.T. is not isolated. The members of the Department share problems which extend into other fields and other departments of M.I.T. Often these are shared unofficially, but there are so many cross connections that several interdepartmental laboratories are in active operation. The challenge of diverse problems and intimacy with current work illuminates teaching.

The Physics Department does not expect that all its graduates will work in the field of physics. There are opportunities for the trained physicist in many places. Advanced work is often done by our graduates in allied fields. They may become metallurgists or physical chemists, to give some examples. In recent years industry has hired an increasing number of physicists to do development work—work which might previously have been assigned to engineers. Applied physics work has increased industrially and also has played a great role in the development of the defensive strength of our country. Some physicists even go farther afield and join the biologists in attacking the fundamental problems of life. At the moment a serious shortage of science teachers exists in secondary schools throughout the country. The opportunities for applying or working in physics seem to be almost limitless.

Physics (Course VIII)

FIRST YEAR

First Term

General Chemistry (5.01)
Physics (8.01, Mechanics)
Calculus (18.01)
Introduction to the Humanities (21.01)
and at least 12 units of elective subjects during the first two years; first-year electives are described in Section 5

Second Term

General Chemistry (5.02)
Physics (8.02, Heat, Kinetic Theory)
Calculus (18.02)
Introduction to the Humanities (21.02)
and at least 12 units of elective subjects during the first two years; first-year electives are described in Section 5

SECOND YEAR

First Term

Physics (Electromagnetism)
Calculus
Humanities
two or three elective subjects (one term of Chemistry *beyond first-year* Chemistry *is required in the First or Second Term)*

Second Term

Elementary Electric Circuit Theory
Physics (Electromagnetism)
Differential Equations
Humanities
one elective subject

THIRD YEAR

First Term

Physics of Atoms, Molecules, and Nuclei I
Electronics
Experimental Atomic Physics I
Advanced Calculus for Engineers
and one elective in Humanities

Second Term

Electronic Devices and Circuits
Physics of Atoms, Molecules, and Nuclei II
Experimental Atomic Physics II
elective subject in Mathematics
and one elective in Humanities

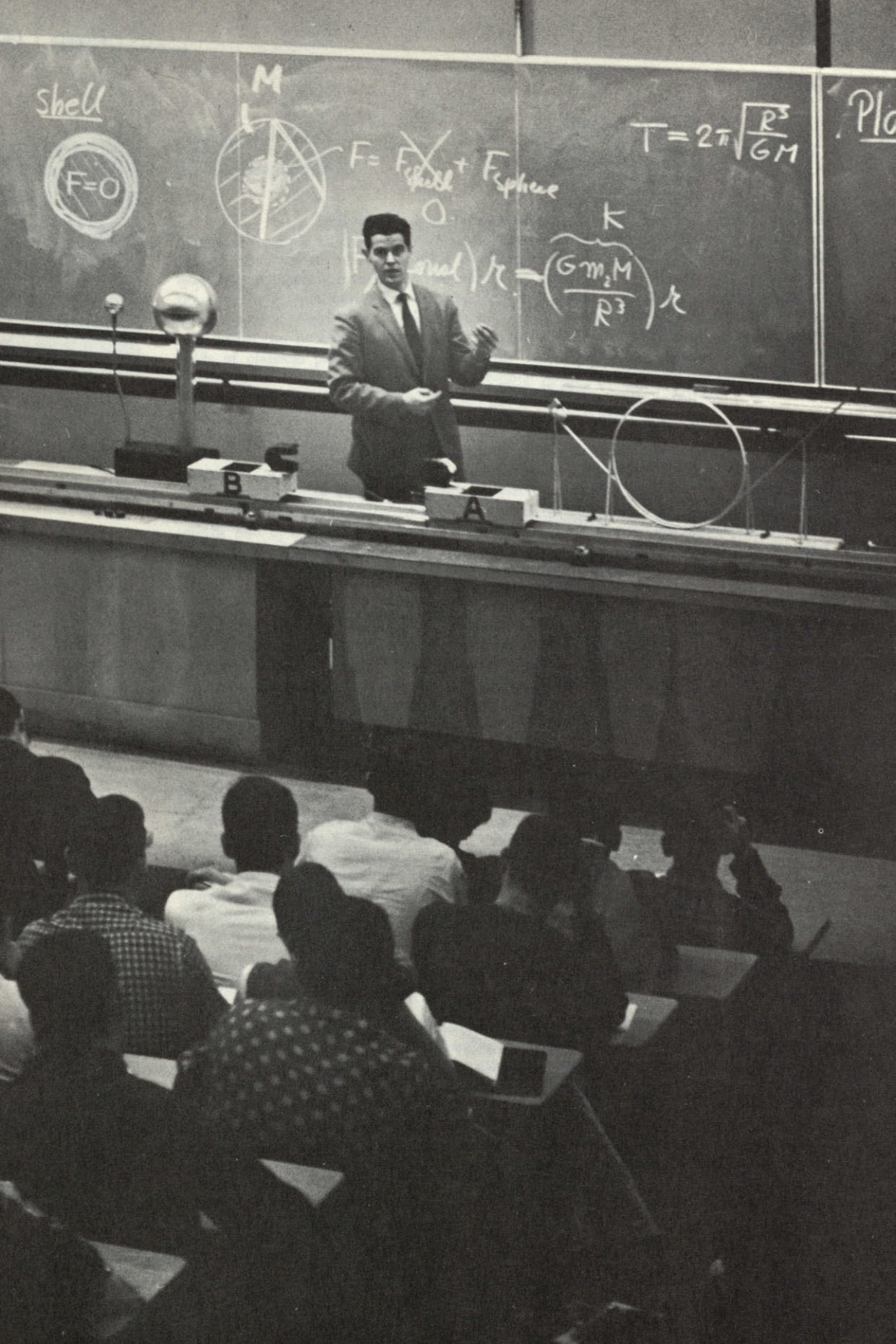
FOURTH YEAR

First Term

Experimental Physics *and* Thesis
Mechanics I
two elective subjects
and one elective in Humanities

Second Term

Statistical Mechanics and Thermodynamics
Electromagnetic Radiation
Thesis
one elective subject
and one elective in Humanities


Shell
F=0
M
$F = F_{shell} + F_{sphere}$
$T = 2\pi\sqrt{\frac{R^3}{GM}}$
$\left(\frac{Gm_2M}{R^3}\right)r$
B
A

5 *The First-Year Subjects*

The following descriptions are of the subjects ordinarily recommended for and taken by first-year students. Before coming to M.I.T. you may wish to consider which of these you will include in your first-year schedule; this should of course be done in accordance with the sample "recommended" curriculum of the Course which you now expect to follow at M.I.T. as given in the previous chapter. And when you arrive at M.I.T., you will want to discuss your choices with your adviser and perhaps modify them in accordance with his suggestions.

HOURS AND CREDITS

With the descriptions on the following pages you will see the credit hours given for each first-year subject. These are presented so as to show the *total* work which a subject requires. Thus, in the case of the first subject shown:

1.002 Technology in Our Civilization 2-4

the credits mean that 2 hours per week are required in class and laboratory and 4 hours per week are required by an average student for outside preparation, for a total of 6 hours. On this basis the normal undergraduate schedule is approximately 45 hours per week total time, including classrooms, laboratories, and preparation. A student taking this much work in one semester is said to be registered for 45 units of credit for that semester.

As you will see, the subjects are numbered according to the department under which they are given. For example, subject 5.01 is given in the Chemistry Department, though it appears in the schedules of many Courses as well as Chemistry.

LANGUAGES.

In addition to the subjects which are described on the following pages, freshmen may register for any subject in a modern language for which they are qualified. M.I.T. offers three-year sequences in Russian, French, and German; special subjects in Spoken French and Spoken German for students who have had three years of either language in high school; and three subjects in Linguistics. Most of these subjects have credits of 3-5, according to the system just described.

2.721 ENGINEERING DRAWING 4–2

This newly revised subject provides an opportunity for students to use graphical techniques effectively. Solution of real problems in a variety of areas of interest: mechanical, electrical, aeronautical, chemical, and civil engineering, and physics, metallurgy, meterology, geology, and architecture. Spatial visualization, experience in creative thinking, and the ability to convey ideas, especially by freehand sketches. Four weeks of training in technical sketching, including orthographic projections and isometric and perspective pictorials, followed by projects representing particular fields of science or engineering.

2.722 DESCRIPTIVE GEOMETRY 4–2

Analysis of three-dimensional space relations on a two-dimensional surface; analysis of problems involving points, lines, planes, and surfaces into fundamental components and development of methods of attack; and development of capacity to think in space terms.

2.723 ELEMENTARY NOMOGRAPHY 2–4

Introduction to graphical solution of equations through alignment diagrams based on plane geometry, including graphical use of central projections and duality of point and line; treatment of empirical data. The practical design of charts will be emphasized.

2.725 GRAPHICAL PROCESSES 2–4

Methods of graphical solution of physical problems: graphical arithmetic and algebra; conic constructions, projective geometry, coordinate systems, graphical calculus, scales, nomograms, empirical curves, and periodic curves. An individual project is included in this subject.

2.727 BASIC MACHINE DRAWING 4–2

Fundamentals of representation by projection. Section views; auxiliary views; dimensioning; fasteners; shop terms and processes; reproduction of drawings. Freehand sketching and instrumental drawing are used where appropriate.

4.00 **STRUCTURE OF THE CITY** 3–3

Lectures, field trips, and reading to familiarize students with the visual form and functioning of their physical environment; to suggest a responsibility and some of the means for its improvement; and to sharpen the powers of observation and the sense of design. Greater Boston will be studied as an example of urban structure —its historical development and current physical problems and the future possibilities of its industry, commerce, living areas, public institutions, and related services.

4.011 **GRAPHICS LABORATORY I** 3–2

Freehand drawing exercises to develop accurate observation and skill in graphic representation. Linear, light and shadow, detail, and perspective renderings of varied subject matter. Control of line, value, color, texture, and form using pencil, pen, and brush.

4.012 **GRAPHICS LABORATORY II** 3–2

Continuation of practice in representational techniques. Exercises employing graphic devices useful in all types of free-hand drawing. Use of charcoal pencil, pen and ink, and water color as effective means to create the graphic equivalent of what is observed or visualized.

5.01 **GENERAL CHEMISTRY** 6–5

Fundamental principles of chemistry: gas laws; mass and energy relationships in chemical changes; writing and the use of chemical equations for quantitative calculations; factors affecting the rate and equilibrium of a chemical reaction; correlation of equilibrium conditions through the mass-action law and the electromotive force of voltaic cells; atomic structure, chemical reactivity of elements, and the Periodic Table; chemistry of certain elements in groups 1, 2, and 3 of the Periodic Table. The laboratory work is largely quantitative in nature and is closely integrated with lectures and recitations.

5.02 **GENERAL CHEMISTRY** 6–5

Application of chemical principles to the correlation of the chemical behavior of the common elements; stability of the various oxidation states; chemistry of the ionic species; quantitative application of the principles of rate and equilibrium to chemical reactions; structural chemistry of crystals and of molecules; acid–base systems; introduction to the chemistry of carbon; nuclear reactions. The laboratory work emphasizes the important chemical facts of the elements. Facts and principles are used to develop a scheme for the qualitative separation of the elements, with stress on the analysis of unknown mixtures.

6.41 **INTRODUCTION TO AUTOMATIC COMPUTATION** 2–4

Principles of describing computation processes and programming digital computers to do them. Emphasis on concepts of computation processes and their realization by machine rather than on proficiency in the art of programming. Stored program computers; binary, octal, and decimal number systems; practice in writing programs in machine language and in Fortran and running them on I.B.M. 704; important kinds of programming languages; elementary treatment of Turing machines. Suitable elementary numerical problems in mathematics and physics; some non-numerical uses of computers.

7.00 **PERSPECTIVES IN LIFE SCIENCE** 3–3

Lectures and demonstrations present the place of man in the world of living organisms; factors important in man's successful adaptation to his external environment, animate and inanimate; and the processes which make possible the various functions of man's body in health and disease, including major concepts of genetics, growth, development, and physiology. Concluding lectures are on the growing importance of biophysics and biochemistry in the shaping of modern biological concepts (biology at the molecular level) and the outlook for theoretical biology.

8.01 **PHYSICS (MECHANICS)** 5–6

The fundamental laws of mechanics of particles and rigid bodies; principles of conservation of mass, energy, momentum and angular momentum. There is free use of elementary calculus during the second half of the subject.

8.02 **PHYSICS (MECHANICS: HEAT AND KINETIC THEORY)** 5–6

Oscillations and waves; hydrodynamics; the equations of the state of gases, liquids, and solids; elementary kinetic theory.

12.00 **EARTH SCIENCE (GEOLOGY, GEOPHYSICS, GEOCHEMISTRY)** 2–4

Lectures and demonstrations on the more important aspects of the origin, history, physical behavior, and chemical constitution of the earth and the methods of reasoning and investigation by which the major concepts, laws, and hypotheses of earth science were formulated. The general topics discussed are: earth origin and methods of determining the sequence of events in geologic history; development of continents, oceans, and mountains; evolution of plants and animals through geologic time; formation, distribution, and methods for discovering minerals, rocks, ores, coal, petroleum, and natural gas; reshaping of the earth's surface features by water, ice, and wind; activities associated with earthquakes, volcanoes, and hot springs; and discussion of the kinds of work carried on by earth scientists as geologists, geophysicists, and geochemists. Local field trips are planned.

12.001 **ASTRONOMY** 3–3

Survey of the history of astronomy and its contributions in philosophy and science to our modern civilization. Emphasis on present theories of the age, origin, and evolution of the Universe. Lectures on the basic physical and chemical principles and the instruments used in modern astrophysics, followed by a study of the planets and their relation to the Universe. Discussion of concepts of stellar magnitudes, spectral classification, stellar energy production, galactic dynamics, Universe expansion, and element origin. Orientation of the Earth to the Universe. Field trips to local observatories.

18.00 **ELEMENTARY NUMBER THEORY** 2–4

The elementary theory of whole numbers includes such topics as divisibility, prime and composite numbers, greatest common divisors, solutions of equations in integers, the congruence notation and its application, and sums of squares.

18.01 **CALCULUS** 3–6

The fundamental ideas of differential and integral calculus: differentiation and graphical representation of algebraic functions and of the sine and cosine; integration of simple algebraic and trigonometric functions; applications to problems in geometry and mechanics: maxima and minima, velocity and acceleration, plane areas, volumes, arc length, areas of surfaces of revolution, center of gravity, and moment of inertia; analytic geometry of the straight line.

18.02 **CALCULUS** 3–6

Analytic geometry of the conic sections; further study of differentiation and integration: trigonometric, inverse trigonometric, exponential, logarithmic, and hyperbolic functions; polar coordinates and parametric representation; complex numbers; elementary vector analysis.

18.08 **TOPICS IN DISCRETE MATHEMATICS** 2–4

Elementary topics in: propositional logic; algebra of sets; permutations and combinations; probability; vectors and matrices; mathematical models and axiomatic method.

19.003 **ELEMENTARY METEOROLOGY I** 3–3

An introduction to meteorological science through examples from all scales of atmospheric motions; radiation balance and the global circulation; air masses and fronts; cyclones and weather forecasting; hurricanes; sea breeze; thunderstorms; micrometeorology; cloud physics; climatology. Laboratory exercises with weather maps.

20.00 **MAN'S FOOD** 3–3

A survey of the natural and cultivated sources of food for mankind from the viewpoint of production, transportation, processing, packaging, and consumption. General topics discussed will be: history of the foods of mankind through the ages; natural food resources; nutritional requirements of man; effects of geography on dietary patterns; food habits and fads; environment, soils and agriculture; plant and animal breeding; harvest, storage and distribution of food; international movement of food; food economics; agricultural economics; federal regulation of agriculture; food industry of the U.S.; food laws and regulations; science and engineering in food technology; population and the world food problem.

21.001 **PHILOSOPHY AND SCIENTIFIC METHODOLOGY** 2–4

A study of the nature of science and scientific inquiry, and of philosophy and its problems: the language problem in science and philosophy; the subject matter of logic; the nature and role of induction and deduction, "facts," hypotheses, laws; experimental methods, prediction, and operational definition; science as a description of experience; scientific law as explanation; critical evaluation of scientific results. Lectures will be implemented by discussion of various key concepts from the physical and biological sciences—their role in science and the light they shed on philosophical problems.

21.002 **ENGLISH COMPOSITION** 2–4

A study of the principles of effective written communication. Particular attention is given to logical organization of papers and to precise and coherent expression of facts and opinions. Numerous papers are required.

21.005 **PUBLIC SPEAKING** 3–3

Principles of effective oral communication: instruction in the delivery, content and logical development of subject matter; individual training in the extemporaneous and impromptu speech situation; and practice and individual criticism.

21.006 **PUBLIC SPEAKING** 3–3

The content and organization of subject matter; emphasis on delivery; and practice in specific speech situations: group discussions, sales talks, speeches to entertain, introduce, and present or receive an award; welcome and response, expert witness, and chairman or master of ceremonies.

21.01, 21.02 **INTRODUCTION TO THE HUMANITIES** 3–5, 3–5

Introduction to history, literature, and philosophy through intensive reading and discussion of important works from classical, medieval, and early modern periods; emphasis on method and structure as well as content. Training in writing through essays based on assigned readings.

AS11, AS12 **AIR SCIENCE** 3–0, 3–0

Introduction to A.F.R.O.T.C.; elements and potentials of air power; air vehicles and principles of flight; military instruments of national security; professional opportunities in the U.S.A.F.: leadership laboratory.

MS11, MS12 **MILITARY SCIENCE** 3–0, 3–0

Basic training is provided in the school of the soldier, exercise of command, military organization, American military history, individual weapons and marksmanship, and the United States in world affairs.

NS11, NS12 **ORIENTATION OF SEA POWER** 4–5, 4–5

Fundamentals of naval knowledge. Concepts of the use of sea power from geographical, geopolitical, and national strategic considerations. Historical influence of sea power in shaping world affairs socially, politically, and economically. (This subject is restricted to students selected for N.R.O.T.C.)

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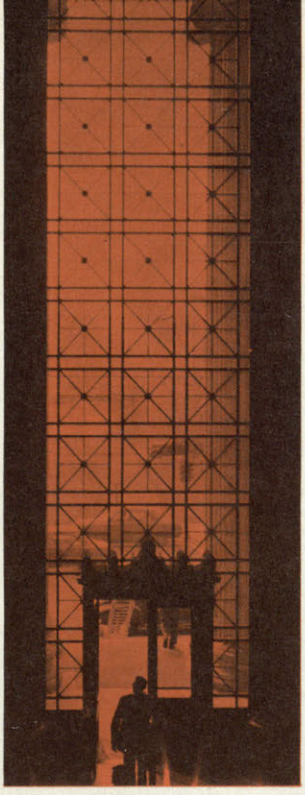

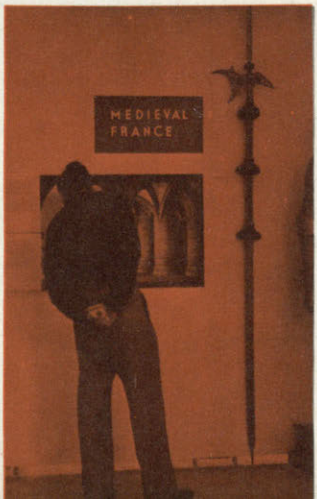
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