FALL,
WINTER &
SPRING
QUARTERS

1967-68

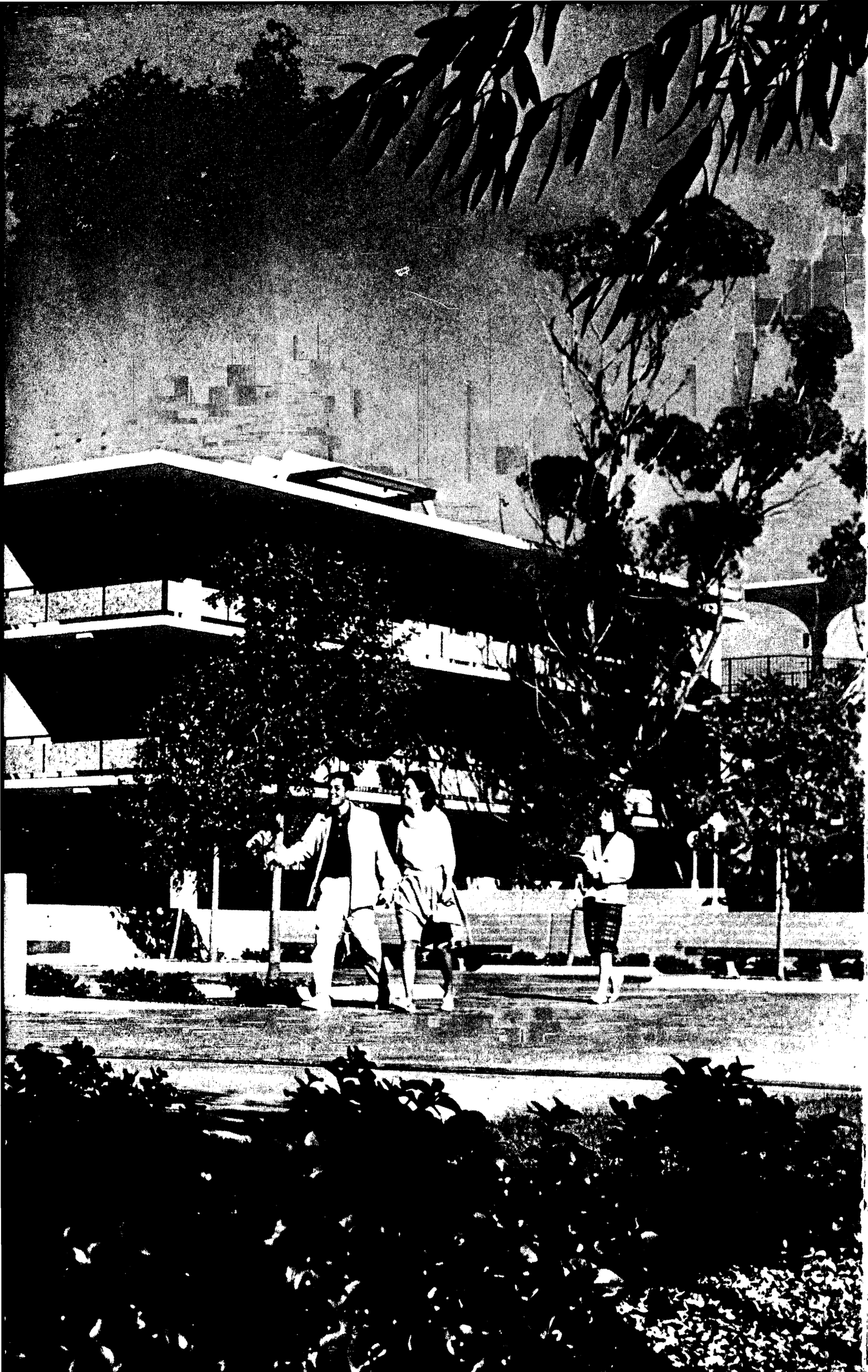
MUIR
COLLEGE

REVELLE
COLLEGE

GRADUATE
DIVISION

UNIVERSITY OF CALIFORNIA, SAN DIEGO

CENTENNIAL EDITION



Price: 50 cents

University of California, San Diego

GENERAL CATALOG

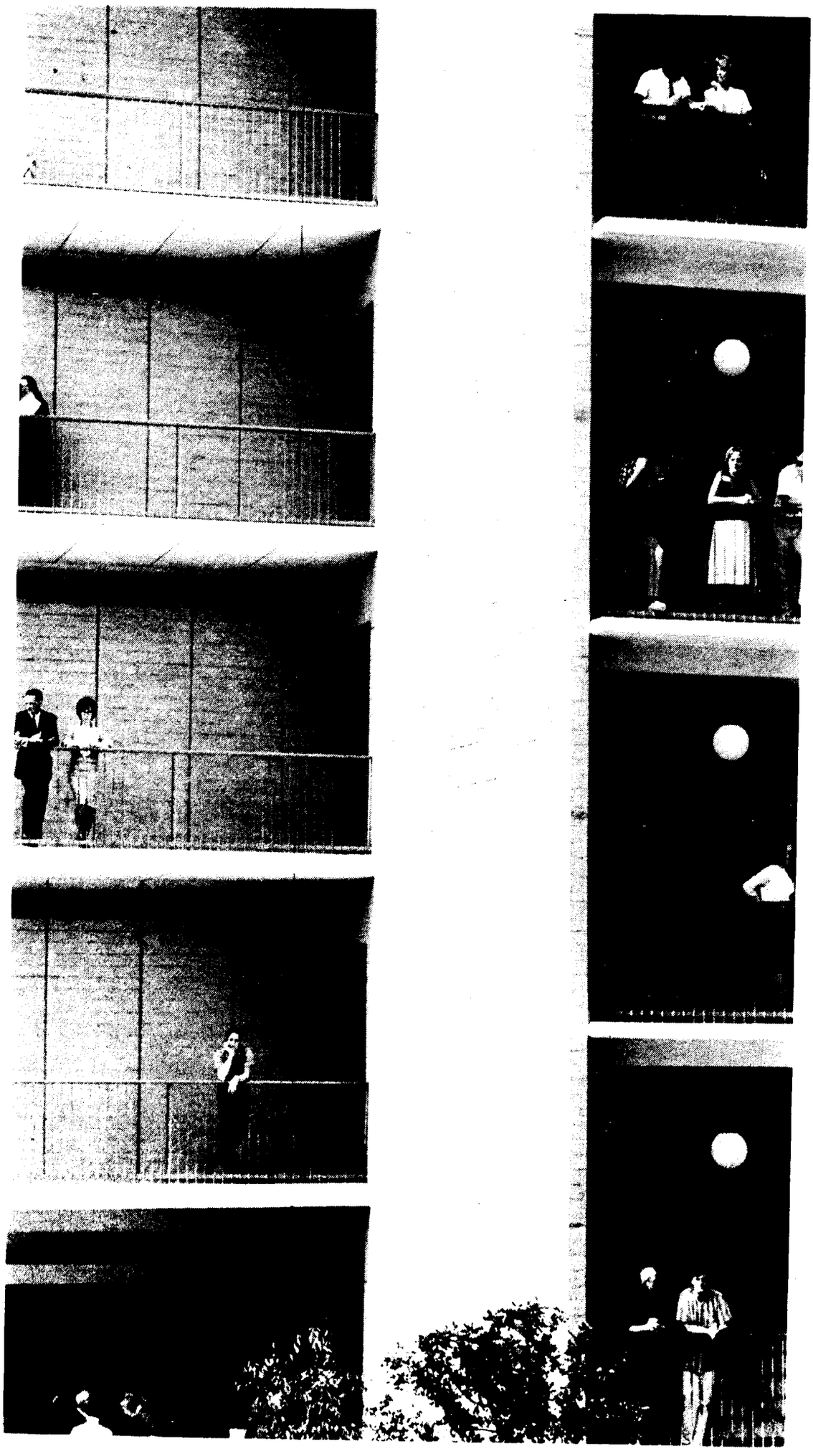
Fall, Winter, and Spring Quarters, 1967-68

UNIVERSITY OF CALIFORNIA, SAN DIEGO
POST OFFICE BOX 109
LA JOLLA, CALIFORNIA 92037

Academic Calendar 1967–1968

	Fall '67	Winter '68	Spring '68
Final dates for filing applications for admission to undergraduate standing in regular, limited, or special status, including applications for a second bachelor's degree or intercampus transfer. (File with Admissions Officer.)	March 1 Wednesday	November 1, '67 Wednesday	February 1 Thursday
Final dates for filing applications for advancement to candidacy for the Master's degree (at least one quarter must intervene between advancement to candidacy and conferring of degree).	May 2 Tuesday	November 3, '67 Friday	February 7 Wednesday
Final dates for filing applications for readmission to undergraduate status. (File with the Registrar.)	August 28 Monday	December 4, '67 Monday	February 26 Monday
Quarter begins.	September 25 Monday	January 2 Tuesday	March 25 Monday
Registration and orientation.	September 25-29 Monday- Friday	January 2-3 Tuesday- Wednesday	March 25-26 Monday- Tuesday
Instruction begins.	October 2 Monday	January 4 Thursday	March 28 Thursday
Final dates for late registration. ($10 fee.)	October 2-6 Monday- Friday	January 4-10 Thursday- Wednesday	March 28 - April 3 Thursday- Wednesday
Final dates for filing official study-list packets without late fee.	October 6 Friday	January 10 Wednesday	April 3 Wednesday
Final dates for filing official study-list packets without lapse of status. ($10 fee.)	October 11 Wednesday	January 12 Friday	April 5 Friday
Final dates for adding courses.	October 13 Friday	January 17 Wednesday	April 10 Wednesday
Final dates for filing notice of candidacy for the bachelor's degree to be conferred at end of quarter. (File in Provost's Office.)	November 1 Wednesday	February 1 Thursday	May 1 Wednesday
Final dates for graduate and undergraduate students	November 1	February 1	May 1

Final dates for filing with the doctoral committee an appropriate draft of dissertation for a doctor's degree to be conferred at end of quarter.	November 3 Friday	February 7 Wednesday	May 1 Wednesday
Academic and administrative holidays.	—	February 12 Monday	May 3 Friday
Final dates for filing applications for graduate fellowships. (Office of Graduate Studies and Research.)	—	February 15 Thursday	—
Final dates for dropping courses without penalty of grade F, or to file notice of withdrawal without penalty of F grades.	November 10 Friday	February 15 Thursday	May 9 Thursday
Academic and administrative holidays.	November 23-24 Thursday- Friday	—	May 30 Thursday
Charter Day.	—	March 1 Friday	—
Final dates for filing with the Office of the Registrar completed copies of thesis for master's degree and dissertation for doctor's degree to be conferred at end of quarter.	December 8 Friday	March 8 Friday	June 6 Thursday
Instruction ends.	December 9 Saturday	March 9 Saturday	June 6 Thursday
Final examinations.	December 11-16 Monday- Saturday	March 11-16 Monday- Saturday	June 7-13 Friday- Thursday
Quarter ends.	December 16 Saturday	March 16 Saturday	June 13 Thursday
Administrative holidays.	December 22 Friday	—	—
	December 25 Monday	—	—
	December 29 Friday	—	—
	January 1, '68 Monday	—	—



The balconies of the seven story Urey Hall in UCSD's Revelle College

Contents

Student dormitories at Revelle College in the late afternoon sun

A class in tennis, part of UCSD's growing physical education program

The University of California

THE STATEWIDE INSTITUTION

The University of California celebrates its centennial this academic year. Founded in 1868 by an act of the State Legislature, it is a unique institution made up of nine campuses strategically located throughout the state. The first of these campuses was established at Berkeley, and others followed at San Francisco, Los Angeles, Davis, Santa Barbara, and Riverside. The most recently established campuses are at San Diego, Irvine, and Santa Cruz.

Each of these campuses has its own distinct character and personality. At the same time, the spirit of cooperation prevails in the necessary sharing of certain educational and research facilities, and in the common participation in statewide scientific institutes. It is possible for graduate students registered at one campus to take courses or do research at another campus of the University. Undergraduates on any UC campus may take advantage of the University's Education Abroad Program to study at a foreign university.

Any qualified student may obtain an education at the University of California. Instruction in the arts and sciences, as well as fundamental training for many of the professions, is available. At present, there is a choice of some two hundred curricula and majors that lead to degrees, certificates, or credentials. Each year approximately eight thousand students earn degrees at the bachelor or first professional level and another three thousand earn advanced degrees.

The University operates several major research stations, including the Lawrence Radiation Laboratory, Lick Observatory, and the Los Alamos Scientific Laboratory, and numerous agricultural experiment stations and extension offices. In addition to its regular program of instruction, the University provides educational services throughout the state in the form of continuing adult education programs, informational services for agriculture, and business and professional conferences and institutes.

THE ADMINISTRATION

The organization and government of the University is entrusted, under the State Constitution, to the Regents of the University of California. The Board of Regents is composed of twenty-four members, sixteen of whom are appointed by the Governor and eight of whom are ex officio members, by reason of the public offices they hold. The executive head of the University, in all its departments and on all its campuses, is the President. He and his staff direct the development of major policy for the entire institution. The Board of Regents appoints the President, and he is directly responsible to them. On each campus the chief administrative officer is the Chancellor, also appointed by the Regents. He and his staff are in charge of all activities on their particular campus.

Subject to the approval of the Board of Regents, the conditions for the admission of students and the granting of degrees and certificates are determined by the Academic Senate. The Senate, which is composed of the faculty and certain administrative officers, also authorizes and supervises all courses of instruction in the academic and professional schools and colleges of the University.

THE SAN DIEGO CAMPUS

The Setting

The University of California, San Diego, is situated near the northern limits of the city of San Diego. Occupying nearly a thousand acres, the campus site spreads from the seashore at the north side of La Jolla Cove, where the Scripps Institution of Oceanography is located, across a large portion of the adjacent Torrey Pines Mesa, high above the Pacific Ocean. Much of the land is wooded; to the east and north lie mountains, to the west the sea.

San Diego is California's oldest and third-largest city, with a metropolitan-area population of just over a million. It has much to offer UCSD students and faculty in the way of cultural and recreational activities.

Within the city, and accessible to the campus, are scores of public beaches, including those of Mission Bay, an area that is being developed into one of the finest aquatic centers in the world. The nearby mountains offer skiing in the winter, hiking and camping the year around. Just beyond the mountains the vast and beautiful Anza-Borrego desert stretches to the Colorado River.

In downtown San Diego is Balboa Park, one of the largest city parks in the country and home of the world-famous San Diego Zoo. The Fine Arts Gallery of San Diego, the Timken Gallery, the Museum of Natural History, and other museums are located in the park. Here also stands the Old Globe Theatre, a replica of an Elizabethan playhouse, where community theater is offered throughout the year and the renowned National Shakespeare Festival is held each summer.

The recently completed Community Concourse, featuring a 3,000–seat civic theater and extensive convention and exhibition facilities, is located in the heart of the city, offering residents and visitors major musical and dramatic productions and providing a beautiful new home for the San Diego Symphony, ballet, and opera.

A major sports stadium in nearby Mission Valley provides playing fields for San Diego's major league football and Triple-A baseball teams. An indoor sports arena near Mission Bay is the home of San Diego's professional basketball and ice hockey teams.

The city's attractions are many and varied. Theater, museums, music, art, sports—all are available in San Diego.

The History

The San Diego campus of the University of California had its origins in the closing years of the nineteenth century when Berkeley zoologists

selected La Jolla as the site for a marine station on the Pacific. This project, which eventually became the Scripps Institution of Oceanography, was made a part of the University of California in 1912. When, in the late 1950's, it was decided to establish a general campus of the University at San Diego, the Scripps Institution—with its distinguished though small staff of scientists—formed the nucleus of the new enterprise.

At first, only graduate studies and degrees in the physical and natural sciences were offered. In the fall of 1964 the campus accepted its first undergraduates, offering a basic lower-division curriculum to prepare students for majors in the humanities, the social sciences, the biological sciences, the physical sciences and mathematics.

The Future

The San Diego campus is expected to reach maximum growth by 1995, with a student enrolment of 27,500. By that time twelve interrelated colleges in clusters of three or four will have been established, each of which will accommodate approximately 2,300 students and provide a wide variety of both undergraduate and graduate programs. The objective is to give students and faculty the opportunity of working together in small academic units while at the same time enjoying the advantages of a major university. Two colleges, Revelle and Muir, are now in operation. Others will be opened at three-year intervals.

Scholars and researchers of international reputation in the humanities, the social sciences, and the natural sciences have been attracted to the UCSD faculty. The University's graduate students are drawn from the upper ranks of the nation's finest colleges and universities and from institutions of comparable standing throughout the world. The San Diego campus offers its students an opportunity for intimate association with some of the greatest names in American education today.

THE COLLEGES

Revelle College

Revelle College was named in honor of Dr. Roger Revelle, former University-wide Dean of Research, and for many years Director of UCSD's Scripps Institution of Oceanography. The College will be in its fourth year of undergraduate instruction in 1967, with about a thousand lower-division students and six hundred upper-division students.

Formerly called the School of Science and Engineering and later First College, Revelle College was established in 1958. After being temporarily housed on the Scripps campus, Revelle College moved into its first completed buildings during the 1963–64 academic year.

In 1960 Revelle College began a graduate program in the physical sciences. From that beginning, it has been rapidly developing its humanities and social science programs, and today the teaching program reflects a broad spectrum of learning. The undergraduate program is based on the axiom that the candidate for the Bachelor of Arts degree must attain an

acceptable level of general education in mathematics, foreign language, the physical, biological, and social sciences, the fine arts and the humanities. He must attain a high quality of competence in one academic discipline, and an understanding of an academic area outside his major field. Students take a common lower-division curriculum, which is based on the principle that an undergraduate should not specialize in his major field until he has had a chance to learn something about the many fields that are open to him. It is anticipated that most graduates of Revelle College will undertake work in graduate schools. Therefore, the main effort in the upper-division years is devoted to intensive work in the major field, although the student will take approximately one-fourth of his upper-division courses in a noncontiguous minor.

The Departments of Aerospace and Mechanical Engineering Sciences, Applied Electrophysics, Biology, Chemistry, Earth Sciences, Economics, History, Linguistics, Literature, Mathematics, Music, Philosophy, Physics, and Psychology now offer major programs for Revelle College students. (See *Contents* for *Revelle College.*)

Muir College

In the fall of this academic year, 1967, John Muir College, second of the twelve colleges planned for UCSD, will admit its first students. During its first two years the college will occupy buildings on the Matthews Campus. In 1969 it will move to its permanent buildings on a site directly north of Revelle College.

The college was named for John Muir, the California naturalist, geologist, and writer. Born in Dunbar, Scotland, in 1838, Muir was educated in Scotland and at the University of Wisconsin. He explored the Sierra Nevada Mountains, Alaska, and the Arctic regions and worked for many years in the cause of forest preservation and the establishment of national parks and forests. His books are still widely read for their vivid and engaging descriptions of the land and the people of early California. Muir made his home in Martinez, California. He was awarded an honorary degree by the University of California in 1913. He died in 1914.

John Muir College offers a balanced program of instruction in all of the principal areas of learning. Students may choose among several ways of fulfilling the general education requirements and are expected to assume some responsibility for developing patterns of study that accord with their interests and aspirations. There will be many opportunities for independent study and for direct participation by undergraduates in research and creative work. (See *Contents* for *Muir College.*)

Third College

On January 30, 1967, the University Regents approved the appointment of Dr. Armin Rappaport as Provost of The Third College on the San Diego Campus. Dr. Rappaport, who was Professor of History on the Berkeley Campus, began his duties as Provost on July 1, 1967.

Third College is scheduled to begin instruction in the fall of 1970 in the Matthews Campus area now occupied by John Muir College. As is the case with UCSD's ultimate plan for each of the twelve semi-autonomous colleges, The Third College will accommodate approximately 2,300 to

2,500 graduate and undergraduate students.

The School of Medicine

The University of California, San Diego, is developing a new school of medicine which began its academic activities in July, 1966, by offering internship and residency programs. The first undergraduate medical class will enrol in September, 1968, at which time the new Basic Science Building will be completed. Plans call for a progressive increase to an entering class size of ninety-six students.

The UCSD School of Medicine will offer a unique, experimental curriculum that will emphasize close affiliation with the general campus and maximum flexibility. The first year will be taught primarily by faculty members from the campus departments at UCSD, with graduate students and medical students taking the same course in cell biology. Formal demonstration laboratories for first-year medical students will be replaced by a system of rotation through various research laboratories similar to that provided for first-year graduate students in biology. Opportunities in research will be enhanced by the uniquely integrated relationship with the faculty in the campus Departments of Biology, Chemistry, Physics, Mathematics, and the behavioral and social sciences. At least 20 per cent of the student's time will be free for research or other elective activities.

The second-year curriculum will introduce the student to organ structure and function in health and disease and will also include an integrated course in the neurosciences, and courses in pathogenic microbiology and pharmacology. During this year, students will be assigned to multidiscipline laboratories where they will be supervised by instructors from various departments of the School of Medicine.

During the third year, students will be introduced to the tools of clinical medicine and will pursue a core clinical curriculum at the three hospital facilities which will be operated by, or affiliated with, the School of Medicine. The 600–bed County-University Hospital is currently operated by the School of Medicine and will be supplemented by a 350–bed University Hospital and an 800–bed Veterans Administration Hospital on the La Jolla campus.

The fourth-year curriculum will be largely elective, allowing a student to pursue his individual interests by taking medical or surgical clerkships, clinical or basic science electives, or continued research.

Selection Factors

Selection will be based on the applicant's scholastic record, letters of recommendation, performance on the Medical College Admission Test, and a personal interview.

A catalog containing more complete information on the School of Medicine is available in the Office of Student Affairs, UCSD School of Medicine, University of California, San Diego.

Programs for Prospective Medical Students

UCSD offers no special premedical program. An undergraduate student considering medicine as a career may choose any program leading to the bachelor's degree, provided that he elects those additional courses which the medical schools of his choice require for admission. This is compli-

cated by the fact that different medical schools have somewhat different admission requirements. All medical schools, however, require courses in general physics, inorganic chemistry, mathematics, the humanities, and the social and behavioral sciences, with most schools requiring additional work in chemistry and biology. The program of a major in biology at UCSD should satisfy the admission requirements of almost all medical schools.

The Faculty of the School of Medicine

Name	Title	Department
Bearden, Alan J., Ph.D.	Assistant Professor	Chemistry
Braunwald, E., M.D.	Professor	Medicine
Braunwald, Nina, M.D.	Associate Professor	Surgery
Bridgman, Charles F., Ph.D.	Assistant Professor	Neurosciences
Bullock, Theodore H., Ph.D.	Professor	Neurosciences
Deutsch, J. Anthony, Ph.D.	Professor	Psychology
Doolittle, Russell F., Ph.D.	Assistant Professor	Chemistry
Fantino, Edmund J., Ph.D.	Assistant Professor	Psychology
Friedman, William F., M.D.	Assistant Professor	Medicine
Fung, Yuan-cheng, Ph.D.	Professor	Aerosp. & Mech. Eng. Scs.
Garsia, Adriano M., Ph.D.	Professor	Mathematics
Getoor, Ronald K., Ph.D.	Professor	Mathematics
Grobstein, Clifford, Ph.D.	Professor, Dean of the School	Biology
Hagiwara, Susumu, M.D., Ph.D.	Professor	Marine Biology
Halasz, Nicholas A., M.D.	Associate Professor	Surgery
Hamburger, Robert N., M.D.	Professor	Pediatrics
Hammel, Harold T., Ph.D.	Professor	Marine Biology
Harris, Seymour E., Ph.D.	Professor	Economics
Intaglietta, Marcos, Ph.D.	Assistant Professor	Aerosp. & Mech. Eng. Scs.
Lindsley, Dan L., Ph.D.	Professor	Biology
Livingston, Robert B., M.D.	Professor	Neurosciences
McGuire, William J., Ph.D.	Professor	Psychology
Nguyen-Huu, Xuong, Ph.D.	Assistant Professor	Physics
Orloff, Marshall J., M.D., Ph.D.	Professor	Surgery
Roth, Thomas F., Ph.D.	Assistant Professor	Biology
Simon, Harold J., M.D., Ph.D.	Assistant Professor	Community Medicine
Stokes, Joseph, III, M.D.	Professor	Community Medicine
Thorson, John W., Ph.D.	Assistant Professor	Neurosciences
Tschirgi, Robert D., M.D., Ph.D.	Professor	Neurosciences
Varon, Silvio, Ph.D.	Associate Professor	Biology
Yoder, Richard D., M.D.	Assistant Professor	Community Medicine
Zweifach, Benjamin W., Ph.D.	Professor	Aerosp. & Mech. Eng. Scs.

The Scripps Institution of Oceanography

The Scripps Institution was originally an independent biological research laboratory. It became an integral part of the University of California in 1912 and at that time was given the Scripps name in recognition of the interest and financial support of Miss Ellen Browning Scripps and Mr. E. W. Scripps. The scientific scope of its research has grown to embrace physical, chemical, geological and geophysical studies of the oceans as well as biological studies. Continuing investigations are conducted of the topography and composition of the ocean bottom, of waves and currents, and of the flow and interchange of matter between seawater and the ocean bottom or the atmosphere. Its own research ships have extended the geographic scope from the Institution's beach and the adjacent coastal waters to all of the world's oceans.

The education program has grown hand in hand with the research program. Instruction is on the graduate level only and students are not usually admitted except as candidates for the Ph.D. Although there is a rapid rate of increase, there are less than a thousand persons currently active as marine scientists, of whom a significant portion are Scripps graduates. Their studies are marked by a high degree of interdisciplinary and international collaboration. Many nationalities are represented among the staff and student body.

The Institution has eight oceanographic research vessels. Their cruises vary from local, limited-objective trips to round-the-world expeditions. In 1965–66, R/V "Argo" was the first oceanographic vessel to make a midwinter voyage to the northwestern Pacific, and the new floating laboratory R/V "Alpha Helix" spent seven months on a ship- and shore-based expedition inside Australia's Great Barrier Reef.

The academic departments associated with the Institution are the Departments of Oceanography, Marine Biology, and Earth Sciences. The forty professors are complemented by an academic staff of a hundred research scientists, many of whom have a regularly scheduled part in the instructional program.

Investigations supported by contracts and grants funded from extra-University sources, primarily Federal, cover a wide latitude of marine research. The general research effort is conducted by three divisions, designated Oceanic Research, Marine Biology, and Earth Sciences. The diversity of their work is extended by three Federally-sponsored laboratories: the Marine Physical Laboratory, the Physiological Research Laboratory, and the Visibility Laboratory, and by the Marine Life Research Group sponsored by the State of California.

Organizationally separate, but sharing close affiliation and proximity with Scripps, are the University of California's Institute of Geophysics and Planetary Physics and Institute of Marine Resources. The Fishery-Oceanography Center, recently built on the San Diego campus by the U. S. Bureau of Commercial Fisheries, is occupied by a laboratory of the Bureau and by the Inter-American Tropical Tuna Commission.

The combination of a large scientific staff and extensive facilities pro-

vides an extraordinary opportunity for the small student body (approximately 160) to enjoy close contact with existing oceanographic concepts and active participation in research.

The Faculty of Scripps Institution of Oceanography

Name	Title	Department
Arrhenius, Gustaf O., Ph.D., D.Sc.	Professor	Earth Sciences
Arthur, Robert S., Ph.D.	Professor	Oceanography
Backus, George E., Ph.D.	Professor	Earth Sciences
Benson, Andrew A., Ph.D.	Professor	Marine Biology
Bramlette, Milton N., Ph.D.	Professor Emeritus	Earth Sciences
Bullard, Edward, Ph.D.	Professor	Non-divisional Res.
Bullock, Theodore H., Ph.D.	Professor	Neurosciences
Cox, Charles S., Ph.D.	Professor	Oceanography
Craig, Harmon, Ph.D.	Professor	Earth Sciences
Curray, Joseph R., Ph.D.	Associate Professor	Oceanic Research
Duntley, Seibert Q., Sc.D.	Professor	Visibility Laboratory
Eckart, Carl, Ph.D.	Professor	Non-divisional Res.
Engel, A. E. J., Ph.D.	Professor	Earth Sciences
Enright, James T., Ph.D.	Assistant Professor	Oceanography
Fager, E. W., Ph.D., D.Phil.	Professor	Oceanography
Fox, Denis L., Ph.D.	Professor	Marine Biology
Gieskes, Joris M. T. M., Ph.D.	Assistant Professor	Oceanography
Gilbert, J. Freeman, Ph.D.	Professor	Earth Sciences
Goldberg, Edward D., Ph.D.	Professor	Earth Sciences
Hagiwara, Susumu, M.D., Ph.D.	Professor	Marine Biology
Hammel, Harold T., Ph.D.	Professor	Marine Biology
Haubrich, Richard A., Ph.D.	Associate Professor	Earth Sciences
Haxo, F. T., Ph.D.	Professor	Marine Biology
Hendershott, Myrl C., Ph.D.	Assistant Professor	Oceanography
Holland, Nicholas D., Ph.D.	Assistant Professor	Marine Biology
Hubbs, Carl L., Ph.D.	Professor Emeritus	Marine Biology
Inman, Douglas L., Ph.D.	Professor	Oceanic Research
Isaacs, John D., B.S.	Professor	Oceanography
Johnson, Martin W., Ph.D.	Professor Emeritus	Marine Biology
Keeling, Charles D., Ph.D.	Associate Professor	Oceanography
Lewin, Ralph, Ph.D.	Professor	Marine Biology
MacIntyre, Ferren, Ph.D.	Assistant Professor	Oceanography
McEwen, George F., Ph.D.	Professor Emeritus	Oceanography
McGowan, John A., Ph.D.	Associate Professor	Oceanography
Menard, Henry W., Jr., Ph.D.	Professor	Inst. of Marine Resources
Mullin, Michael M., Ph.D.	Assistant Professor	Oceanography
Munk, Walter H., Ph.D.	Professor	Earth Sciences

Newman, William A., Ph.D.	Assistant Professor	Oceanography
Nierenberg, William A., Ph.D.	Professor, Dean of the Institution	Physics
Peterson, Melvin N., Ph.D.	Associate Professor	Oceanography
Phleger, Fred B., Ph.D.	Professor	Oceanic Research
Raitt, Russell W., Ph.D.	Professor	Earth Sciences
Rakestraw, Norris W., Ph.D.	Professor Emeritus	Oceanic Research
Revelle, Roger R., Ph.D.	Professor Emeritus, Director Emeritus	Oceanography
Rosenblatt, Richard H., Ph.D.	Assistant Professor	Marine Biology
Schaefer, Milner B., Ph.D.	Professor	Oceanography
Scholander, Per F., M.D., Ph.D.	Professor	Marine Biology
Shepard, Francis P., Ph.D.	Professor	Oceanic Research
Spiess, Fred N., Ph.D.	Professor	Oceanography
Vacquier, Victor, M.A.	Professor	Earth Sciences
Volcani, Benjamin E., Ph.D.	Professor	Marine Biology
Wheelock, Charles D., M.S.	Professor Emeritus	Inst. of Marine Resources
Winterer, Edward L., Ph.D.	Associate Professor	Oceanography
Wooster, Warren S., Ph.D.	Professor	Oceanography
ZoBell, Claude E., Ph.D.	Professor	Marine Biology

The University Library

The University Library of the University of California, San Diego, consists of the General Library, the Science and Engineering Library, the Biomedical Library, the Scripps Institution of Oceanography Library, the Undergraduate Library, and the Lower Division Reading Room. The Library contains more than 400,000 volumes and receives 12,000 periodical and other serial publications.

The General Library, in the Humanities-Library Building, consists of a basic collection and specialized graduate collections in the humanities and social sciences. The Library's Special Collections of rare and valuable books include important collections of D. H. Lawrence, Ernest Hemingway, Baja California, and the Spanish Civil War.

The Science and Engineering Library, in Urey Hall, contains strong collections in aeronautics, astrophysics, atomic energy, chemistry, electronics, engineering, instrumentation, mathematics, missiles research, physics and space sciences.

The Biomedical Library, on the Court Level of the Humanities-Library Building, has been established to serve the School of Medicine and the health-related sciences. The Biomedical Library will move to permanent quarters in the Basic Sciences Building of the Medical School in 1968. A branch of the Biomedical Library is maintained at the County-University Hospital.

The Scripps Institution of Oceanography Library has outstanding collections in oceanography, marine biology and underseas technology,

and also specializes in geology, geophysics and zoology publications.

The Undergraduate Library, at Matthews Campus, will serve the basic needs of students in Muir College in 1967–68 and will later become the base for a general undergraduate library for the first three colleges.

The Lower Division Reading Room, in the basement of the Humanities-Library Building, provides reserved books for lower-division courses in Revelle College.

The Computer Center

The UCSD Computer Center operates a large Control Data Corporation 3600 computer, together with several smaller computers. Most students and staff do their own programming. The actual operation of the computer system is performed by professional computer operators. Non-credit programming courses are conducted by the Computer Center. Programming consultants are available to answer questions on programming. The Computer Center staff develops new operating systems and other programs to improve the efficiency and usefulness of the computers.

THE INSTITUTES

Institute of Geophysics and Planetary Physics

The San Diego branch of the University-wide Institute of Geophysics was established in 1960. Present research activities emphasize the study of the earth's strain field by measurements of gravity, tilt, displacement, and longitudinal strain; of normal nodes of the earth; of tides, waves, turbulence, and the circulation in the atmosphere and oceans.

The Institute does not grant degrees, but makes its facilities available to graduate students from various departments who have chosen to write their dissertations on problems of the earth. Members of the Institute staff now hold joint appointments with the Departments of Earth Sciences, Physics, Oceanography, Aerospace and Mechanical Engineering Sciences, and Applied Electrophysics.

Institute of Marine Resources

This University-wide institute has its headquarters on the San Diego campus. It is devoted to fostering research and investigations into all aspects of marine resources—biological, geological, physical, and socio-economic—and offers many opportunities to graduate students.

Institute for Radiation Physics and Aerodynamics

The Departments of Mathematics, Aerospace and Mechanical Engineering Sciences, Physics, Chemistry, and Applied Electrophysics participate in the Institute for Radiation Physics and Aerodynamics. The Institute, established by the Regents in 1964, is an interdisciplinary research unit for research and graduate training in aerospace sciences, hydrodynamics, atomic and molecular physics, spectroscopy and radiation transport and numerical methods.

The Institute's research is particularly concerned with phenomena

which occur in ionized media at high temperatures and high energy densities.

Institute for the Study of Matter

The Departments of Physics, Chemistry, and Earth Sciences participate in the Institute for the Study of Matter. Research activities are concerned with the behavior of extremely pure metals at all temperatures, particularly very low and very high temperatures.

University Extension

University Extension makes available the resources of the University on a statewide basis to individuals and organizations. Extension programs are organized toward the following educational aims: (1) the intellectual and cultural development of adults; (2) the dissemination of new knowledge resulting from teaching and research activities within the University; (3) the continuing education of scientific, technical, and professional personnel; (4) the development of special educational programs for public and private organizations and agencies; and (5) public affairs education through programs designed to aid adults in meeting their responsibilities as citizens.

The Extension program takes a variety of forms: classes, discussion groups, correspondence courses, conferences, institutes, short courses, lectures, motion picture production, radio broadcasts, educational television, and vocational counseling and testing (Santa Barbara and Los Angeles only).

Veterans may use the educational benefits available to them under Federal and State laws to enrol in the University of California Extension classes, provided the classes are part of their prescribed and recognized objectives approved by the Veterans Administration.

For detailed information on University Extension, local or statewide, write or telephone University Extension, University of California, San Diego, P.O. Box 109, La Jolla, California 92037. Telephone 453-2000, extension 2061.

Education Abroad Program

The Education Abroad program offers opportunities to undergraduate students of the University of California to study in universities overseas. It is administered for the entire University by the Santa Barbara campus and serves also as a source of information on all types of educational exchange experiences.

In 1967–68 the University will continue the operation of its study centers in France, Germany, Greece, Hong Kong, Italy, Japan, Spain, Sweden, and the United Kingdom, and open two new centers, in Israel and Lebanon. The Study Centers' primary purpose is to provide a sound academic experience in a different educational system. They also enable the University of California students to become deeply involved in the language and culture of the host country.

Eligibility requirements are: upper-division standing in the University

at the time of participation, two years of university-level work in the language of the country with a B average or equivalent, an overall B average, seriousness of purpose, and an indication of ability to adapt to a new environment. Transfer students are eligible if they meet the language requirement and have completed at least one language course in the University of California. (The language requirement is not applicable to the centers in Greece, Hong Kong, Japan, Israel, and Lebanon, but study of the languages of those countries will be required as part of the program.) Special arrangements can be made for the participation of graduate students.

The participants will spend from nine to eleven months abroad, including a special orientation program, six or seven weeks of intensive language preparation where applicable, a full academic year in the university of their choice, and some vacation travel. The program in Delphi, Greece, is for the spring and summer quarters only.

Each student will be concurrently enrolled on his home campus and in the host university and will receive full academic credit for courses satisfactorily completed.

The Regents endeavor to bring this year abroad within the reach of all students, regardless of their financial resources.

Applications for 1968–69 will be accepted from October 16, 1967, through January 15, 1968. (Applications for Greece and the United Kingdom must be filed no later than November 17, 1967.)

Further information is available from the Director, Education Abroad Program, 1205 South Hall, University of California, Santa Barbara, or the Dean of International Education, Building 250, Matthews Campus, University of California, San Diego.

Admission to the University

UNDERGRADUATE STANDARDS OF ADMISSION

The admission requirements of the University of California are based on two principles:

1. That the best assurance of success in the University is shown by high quality of scholarship in previous work.
2. That the study of certain specified subjects will give the student both good preparation for study in the University and reasonable freedom in choosing his field of specialization.

All communications concerning undergraduate admission should be addressed to the Office of Admissions, 2112 Urey Hall, University of California, San Diego, La Jolla, California 92037.

Note: Entrance requirements may be revised for the fall of 1968 and thereafter. Changes in requirements, if any, will be stated in detail in the *Undergraduate Admissions Circular* (available on or after September 1, 1967), which will be included with the application for admission forms. The *Circular* will also be available in the counseling offices of California high schools and junior colleges.

Application for Admission

An application for admission should be filed with: Office of Admissions, 2112 Urey Hall, University of California, San Diego, La Jolla, California 92037.

Application forms may be obtained from the Office of Admissions during the periods listed below. The applicant is urged to apply early in the filing period to avoid unnecessary delays in the processing of his application.

Undergraduate applications, including intercampus transfers, must be filed for the fall quarter between October 1 and March 1, for the winter quarter between May 1 and November 1, and for the spring quarter between August 1 and February 1. A summer quarter is not offered at the present time at San Diego.

Admission requirements are uniform on all campuses of the University. Admission entitles the student to attend the campus of his choice if the required facilities are available. Since applications will be processed and acted upon in only one Office of Admissions, applications should not be directed to more than one campus.

If after an applicant has filed for admission his plans change, and he prefers to register on a different campus, he must write to the Director of Admissions, 570 University Hall, University of California, Berkeley, California 94720, indicating the campus at which he now wishes to register and the reason for his change. His records will be transferred to the campus he indicates, provided facilities are available there. Such requests must be received within the filing periods shown above. These filing periods apply to *all* undergraduate applicants (regular, special, limited, second degree, and intercampus transfer).

Application Fee

A nonrefundable fee of $10 is charged for each application for admis-

sion filed. Remittance by bank draft or money order, payable to *The Regents of the University of California*, must be attached to the application.

Transcripts of Record

Each applicant is responsible for requesting the high school from which he graduated and each college he has attended to send official transcripts of record directly to the Office of Admissions where his application is on file.

Those applying as entering freshmen should ask the high school to submit, as soon as possible, preliminary transcripts showing the complete record through the sixth semester and listing courses in progress or planned. In every case, a final transcript, which includes a statement of graduation and a list of courses and grades for the seventh and eighth semesters, will be necessary.

Those applying in advanced standing should arrange for the graduating high school to send immediately to the Office of Admissions a complete and final transcript including a statement of graduation. Transcripts from the last college attended should include a statement of good standing or honorable dismissal. A preliminary transcript should show work in progress.

Any additional schools attended after an application for admission has been filed are considered to be part of the applicant's record and must be reported to the Office of Admissions. Transcripts and other documents submitted become the property of the University and cannot be returned.

Notification of Admission

Applicants for admission to the fall quarter will be notified regarding admission beginning about January 15, and most will have been notified by April 15. Applicants for the winter and spring quarters will be notified as soon as possible following receipt of all appropriate transcripts. (Delays may occur if required documents or fees have not been received by the Office of Admissions.)

Those admitted will be required to return a *statement of intention to register*, together with a nonrefundable fee of $50, which will be credited to the incidental fee if the student registers in the quarter for which he applied.

Failure to Register

An applicant who is not eligible for admission or one who has been admitted but fails to register in the term for which he applied, and who thereafter desires to attend the University, must submit a new application for admission, with a $10 fee.

Subject A: English Composition

Every undergraduate is required to demonstrate an ability to write English without gross errors in spelling, grammar, diction, sentence structure, and punctuation. This requirement (Subject A) may be met

in any *one* of the following ways:

1. By passing the Subject A examination given at testing centers on the last Saturday in April and on campus at the opening of each quarter. The examination is a written, three-hour test in two parts: (a) a set of objective questions dealing with sentence structure, vocabulary, and punctuation, and (b) a 500–word composition. Papers submitted in the examination are rated either *passed* or *failed*; any student who is not present for the examination he is scheduled to take will be regarded as having failed the examination. No student may have the privilege of re-examination in Subject A. Fee for the examination is $5.
2. By achieving a score of 600 or higher in the College Entrance Examination Board Achievement Test in English composition after completion of the eleventh grade in high school.
3. By entering the University with credentials showing the completion of an acceptable college-level course in English composition with a grade of C or better. This exemption from the Subject A requirement is determined by the Admissions Office.

Those students who fail the examination or do not otherwise meet the requirement must enrol in the non-credit course in Subject A during the first quarter in residence. Students who maintain a grade of A in the Subject A course may, on recommendation of the Committee on Subject A, be permitted to withdraw from the course at a date to be determined by the Committee and be given credit for Subject A. Should a student fail the course in Subject A, he must repeat it each quarter of his residence until he passes. A fee of $45 is charged for the course; the charge will be repeated each time the course is repeated. A student who fails the Subject A course at the University and then, either during the summer or while not enrolled in the University, completes at another institution an acceptable college-level course in English composition with a grade of C or better will be considered to have met the Subject A requirement. Satisfactory completion of the Subject A requirement is prerequisite to taking any regular course involving English composition and to receipt of the bachelor's degree.

Preparation for University Work

In addition to the high school subjects required for admission to the University, certain preparatory subjects are recommended for many University curricula to give the student an adequate background for his chosen field of study. Lack of a recommended high school course may delay graduation from the University. Details of these recommendations will be found in the bulletin *Prerequisites and Recommended Subjects*, which is ordinarily in the hands of high school and junior college counselors and which may be obtained from the campus Office of Admissions or the University Dean of Educational Relations, University Hall, University of California, Berkeley, California 94720.

A student needing additional preparation is advised to attend one of

the many excellent California junior colleges. There he can take courses applicable toward the requirements of the college or school of the University in which he wishes to enrol.

Freshman Standing

An applicant for admission to freshman standing is one who has not registered in regular session in any college-level institution since graduation from high school.

If, at the time of high school graduation, the applicant does not meet the requirements given below for admission to freshman standing or does not qualify by examination, he must meet the requirements for admission to advanced standing. An exception to this regulation will be made only if the student's deficiency was the result of his not having studied one or more required high school subjects. Such a student can sometimes remove the deficiency during the summer; he should consult the Office of Admissions in advance. Applicants for admission as entering freshmen are urged to offer a full set of aptitude and achievement tests in order to (1) assist in counseling and placement, (2) fulfil the Subject A requirement, or (3) meet the requirements for admission by examination.

Admission to Freshman Standing

An applicant for admission to freshman standing must meet the requirements listed below.

Graduation from High School

An applicant who has been graduated from a California high school with the required scholarship average in the prescribed courses will be admitted to the University. When a resident of California has been graduated from a high school outside California, the acceptability of the record is determined by the Office of Admissions.

Subject Requirements

A. HISTORY, 1 UNIT

This must consist of 1 unit of United States History, or one-half unit of United States History and one-half unit of civics or American Government.

B. ENGLISH, 3 UNITS

These must consist of three units of English composition, literature, and oral expression.

C. MATHEMATICS, 2 UNITS

These must consist of two units of subjects such as elementary algebra, geometry, intermediate and advanced algebra, trigonometry, calculus, elementary functions, matrix algebra, probability, statistics, or courses combining these topics, but excluding arithmetic and such nonacademic subjects as shop mathematics and business mathematics.

D. LABORATORY SCIENCE, 1 UNIT

This must consist of an eleventh- or twelfth-grade year course in one laboratory science. Both semesters must be in the same subject field.

E. FOREIGN LANGUAGE, 2 UNITS

These must be in one language. Any foreign language with a written literature is acceptable.

F. ADVANCED COURSE, 1 (OR 2) UNITS

This must be chosen from the following:

Mathematics, a total of 1 unit of second-year algebra, solid geometry, trigonometry, or an advanced course for which trigonometry is a prerequisite. Foreign language, either 1 additional unit in the same foreign language offered under *e* or 2 units of another foreign language. Science, 1 unit of either chemistry or physics in addition to the science offered under *d*.

ELECTIVES

Additional elective units to complete the minimum of 15 standard entrance units are also required.

Scholarship Requirements

At least a B average is required in courses taken after the ninth year used to meet the subject requirements. Grades received in elective courses or in courses taken in the ninth year or earlier are not used in computing this average. Subject requirements are satisfied by courses in which a grade of C or higher has been assigned. Grades are considered on a semester basis, except from schools that give only year grades. Grades are accepted as they appear on the transcript.

In determining the B average, a grade of A in one course will be used to balance a C in another, but an A may not be used to compensate for D, E, or F grades.

Courses taken in the ninth year or earlier in which a grade of D or lower is received may be repeated to establish subject credit.

Courses taken after the ninth year in which a grade of C or lower is received may be repeated to establish subject credit or to improve scholarship. Grades earned in the first repetition may be used to satisfy scholarship; grades of C or higher in additional repetitions will satisfy the subject requirement, but will not be counted higher than a C in scholarship computation.

Courses may be repeated in an amount not to exceed 2 units of the *a*-to-*f* pattern.

Note: The following revised rules concerning the repetition of courses will apply to all applicants for admission for the fall quarter, 1968, and thereafter.

Courses taken in the ninth year or earlier in which a grade of D or lower is received may be repeated to establish subject credit.

Courses taken after the ninth year in which a grade of D or F is received may be repeated to establish subject credit or to improve scholarship. Courses may be repeated in an amount not to exceed a total of 1 unit of the *a*-to-*f* pattern. Grades earned in such repetitions will not be counted higher than a C in determining scholarship average.

Examination Requirements

As a requirement for admission all Freshmen must submit scores from

the following examinations given by the Educational Testing Service for the College Entrance Examination Board: (1) the Scholastic Aptitude Test, (2) three achievement tests, which must include English, social studies or foreign language, and mathematics or science.

An applicant whose scholarship average in the required high school subjects is 3.00 to 3.09 inclusive, must achieve a minimum total score of 2500 on the required examinations. The test results of applicants with a grade-point average of 3.10 or higher will be used for purposes of counseling, guidance, placement, and satisfaction of Subject A if possible.

Admission by Examination Alone

An applicant ineligible for admission to freshman standing on the basis of his high school record, and who has not attempted college work subsequent to high school (except during the summer session immediately following graduation), may qualify for admission by examination.

The University does not offer entrance examinations but accepts the results of examinations given by the Educational Testing Service for the College Entrance Examination Board.

To qualify by examination, the applicant must present scores in the Scholastic Aptitude Test (S.A.T.) and three Achievement Tests, which must include:

1. English Composition
2. Social Studies or Foreign Languages
3. Mathematics or Sciences

The tests must not be taken before completion of the first half of the eleventh grade. The Achievement Test in English composition cannot be used to satisfy the Subject A requirement unless taken after completion of the eleventh grade. The first repetition of a test will be accepted, but the verbal and mathematics scores on the Scholastic Aptitude Test must be from the same sitting. The total score on the Scholastic Aptitude Test must be at least 1100; the scores on the three Achievement Tests must total at least 1650; and the score on any one Achievement Test must not be less than 500.

Arrangements to take the tests should be made with the Educational Testing Service, P.O. Box 1025, Berkeley, California 94701, or P.O. Box 592, Princeton, New Jersey 08540. The fees are to be paid to the Educational Testing Service. Scores will be regarded as official only if they are received by the Office of Admissions directly from the Educational Testing Service.

Test Dates	Application Deadline
Saturday, November 4, 1967	October 7, 1967
Saturday, December 2, 1967	November 4, 1967
Saturday, January 13, 1968	December 9, 1967
Saturday, March 2, 1968	February 3, 1968
Saturday, May 4, 1968	April 6, 1968
Saturday, July 13, 1968	June 8, 1968

Applicants should arrange to take the tests as early as possible so that the scores can be reported in time to be considered for admission.

Advanced Standing

An applicant who has registered in a junior college, a four-year college, a university, extension classes of college level, or any comparable institution since graduation from high school is subject to regulations governing admission to advanced standing. The applicant may not disregard his college record and apply for admission to freshman standing.

Admission to Advanced Standing

An applicant for admission to advanced standing must meet the requirements listed below:

The requirements for admission to advanced standing vary in accordance with the high school record of the applicant. Each applicant, however, must present from the last accredited college or university attended a statement of good standing and an academic record with a grade-point average of C (2.0) or better. If the record established in any one accredited institution is below a C (2.0) average, an additional unit and scholarship requirement may be imposed on subsequent credit completed to offset the deficit incurred. In addition, the applicant must meet one of the following conditions:

1. An applicant who was eligible for admission to the University in freshman standing may be admitted at any time he has established an overall grade-point average of C (2.0) or better.
2. An applicant who was ineligible for admission to the University in freshman standing, but whose only deficiency arose from not having studied one or more of the required high school subjects, may be admitted when the following conditions are met:
   a. He has established an overall grade-point average of C (2.0) or better.
   b. He has satisfied by appropriate courses with a grade of C or better, the subject requirements for admission to freshman standing.

   Exception: Deficiencies in subject requirements will be waived in an amount not exceeding 2 high school units if the applicant has established a minimum of 84 acceptable quarter units or 56 acceptable semester units passed with a grade-point average of 2.4 or better. Subject deficiencies in excess of 2 units must be satisfied.
3. An applicant who was ineligible for admission to the University in freshman standing because of low scholarship or a combination of low scholarship and incomplete subject preparation (omission, or by grades of D or lower) may be admitted when the following conditions are met:
   a. He has established a minimum of 84 acceptable quarter units or 56 acceptable semester units passed with a grade-point average of 2.4 or better.
   b. He has satisfied, by appropriate courses, subject requirements for admission to freshman standing, except that subject deficiencies will be waived in an amount not exceeding 2 high school units.

Credit for Work Taken in other Colleges

The University grants unit credit for courses consistent with its curriculum that have been completed in colleges and universities accredited by appropriate accrediting agencies.

As an integral part of the system of public education of California, the University accepts, at full unit value, approved transfer courses completed with satisfactory grades in the public junior colleges of the state. Frequently, students who intend to complete their advanced studies at the University will find it to their advantage to complete the first two years of their college course in one of the many excellent California public junior colleges. After a student has earned 105 quarter units or 70 semester units acceptable toward a degree, no further credit will be granted for courses completed at a junior college.

The decision regarding the acceptability of extension courses taken at an institution other than the University rests with the Office of Admissions. The decision regarding the applicability of such course work in satisfaction of degree requirements rests with the faculty of the particular school or college in which the student plans to enrol.

Requirements for Nonresident Applicants

It has been necessary to place some limitation on enrolment of applicants who are not residents of California, and, therefore, only those of exceptional promise will be eligible for admission. The requirements below are designed to admit nonresident applicants whose standing, as measured by the scholastic records, is in the upper half of those who would be eligible under the rules for California residents.

Admission by High School Record

Graduation from High School. The acceptability of records from high schools outside California will be determined by the Office of Admissions.

Subject Requirements. The same subject pattern as for a California resident is required.

Scholarship Requirements. The scholarship requirements for a resident applicant apply to a nonresident applicant, except that the scholarship average must be 3.4 or higher on the required high school subjects.

Admission by Examination

A nonresident applicant who is ineligible for admission to freshman standing and who has not attempted college work subsequent to high school (except during the summer session immediately following high school graduation) may qualify for admission by examination. The requirements for a resident applicant apply to a nonresident applicant, except that the total score on the Scholastic Aptitude Test must be at least 1100 and the scores on the three Achievement Tests must total at least 1725.

Admission to Advanced Standing

In addition to the regular admission requirements, a nonresident applicant for admission to advanced standing must have maintained a grade-

point average of 2.8 or higher in college subjects attempted and acceptable for transfer credit. If the applicant did not have at the time of high school graduation an average of 3.4 or higher in courses satisfying the required subject pattern, he must present a minimum of 84 acceptable quarter units or 56 acceptable semester units passed with a grade-point average of 2.8 or higher.

Admission of Undergraduate Foreign Students

Undergraduate foreign students must have a sufficient command of English to benefit from study conducted in that language. To demonstrate this, every student whose native language is other than English must take the *Test of English as a Foreign Language* (TOEFL) prior to coming to the United States. Arrangements for the test may be made by writing to the Educational Testing Service, P.O. Box 1025, Berkeley, California 94701, or P.O. Box 592, Princeton, New Jersey 08540. The results of this test will be used to determine whether the applicant's command of English is sufficient to enable him to pursue his studies effectively. Foreign students whose command of English is slightly deficient will be required to take a non-credit English course, and, therefore, a reduced program. For this reason, foreign applicants are strongly advised to perfect their English before coming to the United States.

In addition to an adequate English background, the foreign student must have adequate funds to cover all fees, living and other expenses, and transportation connected with his stay in the United States. He should bear in mind that expenses are likely to be heaviest at the beginning. (See *Contents* for *Fees and Expenses.*)

Admission regulations are the same for foreign students as for domestic students. (See *Undergraduate Standards of Admission* above.) Because educational systems vary from country to country, the foreign student is urged to submit completed documents as early as possible.

For information concerning health insurance requirements for foreign students, see *Contents* for *Health Service.*

GRADUATE STANDARDS OF ADMISSION

Students seeking admission to graduate status at the University of California must hold a bachelor's degree or its equivalent from an institution of acceptable standing. The program of preparation should be substantially equivalent in both the distribution of academic subject matter and in scholarship achievement to the requirements for a comparable degree at the University of California. Applications for admission are evaluated in terms of scholastic qualifications and formal preparation for the graduate field of study.

The Vice Chancellor–Graduate Studies or the department in which the applicant wishes to pursue an advanced degree may deny him admission if his scholastic record or his undergraduate program of study is judged not adequate as a foundation for advanced academic or professional study. This procedure applies to all applicants, whether they come from schools

or colleges within the University of California or elsewhere. Individual departments may have special requirements for admission to graduate status, and certain departments and schools require an *additional* and special application for admission to their advanced-degree program.

Admission without an Advanced-Degree Objective

Students who do not desire to become candidates for higher degrees must meet the same admission requirements as those who are prospective candidates for degrees. They must be admitted to a specified field of study and the Vice Chancellor–Graduate Studies must be satisfied that their program of study has a definite scholarly or professional purpose. Such students are not eligible for exemption from the nonresident tuition fee.

Admission Procedures

Each student seeking admission to the Graduate Division on the San Diego campus will be given consideration as rapidly as information on his background becomes available. However, before final action on his application can be taken, he must file with his prospective major department a formal application, an official transcript of his record from each college and university he has attended, and a nonrefundable application fee of $10, not later than two months before the first day of classes of the quarter in which he wishes to enrol. A single form is sufficient to apply both for admission to graduate standing and for University-administered financial support, but the deadlines to be observed if support is sought are earlier. (See *Contents* for *Financial Aids.*) The form and more detailed instructions may be obtained from the applicant's prospective major department, from the Office of Admissions, or from the Office of Graduate Studies and Research. The Medical School and some departments have special admission procedures; therefore, each applicant is urged to communicate with his prospective major department as early as possible.

An applicant who has taken the Graduate Record Examination should submit with his application a copy of the results of the examination. This will be especially helpful for a student whose grade-point average is near the minimum requirement for admission in regular graduate status.

Admission of Graduate Foreign Students

In addition to an acceptable professional background, applicants from outside the United States must have a sufficient command of English to benefit from graduate study conducted in that language. They must also have available adequate funds to cover all fees, living and other expenses, and transportation connected with their stay in the United States. They are held to the same regulations affecting admission as are applicants from within the United States, except that their application materials should be received by their prospective major department four months prior to the beginning of the quarter in which they plan to enrol. Since

school systems outside the United States may be based on examinations in subject fields or other methods for determining academic accomplishment rather than a course system, it is especially important that adequate documentation relating the background of the applicant to its equivalent in the United States be included at the time of application.

Every student whose native language is other than English must take the *Test of English as a Foreign Language* (TOEFL) prior to coming to the United States. Arrangements for the test may be made by writing to Educational Testing Service, P.O. Box 1025, Berkeley, California 94701, or P.O. Box 592, Princeton, New Jersey 08540. The results of this test will be used to determine whether the applicant's command of English is sufficient to enable him to pursue his graduate studies effectively. Foreign students whose command of English is slightly deficient will be required to take a non-credit English course and, therefore, a reduced graduate program. For this reason, foreign applicants are strongly advised to perfect their English prior to coming to the United States.

For information concerning health insurance requirements for foreign students, see *Contents* for *Health Service*.

Duplication of Advanced Degrees

The duplication of advanced degrees is discouraged. The holder of a master's degree in a given field received at another institution may not become a candidate for a degree in the same field in this University. However, petitions for a master's degree in a different field will be considered on their individual merits. The holder of a Ph.D. degree may not become a candidate for that degree in any field, though he may earn other doctorates, e.g., M.D., D.D.S.

Advanced Degrees for Members of the Academic Senate

Voting members of the Academic Senate are not eligible for advanced degrees at the University of California.

Enrolment of Postdoctoral Scholars

The University provides opportunities and facilities for postdoctoral scholars to carry out individual programs of study and research. Postdoctoral scholars are defined as persons holding any doctoral degree (Ph.D., M.D., D.D.S., D.V.M., or D.P.H.) who wish to pursue, either under the direction of, or in consultation with, members of the faculty, special studies or training to further their preparation in a given field. Not included in this classification are visiting scholars with permanent positions in other institutions, and interns or residents receiving advanced training which leads to a professional certificate.

All postdoctoral scholars should make arrangements to enrol for such studies and training through the department or research unit with which they may be associated. Upon arrival, postdoctoral scholars should apply at the Registrar's Office for a certificate of enrolment, which is official evidence of their affiliation with the University and also entitles them to

certain special privileges, including reduced admission charges to some University functions. No fee is charged for the certificates.

Accommodation of Visiting Scholars

The University of California has always been hospitable to faculty members and research scholars from other institutions who wish to visit the University. Facilities for study and research are made available whenever possible.

Muir College

THE CHARACTER OF THE COLLEGE

John Muir College is a community of scholars engaged in inquiry and the exchange of ideas, and its planners have taken this into account in everything from the curriculum to the design and placing of the buildings. They intend that learning shall reach beyond the classrooms into many other aspects of life in the community.

The buildings of John Muir College will facilitate integration of learning and living. Small classrooms have been placed in the residence halls so that discussions begun in class can be carried on beyond the class, into the corridors and lounges, and onto the campus itself. Several faculty offices are also placed in the residence halls, and faculty members who enjoy informal conversations with students will be able to meet them easily, in agreeable surroundings. Through the generosity of Mr. Ernest W. Mandeville, the first Honorary Fellow of John Muir College, a suite for distinguished visitors will be provided in one of the residence halls. Students not living in the residence halls will be able to participate fully in the life of the college. The lounge areas of the college are planned to include them; they will have ample room for storing books and equipment; and there will be rooms in the residence halls in which they can stay overnight when they wish to remain on the campus to study, attend a lecture, take part in a discussion or organizational meeting, rehearse for a play or concert, or simply to be with their friends. Finally, the flow of life in the college as a whole is intended to stimulate curiosity about all aspects of research and learning in the college—curiosity which should lead to unexpected and adventuresome choices of courses, as, for example, when a student specializing in music becomes inquisitive enough to elect a course in experimental psychology or one of the computer sciences.

In 1967–68 and 1968–69 the college will be located in temporary buildings on the Matthews Campus. Thus, students who enter in the fall of 1967 will spend two years in these temporary buildings.

The general education requirements and the curriculum as a whole encourage active rather than passive learning by involving the students directly with research and creative work. The science courses will provide opportunities for a student to choose his own problem and design his own experiment; the fine arts courses will include periods of studio work or its equivalent. All first-year students are required to complete a course in contemporary issues. There will be a "public affairs laboratory" where they can find periodicals and newspapers from all over the world, maps, charts, pictures, and other visual aids on exhibit, and books especially chosen for their relevance to the issues under discussion. Most important of all, the students will be working among faculty members, postdoctoral fellows, and graduate students who are themselves actively engaged in creation and discovery.

Such active learning fosters self-education and necessitates opportunities for independent study. The programs in the sciences and fine arts obviously foster such study. Moreover, subject to certain restrictions, a student may substitute reading courses for regular courses, permitting him to investigate in more than usual depth the topics of special interest to him. Superior students will be eligible for the Honors Program of the college. Once admitted to the program a student may be allowed to complete by means of independent study any general education requirements he has still to finish. Exceptional students will occasionally be admitted upon entering the college and thus be eligible to meet any of the general education requirements by independent study. The major programs provide many forms of independent study. They are not confined to the last two years, but may be undertaken by students of the college whenever the departments or the directors of interdisciplinary majors judge them to be ready. Finally, those students who choose not to pursue a major (see below) will be expected to complete projects that demand much independent investigation.

In John Muir College no new theory, no new discovery, no new work of art will long go unexamined or undiscussed. It will not be a comfortable place for those whose minds are made up.

The Requirements for Graduation

To receive a bachelor's degree from John Muir College a student must:

1. Meet the general University requirement in Subject A. (See *Admission to the University.*) This requirement asks that the student demonstrate an ability to write English without gross errors in spelling, grammar, diction, sentence structure, and punctuation. Satisfaction of the requirement in Subject A is a prerequisite to taking any further course in which the writing of themes or papers forms a substantial part of the student's work.
2. Meet the Muir College requirement in writing proficiency. This requirement asks that the student demonstrate an ability to write English according to standards appropriate for all college work.
3. Fulfil the general University requirement in American History and Institutions. (See *Departments of Instruction: History.*)
4. Pass 45 full courses or their equivalent.
5. Fulfil the general education requirements described below. Exemption from part or all of the course work taken to fulfil a given requirement will be granted to properly qualified students. (Exemption does not reduce to less than 45 the number of courses required for graduation.) Others who have prior training which is not enough to warrant exemption but does put them ahead of the ordinary student may be allowed to fulfil part or all of a requirement by independent study. Finally, as noted above, a student admitted to the Honors Program may be allowed to complete by means of independent study any general education requirements still to be finished.

6. Show in some form a concentration and focus of studies as part of his preparation for the bachelor of arts degree. This requirement may be fulfilled by a departmental or interdisciplinary major, but a major itself is not required. (For discussion of major programs, see below.) Normally a student who is affiliated with John Muir College and wishes to undertake a major program as his form of concentration would choose one offered in the College. (The opportunity to engage in the program would be an important reason for choosing Muir College.) However, the student may fulfil this requirement by completing any major program offered at UCSD to which he can gain admission.

   A student who does not choose to meet this requirement by means of a major must complete a special project, normally undertaken in the senior year, having such scope and significance that it integrates and summarizes much of the student's learning. Some appropriate projects might be, for example, a thesis-length essay in literature, history, or anthropology; field research on a social problem of the San Diego area; composing a three-movement work for a string quartet; painting a mural.

   Students who do not undertake a major must have their programs for the junior and senior years approved by a faculty adviser and the Provost of the College. Their plans of study must have some rationale, and they will be expected to explain for what purposes they have chosen a particular pattern of courses. Under no circumstances should students suppose that a non-major program is, or can be made to be, less authentic than the ordinary one involving a major.

The General Education Requirements

Unless granted an exemption from the work undertaken to fulfil a requirement or allowed to complete all or part of that work by means of independent study, each student is expected to:

1. Complete a three-term sequence of courses which will serve as an introduction to a cultural tradition.
2. Complete a three-term sequence of courses in one of the humanities or fine arts.
3. Complete a three-term sequence in mathematics. *This requirement must completed before the end of the sophomore year.*
4. Complete a six-term sequence in science. *Normally the first five courses of the sequence are completed by the end of the sophomore year.*
5. Complete a course on contemporary issues. *This requirement must be met during the first year.*
6. Demonstrate conversational proficiency adequate to engaging in ordinary class discussions in a foreign language, and reading ability in that language sufficient for passing the graduate reading examination.

Introduction to a Cultural Tradition. Students select one from among several three-term sequences which inquire into the nature of particular cultures by way of their literary, artistic, historical, philosophical, and socio-anthropological aspects. Some of these sequences may require that students read works in a foreign language, and the texts increase in difficulty and quantity as the sequence progresses. Thus students can enter such sequences only if they have had adequate language training. Students with no language training and those whose competence is not enough to enable them to cope with the material will need to take as much language training as will bring them up to the level of the first course. Such training would, in any event, be needed to enable these students to meet the language proficiency requirement of John Muir College. Ordinarily it should be started during the freshman year. With the usual high school preparation in language most students will require about one year of training. Students who complete a sequence involving foreign language will be considered to have met the language requirement.

Several of the sequences inquire into the nature of cultures whose languages are such that it is not appropriate to require that students be able to read texts written in them. Students electing to fulfil the cultural traditions requirement by means of these sequences will be obliged to demonstrate their language proficiency in other ways.

The Humanities and Fine Arts Sequences. Students select one from among several three-term sequences which provide either (a) an introduction to one of the humanities or (b) an introduction to an artistic medium intended to develop sensitivity and standards of critical judgment. In addition to the ordinary lectures and discussion meetings, the courses in the arts include some studio or creative work and, where appropriate, attendance at performances and exhibitions.

Courses offered in satisfaction of the humanities and fine arts requirement during 1967-68 are: History 10A-10B, 165; Literature 1A-1B-1C; Music 1A-1B-1C; Visual Arts 1A-1B-1C. (See *Departments of Instruction.*)

The Mathematics Sequences. With the help of the Mathematics Department the student will select from among three sequences the one which best fits his diverse interests, training, and educational goals. Students who will not use mathematics as a tool in further work can select a sequence which deals with fundamental concepts of mathematics without insisting upon technical proficiency. Students planning to take advanced courses or major in the physical sciences can select a more traditional sequence in calculus and analytic geometry. Certain well-prepared and well-motivated students will be encouraged to take three courses on special topics, such as probability and statistics, or the theory of games. During each term at least one such topics course will be offered. Students initially enrolled in another sequence will be allowed to transfer to a topics course if they show sufficient aptitude. Students who have had college-level mathematics for which UCSD grants credit will be considered to have satisfied part or all of the mathematics requirement.

Departments may designate particular mathematics sequences as pre-

requisites for advanced work in their fields. (For further information on this point see the discussion of major programs below.)

For courses offered during 1967–68 in satisfaction of the mathematics requirement, see *Departments of Instruction: Mathematics.*

The Science Sequence. The science requirement is intended to inculcate general literacy with respect to the basic assumptions, ideas, and methodologies underlying scientific inquiry, together with some understanding of the role of science itself as a social institution whose dynamism profoundly affects modern cultures. Each student will take a five-term sequence, to be completed by the end of the sophomore year, and a separate, one-term course.

Students not planning to do advanced work in the physical sciences may satisfy the requirements by taking the sequence Science 1A through 1E, followed by either Science 1FL or Science 1FR. No laboratory work is included in the first five courses; laboratory experience is gained in Science 1FL or Science 1FR.

Students planning to go on to advanced work in the physical sciences should take the sequence consisting of Science 2A through 2F. Science 2F is a special course on the social and philosophical implications of modern science. Students may find it to their advantage to defer taking this course until their senior year, when their acquaintance with science is both wider and deeper. (See *Interdisciplinary Courses: Science.*)

Departments may designate particular science sequences as prerequisites for major work in their fields. (For further information on this point see the discussion of major programs below.)

The Contemporary Issues Courses. The contemporary issues requirement can be met in one of two ways: by attending a series of lectures and discussions involving members of the faculty and distinguished visitors (Contemporary Issues 1), or by enrolling in a freshman seminar which concentrates upon a single area or problem (Contemporary Issues 2.)

The lecture course is under the direction of the Provost and a steering committee of faculty members and students. Particular effort will be made to present leaders in public affairs of the moment. Insofar as possible, discussions will be guided by the students themselves. The course will be supplemented by selected reading and occasional papers.

The freshman seminars will be offered each term and will be limited to fifteen students. The staff will consist of members of the faculty from all areas of learning, chosen for their interest in the topics, without regard to college affiliation. Freshmen who wish to fulfil the requirement by means of a seminar must indicate their preference at the beginning of the year, even though the seminar of their choice may not come until the second or third term. They are welcome to attend the lectures given in the large course, but not the discussion meetings. (See *Interdisciplinary Courses: Contemporary Issues.*)

Both the large lecture course and the freshman seminars will make use of the facilities of a "public affairs laboratory" in which students may study at leisure books, periodicals, newspapers, and pictures and other

visual aids accumulated from all parts of the globe and arranged to supplement the discussions then under way.

Language Proficiency. Several of the three-course sequences which may be taken to fulfil the cultural traditions requirement demand competence in a foreign language. Therefore, successful completion of such a sequence is regarded as evidence of having fulfilled the language requirement, and no other proof of language proficiency will be required. Students who do not complete such a sequence will be expected to demonstrate their proficiency in other ways, ordinarily by means of examination. For courses offered students who need training in foreign language to meet the language proficiency requirement of the college (whether by completing a three-course sequence in a cultural tradition or by passing an examination), see *Interdisciplinary Courses: Language.*

Transfer Students

Transfer students accepted by Muir College will, in general, be held to the lower-division general education requirements and to the lower-division prerequisites for a major. The general education requirements, however, will be interpreted rigorously only for those subjects that are directly related to the student's proposed major. The Provost, in consultation with appropriate departments, will evaluate the credentials of each transfer student on an individual basis. Transfer without penalty will be authorized upon approval of the Provost and the responsible department. A transfer student at the junior or senior level may be admitted to a major even though he has not completed the lower-division general education requirements. In such cases, the general requirements must be completed before graduation. (See *Admission to the University: Advanced Standing.*)

Major Programs

A student in John Muir College may pursue any major program offered at UCSD for which he is prepared, though normally he would undertake one offered in the college. He may begin the major whenever he is judged ready for it. However, all programs can be completed by students who start them at the beginning of the junior year, and it is likely that most students will wait until then to begin.

Below is a list of subjects in which major programs will be available. Interdisciplinary programs will be developed later.

Anthropology
Applied Electrophysics*†
Biology
History
Linguistics
Literature
Mathematics*
Music

Psychology*
Sociology
Visual Arts

*Requires a particular mathematics sequence.

†Requires the science sequence designed for those going on to advanced work in the sciences.

The Honors Program

Admission to the honors program calls for a special recommendation by either the Provost or a departmental chairman, and normally requires at least a B average. In special cases a student may be permitted to enter the Honors Program immediately upon arrival at John Muir College, but this would require, for a freshman, an A average at high school or, for a transfer student, an A-minus average at his previous institution. To remain in the Honors Program a student must normally maintain at least a B average and must demonstrate by superior achievement his capacity for honors work. Once admitted, a student may be allowed to complete by means of independent study any general education requirements still to be finished.

Honors students engaged in a major program will be offered opportunities and be expected to show accomplishments beyond those of the ordinary student. An honors student may participate in special seminars, tutorial programs, or courses normally open only to graduate students, or he may be permitted to undertake an especially challenging project of his own. Honors students not pursuing a major would differ from other non-major students in having more opportunities for independent work, especially on the senior project. Whether majoring or not, the honors student will be able to develop a pattern of study that gives scope to his superior qualifications.

The Honors Program will be supervised by a faculty accreditation committee consisting of the Provost, his adviser for non-departmental honors students (both those not taking a major and those pursuing an interdisciplinary major), and the relevant departmental advisers for other honors students.

Reading Courses and Examinations

Subject to certain restrictions, a student in John Muir College can substitute reading courses for regular courses. To help him to comprehend a reading course as a whole and to understand how it relates to the content of his regular courses, he will be allowed a suitable period of reflection (not to exceed two terms after the end of the reading course) and then be required to take an examination on the reading.

A student may use reading courses during a particular term only if he has had his program approved by an appropriate faculty member *at least one term in advance of his entering the program.* Arrangements for the examinations on the reading must be made and approved at the same time. Proposals for reading that necessitates an inordinate amount of special faculty work will have to be denied.

The First Year

John Muir College offers the incoming student considerable freedom

in choosing the courses for his first year. This freedom should be wisely used to fit a program to the student's particular training and interests, leaving some scope for exploration of new areas of learning while attending to the requirements for graduation which are best fulfilled during the first two years.

To help incoming students and their advisers with the planning of the first year's program, four possible combinations are described below.

The first combination is suited to students with the usual preparatory training in language and mathematics who do not expect to take advanced work in the physical sciences.

Fall	Winter	Spring
Science 1A	Science 1B	Science 1C
Mathematics 1A or 5A	Mathematics 1B or 5B	Mathematics 1C or 5C
Language	Language	Language
Literature 1A	Literature 1B	Literature 1C
Contemporary Issues 1	Contemporary Issues 1	

Comment: A student taking this combination does not plan to do advanced work in the physical sciences. If he wished to do such advanced work, he would need to take Mathematics 1A or 2A before beginning the sequence of Science 2A, 2B, etc. (see next example). The mathematics requirement must be met before the end of the sophomore year. Thus one is not compelled to begin it immediately. However, many students will not wish to have an interval of a year between finishing high school and beginning their mathematics courses, and as a consequence will schedule a sequence that will enable them to meet the mathematics requirement during the first year. Moreover, this combination assumes that the student needs a full year of language study in order to fulfil the language requirement, whether by means of a Cultural Traditions sequence or by means of an examination. It also assumes that the student wants to meet the humanities and fine arts requirement in the freshman year and has chosen a sequence of three literature courses for that purpose. Finally, the Contemporary Issues course of lectures, required of all freshmen except those admitted to a freshman seminar, is spread across two terms.

The second combination is appropriate to students who are interested in majoring in Applied Electrophysics or in taking other advanced courses in the physical sciences.

Fall	Winter	Spring
Elective	Science 2A	Science 2B
Mathematics 1A or 2A	Mathematics 1B or 2B	Mathematics 1C or 2C
Language	Language	Language
Music 1A	Music 1B	Music 1C
Contemporary Issues 1	Contemporary Issues 1	

Comment: The science sequence for students planning more work in the physical sciences should not be started until the students have completed either Mathematics 1A or 2A. Therefore Science 2A is undertaken in

the winter term, which means that the students will complete Science 2E in the spring of the second year, as prescribed in the general education requirements. (Thereafter a student may take the sixth course, Science 2F, at any time before graduation.) This example assumes that the student using it has to do a full year of language work and that he has decided to fulfil his humanities and fine arts requirement in the first year by studying music for three terms. Note that the student has a free elective in the first term, which can be used to explore subjects (such as psychology and sociology) which he has not encountered before coming to college. Or, he might use this elective to gain admission to a freshman seminar, in which case he would not need to take the Contemporary Issues lecture sequence (although he would be welcome to attend the lectures).

The third combination would be an appropriate one for students who do not plan to use mathematics as a tool for further work and who are qualified to begin a major program in the freshman year. (Students may begin a major as soon as they are judged ready for it. On the other hand, those who wish may wait until the first term of the junior year before undertaking it.) In this example we assume that the major is in Visual Arts.

Fall	Winter	Spring
Science 1A	Science 1B	Science 1C
Mathematics 5A	Mathematics 5B	Mathematics 5C
Language	Language	Language
Art 11A	Art 11B	Art 110A
Contemporary Issues 1	Contemporary Issues 1	

Comment: Only an unusually well-prepared student should think of attempting to begin a major in the first year. Here, the student, after obtaining special permission to take Art 11A and demonstrating a great skill, is admitted to Art 11B and then to Art 110A. It should be noted that the Art courses listed here do not satisfy the humanities and fine arts requirement. Therefore the student following this program will need to take a three-course sequence in one of the humanities, such as literature, or one of the other arts, such as drama, sometime before graduation.

The fourth combination is appropriate to those students who are far better prepared in language and mathematics than most students entering American colleges and universities. As a consequence of their training, such students have more free electives and can do more advanced work from the outset.

Fall	Winter	Spring
Elective	Science 2A	Science 2B
First Course in a Cultural Tradition	Second Course in a Cultural Tradition	Third Course in a Cultural Tradition
Mathematics 10A	Elective	Elective
Art 1A	Art 1B	Art 1C
Contemporary Issues 1	Contemporary Issues 1	

Comment: In this example, the student plans to do advanced work in the physical sciences and selects the sequence of Science 2A, 2B, etc. His training in mathematics is so excellent that he gains admission to Mathematics 10A and demonstrates such understanding of the subject that he is considered to have fulfilled the mathematics requirement. As a consequence, he has at least three electives in his first year. He may wish to use them for more mathematics courses, since one of the advantages of good prior training is the greater freedom to concentrate on those subjects that most interest one. Or, he may use the time to sample subjects which are new to him. This same student is so well prepared in a foreign language that he can begin at once a Cultural Traditions course using that language.

There are, of course, many other possible combinations. In seeking the one which best suits him, an entering student should keep several things in mind:

1. The science requirement normally must be fulfilled in the first two years, except that students choosing the Science 2A through 2F sequence take the last course sometime during the junior or senior year.

2. The mathematics requirement must be fulfilled by the end of the second year, and it is usually good practice to complete it during the freshman year so that skills acquired in high school will not decline. Students taking the Science 2A–2F sequence will need to take Mathematics 1A or 2A in the fall quarter of the freshman year.

3. Those students who need to take more language training should certainly begin it promptly.

4. Students should avoid aimless shopping around. The college grants freedom of choice in the assumption that it will be used to prepare a rational plan.

The Faculty of Muir College

Name	Title	Department
Alazraki, Jaime, Ph.D.	Assistant Professor	Literature
Anderson, Norman H., Ph.D.	Professor	Psychology
Axford, William I., Ph.D.	Professor	Applied Electrophysics/Physics
Banks, Peter M., Ph.D.	Assistant Professor	Applied Electrophysics
Baron, Samuel H., Ph.D.	Professor	History
Barraclough, Geoffrey, M.A.	Professor	History
Berman, Ronald S., Ph.D.	Associate Professor	Literature
Booker, Henry G., Ph.D.	Professor	Applied Electrophysics
Bowles, Kenneth L., Ph.D.	Professor	Applied Electrophysics
Brach, Paul H., M.F.A.	Professor	Visual Arts
Brody, Stewart, Ph.D.	Assistant Professor	Biology

Carmack, Robert, Ph.D.	Assistant Professor	Anthropology
Céspedes del Castillo, Guillermo, Ph.D.	Professor	History
Chrispeels, Maarten J., Ph.D.	Assistant Professor	Biology
Cohen, Marshall, Ph.D.	Professor	Applied Electrophysics
Crowne, David, Ph.D.	Assistant Professor	Literature
Deutsch, J. Anthony, Ph.D.	Professor	Psychology
Dolin, Edwin F., Jr., Ph.D.	Assistant Professor	Literature
Eckart, Carl, Ph.D.	Professor	Physics
Eke, Barry G., Ph.D.	Assistant Professor	Mathematics
Erickson, Robert, M.A.	Professor	Music
Faber, Richard L., Ph.D.	Assistant Professor	Mathematics
Fejer, Jules A., D.Sc.	Professor	Applied Electrophysics
Fillmore, Jay P., Ph.D.	Assistant Professor	Mathematics
Fussell, Edwin J., Ph.D.	Professor	Literature
Goodkind, John M., Ph.D.	Associate Professor	Physics
Gragg, William B., Jr., Ph.D.	Assistant Professor	Mathematics
Green, David M., Ph.D.	Professor	Psychology
Guillén, Claudio, Ph.D.	Professor	Literature
Halpern, Francis R., Ph.D.	Associate Professor	Physics
Helstrom, Carl W., Ph.D.	Professor	Applied Electrophysics
Jacobs, Irwin M., Sc.D.	Associate Professor	Applied Electrophysics
Jameson, Fredric R., Ph.D.	Associate Professor	Literature
Korevaar, Jacob, Ph.D.	Professor	Mathematics
Kuroda, Sige-Yuki, Ph.D.	Assistant Professor	Linguistics
Langdon, Margaret H., Ph.D.	Assistant Professor	Linguistics
Langham, Michael S., LL.D.	Professor	Drama
Ledden, Patrick J., Ph.D.	Assistant Professor	Mathematics
Lee, Eugene T. Y., Ph.D.	Assistant Professor	Mathematics
Lewak, George J., Ph.D.	Assistant Professor	Applied Electrophysics
Lewallen, Donald G., M.A.	Assistant Professor	Visual Arts
Lindsay, Peter H., Ph.D.	Assistant Professor	Psychology
Manaster, Alfred B., Ph.D.	Assistant Professor	Mathematics
Mandler, George, Ph.D.	Professor	Psychology
Marlay, Peter C., Ph.D.	Assistant Professor	Literature
McGill, William J., Ph.D.	Professor	Psychology
Moore, Robert D., Ph.D.	Assistant Professor	Applied Electrophysics
Munsinger, Harry L., Ph.D.	Associate Professor	Psychology
Nee, Thomas B., M.A.	Associate Professor	Music
Newmark, Leonard D., Ph.D.	Professor	Linguistics
Ogdon, Wilbur L., Ph.D.	Professor	Music
Orloff, Marshall J., M.D., Ph.D.	Professor	Surgery

Perrin, Charles L., Ph.D.	Assistant Professor	Chemistry
Reynolds, George S., Ph.D.	Associate Professor	Psychology
Rifat,, David, Diploma of Art	Assistant Professor	Art
Rodin, Burton, Ph.D.	Associate Professor	Mathematics
Röhrl, Helmut, Ph.D.	Professor	Mathematics
Rosenblatt, Murray, Ph.D.	Professor	Mathematics
Rotenberg, Manuel, Ph.D	Associate Professor	Applied Electrophysics
Rumsey, Victor H., B.A.	Professor	Applied Electrophysics
Schulman, Herbert M., Ph.D.	Assistant Professor	Biology
Silber, John J., Ph.D.	Professor	Music
Soulé, Michael E., Ph.D.	Assistant Professor	Biology
Stewart, John L., Ph.D.	Professor, Provost of the College	Literature
Thiess, Frank B., Ph.D.	Assistant Professor	Mathematics
Tureck, Rosalyn	Professor	Music
Warschawski, Stefan E., Ph.D.	Professor	Mathematics
York, Herbert, Ph.D.	Professor	Physics

Revelle College

THE EDUCATIONAL PHILOSOPHY

With the establishment of Revelle College, the first college on the UCSD campus, the faculty was given a rare opportunity to shape an undergraduate curriculum that would, insofar as any educational program can, prepare its students for the modern world. From the outset of planning the curriculum, the faculty asked: What sort of knowledge must students have if they are to be liberally educated? In what areas? To what depth? How specialized must that education be in the undergraduate years?

The educational philosophy of Revelle College was developed in response to such fundamental questions. Its undergraduate program is based on the assumption that a student who is granted the Bachelor of Arts degree will have attained:

1. An acceptable level of general education in mathematics, foreign language, the physical, biological, and social sciences, the fine arts and the humanities.
2. Preprofessional competence in one academic discipline.
3. An understanding of an academic area outside his major field.

To this end, a lower-division curriculum has been established which should enable the student to acquire an understanding of the fundamental problems, methods, and powers of the humanities and the arts, the social and behavioral sciences, mathematics, and the natural sciences.

The lower-division curriculum assumes that an undergraduate should not concentrate heavily in a special field until he has had a chance to learn something about the various fields that are open to him. His general education must, then, be thorough enough for him to see the possibilities of those fields. Early in his career, he should know, as it were, three languages: his own, a foreign language, and the universal language of mathematics. He will learn more about his own culture in a two-year humanities sequence—an introduction to major literary, philosophical, and historical documents which requires the regular writing of essays. He will study a foreign language as a spoken, vital means of communication; studying that language, he will come to know something of the general nature of language itself. And he will study mathematics as part of general education and as preparation for a required sequence of courses in the physical and biological sciences. Finally, he will, as a sophomore, study the social and behavioral sciences. He will also have some elective time in which he can take courses in disciplines that he would like to explore further. Once he has completed this program, he will be ready for the relatively more specialized work of the upper division.

During the student's upper-division years (junior and senior), his main effort will be devoted to intensive work in his major field at a level of competence that will enable him to continue his study in the graduate division.

The student's *general* education will not, however, stop at the end of the sophomore year; in addition to his major, every upper-division student will do a substantial fraction of his course work in an area of learning distinctly different in content and method from that of the major. (Generally, the following will be considered "areas of learning" in the above sense: mathematics and natural sciences; the social sciences; humanities.) The courses that the student elects for this noncontiguous minor must compose an integrally related complex which will equip him for continued informal study in adult life.

Revelle College stresses the broad character of its curriculum. Every student, for example, is required to achieve a certain competence in calculus. The emphasis on calculus and physical science is in some respects a deviation from educational theory of the last hundred years. The older "general education" theory demanded that scientists achieve a reasonable competence in the social sciences and humanities. The rising importance of science justifies the application of the theory to non-scientists as well.

Four years of college can at best yield only a limited knowledge; the major task is to train the student so that he can adapt quickly and effectively to the rapidly changing world.

THE GENERAL EDUCATION REQUIREMENTS

Revelle College students are required to demonstrate an acceptable level of basic knowledge in the humanities, fine arts, social sciences, language, mathematics, and the physical and biological sciences before entering a major academic field for specialization during the junior and senior years. They will reach the required level through a set of courses that comprise approximately 80 per cent of their work in the lower division (first two years).

Students are encouraged to meet the requirements of the lower division and the major requirements of the upper division as rapidly as possible. The entire program, including the general education requirements of the upper division, is designed to be completed in four years. Variations within the program will occur, of course, depending on the student's interests, prior training, and ability to make use of individual study. Those who demonstrate superior achievement and competence in an academic area may take advanced courses and individual-study programs that give them an opportunity to complete degree requirements in fewer than four years.

Lower Division

In order to fulfil the minimum lower-division requirements in the principal fields of knowledge, the student takes a recommended set of courses, the prerequisites for which have been met by the genral admission standards of the University.

The lower-division general education requirements are as follows:

1. Seven courses in humanities and the fine arts.
2. Three courses in mathematics (including calculus).
3. Three courses in the social sciences.

4. Five courses in the natural (physical and biological) sciences.
5. Verbal and reading proficiency in a modern foreign language.
6. Satisfaction of the general University Subject A requirement.

Humanities. The humanities sequence introduces the student to his cultural heritage. It rests on the principle that this heritage is best found in the great documents of Western Civilization in which it has assumed concrete form. The student is invited to confront these literary, philosophical and historical documents directly; through lectures, group discussions, themes, and conferences he will learn to interpret them, to discover their interrelations, and to perceive their continuity.

The sequence opens with the study of contemporary works, then goes back to the Judaeo-Grecian beginnings and traces the development of Western Civilization forward again to the present. Essential to the course are the student's themes; in these he will be asked to come to direct and personal terms with what he has read, and to acquire the skills of clear and cogent expository writing. For the courses to be taken in fulfilment of this requirement see *Interdisciplinary Courses: Humanities.*

Fine Arts. One course is required and is usually taken in the freshman year. Students may choose from: Fine Arts 1 (see *Interdisciplinary Courses*); Music 1A-1B-1C; Visual Arts 10, 11, 12.

Mathematics. Mathematics has for centuries held an important place in education, in the sciences, and in the humanities. As an integral part of his liberal education, the student will be brought into contact with a significant area of mathematics. Furthermore, he will gain the facility to apply mathematics in his studies of the physical, biological and behavioral sciences.

Two beginning-year course sequences are offered for Revelle College students. Freshmen enrolment in these sequences is dependent on the student's high school and college preparation in mathematics as well as his future plans. Both sequences include integral and differential calculus and linear algebra. (See *Departments of Instruction: Mathematics.*)

Social Sciences. Until a single, integrated social science course sequence may be devised to meet this requirement, students will choose among several social science sequences, for example, Economics 1A-1B-1C, Philosophy 20, 21, 22, or Psychology 10, 11, 12. (See *Departments of Instruction.*) Other suitable course sequences may become available during 1967–68. One sequence must be taken in its entirety in order to satisfy the requirement.

Natural Sciences. The Natural Science sequences present the fundamental concepts of modern physical science and biology. For the student who may major in one of these disciplines, the courses provide a background and preparation for further study; for those students who will continue their studies outside the sciences, they offer an opportunity to gain a certain understanding and appreciation of current developments in these fields.

Two sequences are offered, both beginning in the winter quarter of the freshman year. A student enrols in one or the other sequence depend-

ing on his performance in the fall quarter of freshman mathematics. Five courses in one sequence will satisfy the natural sciences requirement. (See *Interdisciplinary Courses: Natural Sciences.*)

Language. Revelle College has set its language requirements in terms of levels of proficiency that must be attained by the student, rather than in terms of a certain course or number of courses that must be passed. Three language requirements in Revelle College should be carefully distinguished:

A. Oral proficiency as a lower-division requirement.
By the end of his sophomore year the student is expected to have demonstrated his ability to carry on ordinary conversation comfortably in a modern foreign language. The skill aimed at is what would be adequate for the student to continue his education by participating in substantive courses conducted in the foreign language, e.g., the courses offered by the Department of Literature on this campus or courses offered to native speakers of the language in their own country.

B. Reading proficiency as a lower-division requirement.
By the end of his sophomore year the student is expected to have demonstrated his ability to read ordinary material—e.g., newspapers and popular literature—in a foreign language. The level aimed at is that which college students in this country normally attain by the end of their second year of training in the language.

C. General oral and reading proficiency as a requirement for graduation. (See *Foreign Language Proficiency in Upper Division* below.)

The normal preparation for lower-division language proficiency will be language courses in the student's freshman year. With normal high school preparation in language most students will require about a year of course work to prepare for the examination, but some students will take less time and some more, because of differences in ability, industry, and previous language work in high school, on other campuses, or in informal extracurricular activities (e.g., foreign movies, language clubs, language tables) involving the language.

To assist the student in attaining the required language proficiencies, three special kinds of aid are offered:

1. Self-instructional materials and equipment, which the student can use to advance his proficiency at his own optimum speed.
2. A program of small tutorial classes, conducted by native speakers of the language. A student's assignment to a new tutorial class will be a measure of his increased proficiency; the classes will be recomposed weekly to maintain homogeneity of class membership, permitting each class to be conducted at the highest level possible for each of its members.
3. Instruction by linguistic scientists about language and the learning of languages. This instruction is intended to broaden the scope of the student's education as well as to assist him in his own language study.

Subject A. Satisfaction of the University requirement in Subject A (English composition) is a prerequisite to taking any regular course in English composition, or any course in the Humanities sequence beyond Humanities 1. (See *Interdisciplinary Courses: Humanities; Subject A.*)

FRESHMAN YEAR

Fall	Winter	Spring
Humanities 1	Humanities 2	Humanities 3
Language	Language	Language
Mathematics 1A or 2A	Mathematics 1B or 2B	Mathematics 1C or 2C
Fine Arts	Natural Science 1A or 2A	Natural Science 1B or 2B

SOPHOMORE YEAR

Fall	Winter	Spring
Humanities 4	Humanities 5	Humanities 6
Natural Science 1C or 2C	Natural Science 1D or 2D	Natural Science 1E or 2E
Social Science	Social Science	Social Science
Elective/Language	Elective/Language	Elective/Language

Upper Division

The Major

The following departments offer major programs for Revelle College students:

Aerospace and Mechanical Engineering Sciences
Applied Electrophysics
Biology
Chemistry
Earth Sciences
Economics
History
Linguistics
Literature
Mathematics
Music
Philosophy
Physics
Psychology

The major program will require up to fifteen upper-division courses (the actual number varies by departments.) For details of the major in each department, see *Departments of Instruction.*

Restricted Electives

In addition to the major requirements, departments may require a

student to pass a number of courses in his general area of learning. The requirement is intended to give breadth as well as depth to the student's major. The major program and related elective choices may total up to eighteen courses in the upper division.

The Noncontiguous Minor

In addition to the major and any restricted electives, Revelle College students are required to complete a noncontiguous minor—a coherent grouping of six courses in an area of studies *other than* that of the major. For the purposes of this requirement, the humanities, the social sciences, and the natural sciences (including mathematics) will be considered three different areas. The requirement may be met in either of the following ways:

1. *Project minor.* Such a minor centers on a problem or period chosen by the student after consultation with his major adviser. It may be interdepartmental, so that the courses constituting it may be selected from various departmental offerings. However, the "center of gravity" of such a minor must be in a given department, that department being in an area other than the student's major. After consultation with his major adviser, the student will consult with the minor adviser in the appropriate department and determine with him which courses will constitute the minor. Every minor program of this kind, as well as any later changes in it, must be approved by a minor adviser.
2. *Departmental minor.* Such a minor consists of six courses taken within one department outside the area of the student's major. After consultation with his major adviser, the student will consult with the minor adviser of the chosen department and determine with him which courses will constitute the minor. Every departmental minor as well as any later changes in it must be approved by the minor adviser of the department.

No more than three lower-division courses may be included in a minor program.

Each department will designate a minor adviser. Minor programs are subject to approval by the Provost.

Foreign Language Proficiency in Upper Division

In order to graduate from Revelle College, the student must have demonstrated an overall ability to perform in a foreign language. For upper-division *oral proficiency,* previous passing of the lower-division language requirements will be taken as satisfactory demonstration. To demonstrate upper-division *reading proficiency,* the student will take an appropriate examination. The student will normally take this examination at the end of his junior year; if he does not pass it then, he will have his senior year in which to gain the required proficiency.

The Graduation Requirements

In order to graduate from Revelle College, a student must:

1. Satisfy the lower-division general education requirements (includ-

ing Subject A).
2. Complete a major.
3. Complete a noncontiguous minor.
4. Demonstrate proficiency in a modern foreign language (upper division).
5. Satisfy the general University requirement in American History and Institutions. See *Departments of Instruction: History.*
6. Pass at least 48 courses.
7. Attain a C average (2.0) or better in all work attempted in the University of California (exclusive of University Extension) and a C average in all upper division courses in the major attempted in the University.

Upon satisfaction of the graduation requirements, Revelle College will recommend that the student be awarded the degree Bachelor of Arts, with a diploma specifying the major field.

Transfer Students

Transfer students accepted by Revelle College will, in general, be held to the lower-division general education requirements and to the lower-division prerequisites for a major. The general education requirements, however, will be interpreted rigorously only for those subjects that are directly related to the student's proposed major. The Provost, in consultation with appropriate departments, will evaluate the credentials of each transfer student on an individual basis. Transfer without penalty will be authorized upon approval of the Provost and the responsible department. A transfer student at the junior or senior level may be admitted to a major even though he has not completed the lower-division general education requirements. In such cases, the general requirements must be completed before graduation.

In order to transfer to Revelle College from another college or school within the University of California, a student will be required to have a C (2.0) average or better on all work attempted at the University. (See *Admission to the University: Advanced Standing.*)

The Faculty of Revelle College

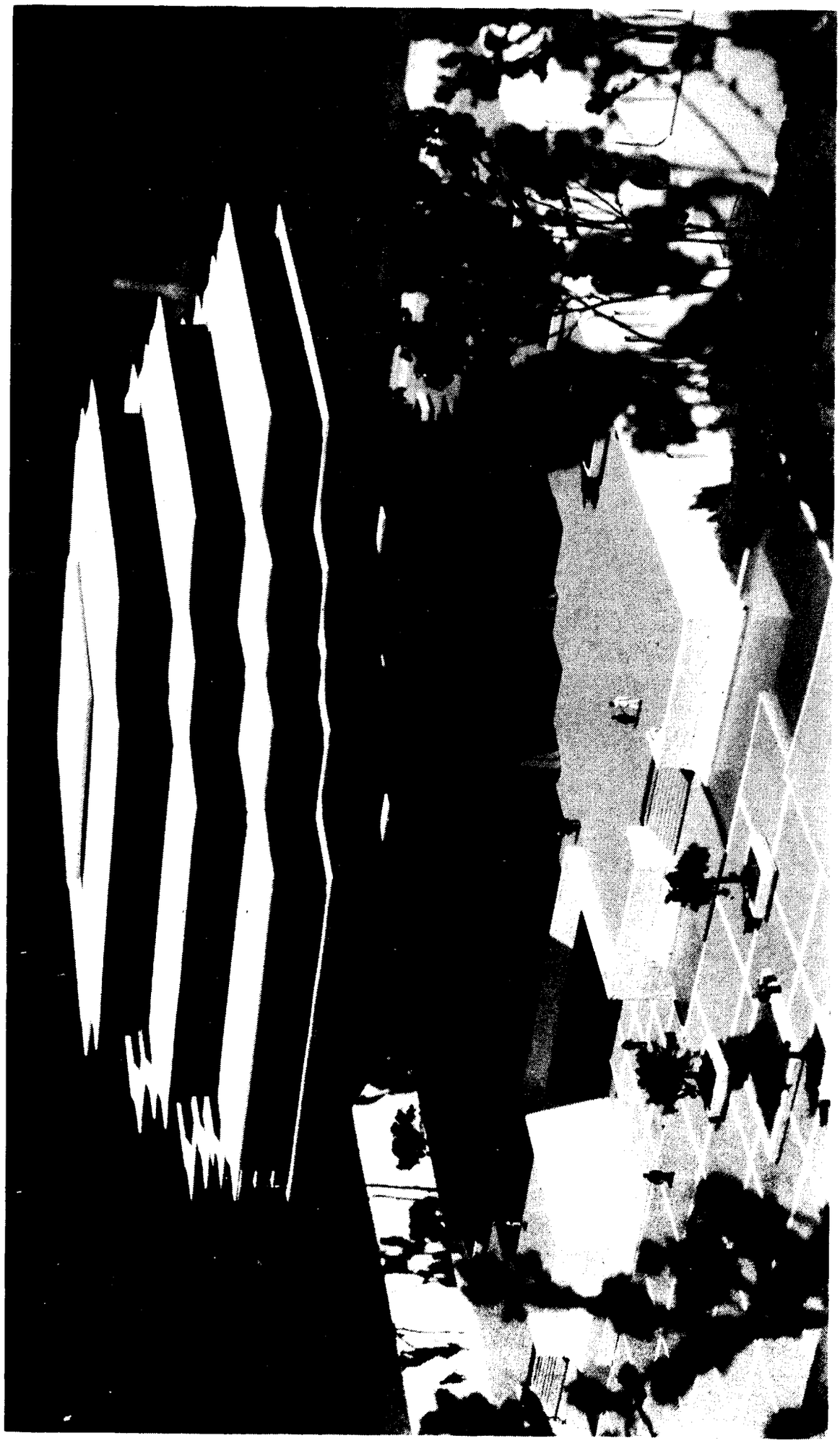
Name	Title	Department
Andrea, Stephen A., Ph.D.	Assistant Professor	Mathematics
Ariotti, Piero E., Ph.D.	Assistant Professor	Philosophy
Arnold, James R., Ph.D.	Professor	Chemistry
Attiyeh, Richard E., Ph.D.	Associate Professor	Economics
Bass, Manuel N., Ph.D.	Assistant Professor	Earth Sciences
Bear, Donald V. T., Ph.D.	Associate Professor	Economics
Bearden, Alan J., Ph.D.	Assistant Professor	Chemistry
Behar, Jack, Ph.D.	Assistant Professor	Literature
Bishop, Errett A., Ph.D.	Professor	Mathematics
Blanco, Carlos, Ph.D.	Professor	Literature
Block, Barry, Ph.D.	Assistant Professor	Physics
Blume, Bernhard, Ph.D.	Professor	Literature

Bond, Frederick T., Ph.D.	Assistant Professor	Chemistry
Bradner, Hugh, Ph.D.	Professor	Aerosp. & Mech. Eng. Scs.
Brueckner, Keith A., Ph.D.	Professor	Physics
Burbidge, E. Margaret, Ph.D.	Professor	Physics
Burbidge, Geoffrey R., Ph.D.	Professor	Physics
Burton, Rodney L., Ph.D.	Assistant Professor	Aerosp. & Mech. Eng. Scs.
Butler, Warren L., Ph.D.	Professor	Biology
Casalduero, Joaquin, Ph.D.	Professor	Literature
Chen, Joseph Cheng-Yih, Ph.D.	Assistant Professor	Physics
Clark, Leigh B., Ph.D.	Assistant Professor	Chemistry
Coppi, Bruno, Ph.D.	Assistant Professor	Physics
Craig, Harmon, Ph.D.	Professor	Earth Sciences
DeMoss, John A., Ph.D.	Associate Professor	Biology
Dijkstra, Abraham J., Ph.D.	Assistant Professor	Literature
Doolittle, Russell F., Ph.D.	Assistant Professor	Chemistry
Dunseath, Thomas K., Ph.D.	Associate Professor	Literature
Elliott, Robert C., Ph.D.	Professor	Literature
Ellis, Albert T., Ph.D.	Professor	Aerosp. & Mech. Eng. Scs.
Fahey, Robert C., Ph.D.	Assistant Professor	Chemistry
Feher, George, Ph.D.	Professor	Physics
Frankel, Theodore T., Ph.D.	Professor	Mathematics
Frazer, William R., Ph.D.	Professor	Physics
Fredkin, Donald, Ph.D.	Assistant Professor	Physics
Fung, Yuan-cheng, Ph.D.	Professor	Aerosp. & Mech. Eng. Scs.
Gibson, Carl H., Ph.D.	Assistant Professor	Aerosp. & Mech. Eng. Scs.
Goles, Gordon G., Ph.D.	Assistant Professor	Chemistry/Earth Sciences
Gould, Robert J., Ph.D.	Assistant Professor	Physics
Green, Melvin H., Ph.D.	Associate Professor	Biology
Grobstein, Clifford, Ph.D.	Professor	Biology
Halkin, Hubert, Ph.D.	Associate Professor	Mathematics
Hamburger, Robert N., M.D.	Professor	Pediatrics
Harris, Seymour E., Ph.D.	Professor	Economics
Harrison, Newton A., M.F.A.	Assistant Professor	Visual Arts
Hayashi, Masaki, Ph.D.	Assistant Professor	Biology
Hegemier, Gilbert, Ph.D.	Assistant Professor	Aerosp. & Mech. Eng. Scs.
Helinski, Donald R., Ph.D.	Associate Professor	Biology
Henry, Paul, S.J., D.D., Ph.D.	Professor	Philosophy
Holbrook, John A., Ph.D.	Assistant Professor	Mathematics
Hooper, John W., Ph.D.	Professor	Economics
Huang, Nai-Chien, Ph.D.	Assistant Professor	Aerosp. & Mech. Eng. Scs.

Humphreys, Tom D., II, Ph.D.	Assistant Professor	Biology
Intaglietta, Marcos, Ph.D.	Assistant Professor	Aerosp. & Mech. Eng. Scs.
Jackson, Gabriel, Ph.D.	Professor	History
Kamen, Martin D., Ph.D.	Professor	Chemistry
Kirkby, Ronald V., Ph.D.	Assistant Professor	Philosophy
Kohn, Walter, Ph.D.	Professor	Physics
Kraut, Joseph, Ph.D.	Professor	Chemistry
Kroll, Norman M., Ph.D.	Professor	Physics
Langacker, Ronald W., Ph.D.	Assistant Professor	Linguistics
Lettau, Reinhard, Ph.D.	Professor	Literature
Libby, Paul A., Ph.D.	Professor	Aerosp. & Mech. Eng. Scs.
Liebermann, Leonard N., Ph.D.	Professor	Physics
Lin, Shao-Chi, Ph.D.	Professor	Aerosp. & Mech. Eng. Scs.
Linck, Robert G., Ph.D.	Assistant Professor	Chemistry
Livingston, Robert B., M.D.	Professor	Neurosciences
Loomis, William F., Jr., Ph.D.	Assistant Professor	Biology
Lovberg, Ralph H., Ph.D.	Professor	Physics
Maki, Kazumi, Ph.D.	Associate Professor	Physics
Makkreel, Rudolf A., Ph.D.	Assistant Professor	Philosophy
Marcuse, Herbert, Ph.D.	Professor	Philosophy
Masek, George E., Ph.D.	Professor	Physics
Mathews, William G., Ph.D.	Assistant Professor	Physics
Matthias, Bernd T., Ph.D.	Professor	Physics
Mayer, Joseph E., Ph.D.	Professor	Chemistry
Mayer, Maria Goeppert, Ph.D.	Professor	Physics
McIlwain, Carl E., Ph.D.	Professor	Physics
Mehlhop, W. A. W., Ph.D.	Assistant Professor	Physics
Miles, John W., Ph.D.	Professor	Aerosp. & Mech. Eng. Scs.
Miller, David R., Ph.D.	Assistant Professor	Aerosp. & Mech. Eng. Scs.
Miller, Stanley L., Ph.D.	Associate Professor	Chemistry
Mills, Stanley E., Ph.D.	Associate Professor	Biology
Monroe, James, Ph.D.	Assistant Professor	Literature
Moore, Stanley, Ph.D.	Professor	Philosophy
Nachbar, William, Ph.D.	Professor	Aerosp. & Mech. Eng. Scs.
Nemat-Nasser, Siavouche, Ph.D.	Assistant Professor	Aerosp. & Mech. Eng. Scs.
Nguyen-Huu, Xuong, Ph.D.	Assistant Professor	Physics
Norman, Donald A., Ph.D.	Associate Professor	Psychology
Norton, David F., Ph.D.	Assistant Professor	Philosophy

Olfe, Daniel B., Ph.D.	Associate Professor	Aerosp. & Mech. Eng. Scs.
Orr, Daniel, Ph.D.	Associate Professor	Economics
Pawula, Robert F., Ph.D.	Assistant Professor	Aerosp. & Mech. Eng. Scs.
Pearce, Roy H., Ph.D.	Professor	Literature
Penner, Stanford S., Ph.D.	Professor	Aerosp. & Mech. Eng. Scs.
Peterson, Laurence E., Ph.D.	Associate Professor	Physics
Piccioni, Oreste, Ph.D.	Professor	Physics
Popkin, Richard H., Ph.D.	Professor	Philosophy
Prager, William, Sc.D., Eng.D.	Professor	Aerosp. & Mech. Eng. Scs.
Ramanathan, Ramachandra, Ph.D.	Assistant Professor	Economics
Rand, Sinai, Ph.D.	Associate Professor	Aerosp. & Mech. Eng. Scs.
Roberson, Robert E., Ph.D.	Professor	Aerosp. & Mech. Eng. Scs.
Saltman, Paul D., Ph.D.	Professor, Provost of the College	Biology
Sarolli, Gian-Roberto, D.L.	Professor	Literature
Saunders, Jason L., Ph.D.	Professor	Philosophy
Schane, Sanford A., Ph.D.	Assistant Professor	Linguistics
Schneider, Alan M., Sc.D.	Associate Professor	Aerosp. & Mech. Eng. Scs.
Schrauzer, Gerhard N., Ph.D.	Professor	Chemistry
Schultz, Sheldon, Ph.D.	Associate Professor	Physics
Shore, Herbert B., Ph.D.	Assistant Professor	Physics
Simon, Melvin I., Ph.D.	Assistant Professor	Biology
Singer, S. Jonathan, Ph.D.	Professor	Biology
Smith, Donald R., Ph.D.	Assistant Professor	Mathematics
Stern, Herbert, Ph.D.	Professor	Biology
Stroll, Avrum, Ph.D.	Professor	Philosophy
Suess, Hans E., Ph.D.	Professor	Chemistry
Suhl, Harry, Ph.D.	Professor	Physics
Swanson, Robert A., Ph.D.	Associate Professor	Physics
Thompson, William B., Ph.D.	Professor	Physics
Traylor, Teddy G., Ph.D.	Associate Professor	Chemistry
Urey, Harold C., Ph.D.	Professor	Chemistry
Van Atta, Charles W., Ph.D.	Assistant Professor	Aerosp. & Mech. Eng. Scs.
Vernon, Wayne, Ph.D.	Assistant Professor	Physics
Vold, Robert L., Ph.D.	Assistant Professor	Chemistry
Watson, Joseph W., Ph.D.	Assistant Professor	Chemistry
Wheatley, John C., Ph.D.	Professor	Physics
Wierschin, Martin W., Ph.D.	Assistant Professor	Literature
Williams, Forman A., Ph.D.	Professor	Aerosp. & Mech. Eng. Scs.

Williamson, Stanley G., Ph.D.	Assistant Professor	Mathematics
Wilson, Kent R., Ph.D.	Assistant Professor	Chemistry
Wong, David Y., Ph.D.	Professor	Physics
Wright, Andrew H., Ph.D.	Professor	Literature
Zimm, Bruno H., Ph.D.	Professor	Chemistry
Zweifach, Benjamin W., Ph.D.	Professor	Aerosp. & Mech. Eng. Scs.



Architect's model of Central University Library set for 1970 occupancy

The Graduate Division

GRADUATE DEGREES OFFERED AS OF 1967–68

Aerospace Engineering	M.S., Ph.D.
Applied Electrophysics	M.S., Ph.D.
Applied Mechanics	M.S., Ph.D.
Bioengineering	M.S., Ph.D.
Cellular Biology	Ph.D.
Chemistry	M.S., Ph.D.
Earth Sciences	M.S., Ph.D.
Economics	Ph.D.
Engineering Physics	M.S., Ph.D.
History	Course Work*
Linguistics	M.A., Ph.D.
Literature, English & American	Ph.D.
Literature, Spanish	Ph.D.
Marine Biology	M.S., Ph.D.
Mathematics	M.A., Ph.D.
Oceanography	M.S., Ph.D.
Philosophy	M.A., Ph.D.
Physics	M.S., Ph.D.
Psychology	M.A., Ph.D.

*Graduate course work is now available; arrangements for awarding advanced degrees are pending.

The Nature of Graduate Instruction

A graduate course is a highly advanced course in a field of study already intensively presented in the upper division. It normally carries a number in the 200 series. Graduate courses demand—on the part of both instructors and students—either critical analysis or specialization of research not normally appropriate to an undergraduate major. Graduate courses may be conducted in several ways:

1. As advanced lecture courses.
2. As seminars in which the faculty and students present critical studies of organized fields of knowledge.
3. As independent study or reading courses.
4. As research projects carried on under faculty supervision.

The main purpose of graduate study is to develop independence of mind and originality in the search for knowledge and truth. The candidate must attain a mastery of his chosen field. He must also conduct a successful program of independent research for the Ph.D. Consequently, graduate students are accorded considerable liberty insofar as enrolment in courses is concerned, provided they carry the minimum number of units required to establish residence.

The Master's Degree: General Requirements

Preparation

The preliminary training of the candidate for the degree Master of Arts or Master of Science should be substantially the equivalent of that represented by the corresponding bachelor's degree of the University of California. If the candidate's undergraduate preparation is found to be deficient in any serious respect in its breadth of fundamental training, or fails to provide a proper foundation for advanced work in the candidate's chosen field, he may be required by his department to devote some time to specified undergraduate courses, involving a longer period of residence than would otherwise be required.

Amount and Distribution of Work

At the option of the department of his major field, a student must pursue one of two plans (described below) for fulfilment of the requirements for the master's degree. Under either plan all the requirements for the degree must be satisfied within a calendar year from the time of completion of the course requirement. (See *Departments of Instruction.*)

Plan I. *Thesis Plan*

Credit must be obtained for 30 quarter units, at least 12 of which must be in graduate courses in the major field, 6 additional units in graduate courses, and 12 units in graduate or upper-division courses. A master's thesis must be approved by a committee of three faculty members appointed by the Vice Chancellor–Graduate Studies and Research.

Plan II. *Comprehensive Examination Plan*

Credit must be obtained for 36 quarter units, at least 14 of which must be in graduate courses in the major field, 10 additional units in graduate courses, and 12 units in graduate or upper-division courses. A comprehensive final examination, designated as a master's examination, must be passed.

Foreign Language Requirement

Language requirements, if any, adopted by individual departments, shall be administered as the Graduate Council shall direct. In general, the satisfaction of language requirements for the master's and the doctor of philosophy degrees will be accomplished by similar procedures.

Application for Advancement to Candidacy

Application for advancement to candidacy must be made through the Registrar's Office. Application must be made with the recommendation of the department concerned and must contain a general statement of the studies upon which the application is based. Advancement to candidacy shall take place not later than one quarter prior to the date of completion of requirements for the degree. Admission to candidacy is not automatic; it requires a formal application distinct from registration.

Residence Requirement

The minimum residence requirement is three quarters, at least one of

which must occur after the student has been admitted to candidacy for the master's degree. It is not always possible, however, to complete subject requirements within the minimum period of residence. Residence is established by satisfactory completion of 6 units per quarter, some of which must be on the graduate level.

Standard of Scholarship

Only courses in which the student is assigned grades *A*, *B*, *C*, *P* (passed), or *S* (satisfactory) are counted in satisfaction of the requirements for the master's degree. In addition, a student must maintain a minimum grade-point average of 3.0 in all courses taken after admission to graduate status.

Doctor of Philosophy Degree: General Requirements

Students who desire to become candidates for the doctor's degree should bear in mind that the degree of Doctor of Philosophy is granted by the University of California not for the fulfilment of technical requirements alone, such as residence and the completion of fundamental courses within a chosen field, but more for the student's general grasp of the subject matter of a large field of study and his distinguished attainments within it, for his critical ability, his power to analyze problems and to coordinate and correlate the data from allied fields to serve the progress of ideas. In addition, he must demonstrate, through his dissertation, the ability to make an original contribution to the knowledge of his chosen field, and throughout his career as a graduate student must prove himself capable of working independently.

Preparation

A prospective candidate for this degree must hold a bachelor's degree from one of the colleges of this University, based on a curriculum that includes the requirements for graduate status in the department of his major subject, or must have pursued successfully elsewhere an equivalent course of study.

Residence Requirement

The minimum residence requirement for the Ph.D. degree is six quarters, three of which must be spent in continuous residence at the San Diego campus, except in the case of a joint Ph.D. program, in which the residence requirements will be defined by the Graduate Council. Residence is established by the satisfactory completion of 6 units per quarter, some of which must be at the graduate level.

Foreign Language Requirement

Before taking the qualifying examination for advancement to candidacy for the Ph.D. degree, the student must satisfy the foreign language requirements established by the department and approved by the Graduate Council. Most departments will require students to demonstrate appropriate proficiency in one or more foreign languages. Students are strongly urged to acquire the best possible language preparation appropriate for

their proposed major before entering graduate school, since otherwise their programs may be seriously delayed.

The examinations in foreign languages required by all departments are conducted by the Department of Linguistics, under the supervision of the Graduate Council. Information concerning the examinations is available in the Department of Linguistics. Special non-credit courses in required languages are available for students who do not pass the examinations. (See *Interdisciplinary Courses: Language.*) In some cases, it may be possible to satisfy the language requirements by examination before admission to Graduate School, but the specific approval of the Graduate Council is required in such cases.

Program of Study

The student's program of study must be approved by the Vice Chancellor–Graduate Studies and Research, must embrace a field of investigation previously approved by his department, and must extend over the full period of study. However, recommendation for the degree is based on the attainments of the candidate rather than the duration of his study. (See *Departments of Instruction.*)

Qualifying Examinations

Before admission to candidacy for the Ph.D. degree, a student must have satisfied all preliminary requirements set by his major department and by the Graduate Council and must have passed the qualifying examination conducted by his doctoral committee.

Doctoral Committees

Upon nomination of the department or interdepartmental group of the student's field of study, a doctoral committee will be appointed by the Vice Chancellor–Graduate Studies and Research. This committee conducts the qualifying examination, supervises and passes upon the student's dissertation, and conducts the final oral examination. The committee shall consist of five or more members, of which at least two shall be from departments other than that of the student's major.

Advancement to Candidacy

The candidate must file his application, properly approved by the doctoral committee, with the Office of the Registrar, who determines if all formal requirements have been met. A minimum period of resident study equivalent to three quarters must intervene between the date of formal advancement to candidacy and the date of the final examination. Each applicant must submit a formal application and pay a $25 fee.

Dissertations

A dissertation on a subject chosen by the candidate, bearing on his principal study and showing his ability to make independent investigation, is required of every candidate for the degree. In its preparation the candidate is guided by his doctoral committee, which also passes on the merits of the completed dissertation. The approval of this committee, as well as

that of the Vice Chancellor–Graduate Studies and Research, is required before the student is recommended for the degree.

An appropriate draft of the dissertation must be submitted to each member of the doctoral committee no later than four weeks before the final examination. Copies of the approved dissertation must be deposited in the University Library. Instructions for the preparation and submitting of theses may be obtained from the Office of the Registrar.

Final Examination

The candidate's final examination is conducted by his doctoral committee. The examination is oral and deals primarily with the dissertation subject and its relation to the general field of study.

Students make use of study tables in the Science and Engineering Library

Interdisciplinary and Special Courses

CONTEMPORARY ISSUES

Office: Building 251, Matthews Campus (Provost, Muir College)

These courses are administered by a committee chaired by the Provost of Muir College, and are to be used by Muir College freshmen in fulfilling the Contemporary Issues requirement of the college.

COURSES

1. Contemporary Issues **F-W**

A lecture course treating problems in public affairs. The lectures will be supplemented by discussion meetings, reading in the Public Affairs Laboratory, and the preparation of occasional papers. This is a two-quarter course; both quarters must be taken in order to earn credit.

2. Freshman Seminars on Contemporary Issues **F,W,S**

Seminars directed by members of the UCSD faculty and visiting professors, and treating in depth one contemporary issue or small group of related issues.

199A-199B. Special Studies in Contemporary Issues **F-W**

Individual reading and projects in the areas covered by the visiting lecturers for Contemporary Issues 1. Prerequisite: permission of Provost of Muir College and Director of Contemporary Issues.

FINE ARTS

Office: 1555 Humanities-Library Building (Provost, Revelle College)

This course is offered jointly by the Departments of Music and Visual Arts. It is to be used by Revelle College students in fulfilling the fine arts requirement of the college.

1. Fine Arts **F**

Introduction to the nature of the arts through lectures and examples presented by members of the Departments of Visual Arts and Music. Three meetings.

HUMANITIES

Office: 1555 Humanities-Library Building (Provost, Revelle College)

This sequence of courses is to be used by Revelle College students in fulfilling the humanities requirement of the college. It is offered jointly by the Departments of Literature, Philosophy and History, and has the purpose of introducing the student to the Western cultural tradition. He will learn to interpret major literary, historical and philosophical documents through lectures and discussions, as well as through the writing of themes. One aim of the course is to develop the student's ability to write clear and well-ordered expository prose.

A student may not graduate from Revelle College with a major in humanities. Students interested in the area of humanities must choose a specific major within the humanities, i.e., literature, philosophy, etc. See *Subject A* (this section) for explanation of the Subject A course in Revelle College.

COURSES

1. The Present Age F

Analysis of some major twentieth-century books and cultural trends. Two lectures, one discussion, regular assignments in expository writing.

2. Jews and Greeks W

Readings from the Bible, Homer and the Greek dramatists, historians and philosophers. Two lectures, one discussion, regular assignments in expository writing.

3. Rome and the Middle Ages S

Documents in the literature, philosophy and history of Rome and Medieval Europe. Two lectures, one discussion, regular assignments in expository writing.

4. The Renaissance F

Documents in the literature, philosophy and history of the Renaissance. Two lectures, one discussion, regular assignments in expository writing.

5. Classicism and Enlightenment W

Documents in the literature, philosophy and history of the seventeenth and eighteenth centuries. Two lectures, one discussion, regular assignments in expository writing.

6. The West after the French Revolution S

Documents in the literature, philosophy and history of the nineteenth century. Two lectures, one discussion, regular assignments in expository writing.

LANGUAGE

Office: Language Center, 445 Humanities-Library Building

Language courses are taught under the direction of the Department of Linguistics.

The course sequences numbered 1A-1B-1C and 2A-2B-2C are designed partly to aid the student in attaining basic conversational and reading ability in a modern foreign language, but partly also to increase his general understanding of the nature of language itself and of the civilization in which that language is used. Some students who begin their study of the language at UCSD will be able to achieve required proficiency levels at the end of the 1A-1B-1C sequence; a student who has not done so may continue in the 2A-2B-2C sequence for as many quarters (up to a maximum of three) as he requires. A student who has studied the language for two or more years in high school (or the equivalent elsewhere) is normally not permitted to enrol in the 1A-1B-1C sequence; instead, he

enrols each quarter (to a maximum of three) in the 2A-2B-2C sequence until he reaches the required level of proficiency.

Every course in the 1A-1B-1C and 2A-2B-2C sequence includes, each week, 3 scheduled hours of tutorial classes with a native speaker of the language, 3 unscheduled hours of laboratory, 1-2 scheduled hours of conference classes with a linguist, and 3-6 hours of assigned homework. A student's tutorial section is reassigned to him weekly on the basis of his relative progress through the course; his assignment to a conference class is determined by his section assignment.

The courses numbered 11A-11B-11C and 12A-12B-12C are intended for students whose primary concern is to learn to read the language; credit taken under these course numbers will not ordinarily be counted toward fulfilment of degree requirements. A student who has satisfied his college oral (conversational) proficiency requirements in one language may elect to study another language and receive credit counting toward graduation; such a student should enrol in a language course numbered 1 or 2 (if he wishes to learn to speak as well as read the language) or one numbered 19 (if he wishes to learn to read it only.)

COURSES

Lang/Fr 1A-1B-1C. Elementary French **F-W-S**
See general description above. Three hours tutorial, 3 hours laboratory, 1-2 hours conference with linguist.

Lang/Ge 1A-1B-1C. Elementary German **F-W-S**
See general description above. Three hours tutorial, 3 hours laboratory, 1-2 hours conference with linguist.

Lang/Ru 1A-1B-1C. Elementary Russian **F-W-S**
See general description above. Three hours tutorial, 3 hours laboratory, 1-2 hours conference with linguist. (Not offered 1967–68.)

Lang/Sp 1A-1B-1C. Elementary Spanish **F-W-S**
See general description above. Three hours tutorial, 3 hours laboratory, 1-2 hours conference with linguist.

Lang/En 2A-2B-2C. Intermediate English as a Foreign Language **F-W-S**
A sequence of courses for those undergraduate and graduate students whose native language is not English. Three hours tutorial, 2 hours laboratory.

Lang/Fr 2A-2B-2C. Intermediate French **F-W-S**
See general description above. Three hours tutorial, 3 hours laboratory, 1-2 hours conference with linguist. Prerequisite: two or more years of high school instruction in the language or equivalent, or French 1C.

Lang/Ge 2A-2B-2C. Intermediate German **F-W-S**
See general description above. Three hours tutorial, 3 hours laboratory, 1-2 hours conference with linguist. Prerequisite: two or more years of high school instruction in the language or equivalent, or German 1C.

Lang/Ru 2A-2B-2C. Intermediate Russian F-W-S
See general description above. Three hours tutorial, 3 hours laboratory, 1-2 hours conference with linguist. Prerequisite: two or more years of high school instruction in the language or equivalent, or Russian 1C.

Lang/Sp 2A-2B-2C. Intermediate Spanish F-W-S
See general description above. Three hours tutorial, 3 hours laboratory, 1-2 hours conference with linguist. Prerequisite: two or more years of high school instruction in the language or equivalent, or Spanish 1C.

Lang/Ch 11A-11B-11C. Elementary Chinese Reading F-W
A course designed to prepare students for graduate reading examination. Credit not to be counted toward satisfying degree requirements. (Not offered 1967–68.)

Lang/Fr 11A-11B-11C. Elementary French Reading F-W
A course designed to prepare students for graduate reading examination. Credit not to be counted toward satisfying degree requirements.

Lang/Ge 11A-11B-11C. Elementary German Reading F-W
A course designed to prepare students for graduate reading examination. Credit not to be counted toward satisfying degree requirements.

Lang/Gr 11A-11B-11C. Elementary Greek Reading F-W
A course designed to prepare students for graduate reading examination. Credit not to be counted toward satisfying degree requirements.

Lang/La 11A-11B-11C. Elementary Latin Reading F-W
A course designed to prepare students for graduate reading examination. Credit not to be counted toward satisfying degree requirements.

Lang/Ru 11A-11B-11C. Elementary Russian Reading F-W
A course designed to prepare students for graduate reading examination. Credit not to be counted toward satisfying degree requirements.

Lang/Sp 11A-11B-11C. Elementary Spanish Reading F-W
A course designed to prepare students for graduate reading examination. Credit not to be counted toward satisfying degree requirements.

Lang/Ch 12A-12B-12C. Intermediate Chinese Reading F-W-S
A course designed to prepare students for graduate reading examination. Credit not to be counted toward satisfying degree requirements. (Not offered 1967–68.)

Lang/Fr 12A-12B-12C. Intermediate French Reading F-W-S
A course designed to prepare students for graduate reading examination. Credit not to be counted toward satisfying degree requirements.

Lang/Ge 12A-12B-12C. Intermediate German Reading F-W-S
A course designed to prepare students for graduate reading examination. Credit not to be counted toward satisfying degree requirements.

Lang/Gr 12A-12B-12C. Intermediate Greek Reading **F-W-S**
A course designed to prepare students for graduate reading examination. Credit not to be counted toward satisfying degree requirements.

Lang/La 12A-12B-12C. Intermediate Latin Reading **F-W-S**
A course designed to prepare students for graduate reading examination. Credit not to be counted toward satisfying degree requirements.

Lang/Ru 12A-12B-12C. Intermediate Russian Reading **F-W-S**
A course designed to prepare students for graduate reading examination. Credit not to be counted toward satisfying degree requirements.

Lang/Sp 12A-12B-12C. Intermediate Spanish Reading **F-W-S**
A course designed to prepare students for graduate reading examination. Credit not to be counted toward satisfying degree requirements.

Lang/Ch 19A-19B-19C. Independent Study: Chinese **F-W-S**
Must have passed proficiency requirement in language other than Chinese. Not open to students who have had two years or more of high school Chinese or equivalent.

Lang/Du 19A-19B-19C. Independent Study: Dutch **F-W-S**
Must have passed proficiency requirement in language other than Dutch.

Lang/Fr 19A-19B-19C. Independent Study: French **F-W-S**
Must have passed proficiency requirement in language other than French. Not open to students who have had two years or more of high school French or equivalent.

Lang/Ge 19A-19B-19C. Independent Study: German **F-W-S**
Must have passed proficiency requirement in language other than German. Not open to students who have had two years or more of high school German or equivalent.

Lang/Gr 19A-19B-19C. Independent Study: Greek **F-W-S**
Must have passed proficiency requirement in language other than Greek. Not open to students who have had two years or more of high school Greek or equivalent.

Lang/It 19A-19B-19C. Independent Study: Italian **F-W-S**
Must have passed proficiency requirement in language other than Italian. Not open to students who have had two years or more of high school Italian or equivalent.

Lang/La 19A-19B-19C. Independent Study: Latin **F-W-S**
Must have passed proficiency requirement in language other than Latin. Not open to students who have had two years or more of high school Latin or equivalent.

Lang/Ru 19A-19B-19C. Independent Study: Russian **F-W-S**
Must have passed proficiency requirement in language other than Russian. Not open to students who have had two years or more of high school Russian or equivalent.

Lang/Sp 19A-19B-19C. Independent Study: Spanish **F-W-S**
Must have passed proficiency requirement in language other than Spanish. Not open to students who have had two years or more of high school Spanish or equivalent.

NATURAL SCIENCES

Office: 1555 Humanities-Library Building (Provost, Revelle College)

The two sequences of courses described below are given jointly by the Departments of Physics, Chemistry, and Biology. They are to be used by Revelle College students in fulfilling the natural science requirement of the college. The courses contain material equivalent to traditional lower-division chemistry, biology, and physics courses, but are organized in such a way as to eliminate unnecessary overlap of content.

The sequence Natural Science 1A-1B-1C-1D-1E is intended for students whose mathematics proficiency is at the level of the Mathematics 1 sequence. The material of this sequence is presented in a manner which minimizes the dependence on mathematics in the early quarters. Students who are enrolled in Mathematics 2 or have advanced standing will usually take the sequence Natural Science 2A-2B-2C-2D-2E. In either case, the courses are intended to be taken in the given order. Individual departments may recommend that the above sequences be supplemented with Natural Science 2F or 2FL.

Students who intend to major or minor in science or engineering are strongly advised to enrol in the sequence numbered 2. The more extensive use of mathematics and the deductive presentation enable the student to progress efficiently and in a natural manner to advanced work in science.

If warranted by enrolment and the numbers of students with advanced mathematics placement, an honors option may be offered within the Natural Science 2 sequence.

COURSES

1A. Natural Science: Chemistry **W**
The rudiments of chemistry including the chemical bond are covered from the point of view of atomic structure and the periodic table. Three hours lecture, one hour recitation.

1B. Natural Science: Chemistry **S**
Thermochemistry and electrochemistry are developed on a descriptive level. An introduction to organic chemistry is provided in order to form a basis for the biology taught in Natural Science 1C. Three hours lecture, one three-hour laboratory.

1C. Natural Science: Biology **F**
An introduction to the general principles of biology with emphasis on the cell, heredity, and the chemical and physical bases of living processes. Three hours lecture, one hour recitation.

1D. Natural Science: Physics **W**
Basic physical concepts such as energy, momentum, and angular momen-

tum are studied, and are applied in order to understand motion in space and the behavior of ideal gases. Three hours lecture, two hours recitation.

1E. Natural Science: Physics **S**
Basic electricity and simple quantum ideas are used in gaining an understanding of the physical basis for atomic structure and chemical binding. Three hours lecture, two hours recitation.

2A. Natural Science: Physics **W**
Introductory lectures on the range of natural phenomena which can be understood in terms of the physical sciences are followed by the study of particle motion. Applications are made to astronomy and to the structure of matter. Three hours lecture, one hour recitation, three hours problem session.

2B. Natural Science: Physics **S**
A continuation of Natural Science 2A to the electrical effects of stationary and moving charges, time dependent fields, and waves. Three hours lecture, one hour recitation, two hours problem session.

2C. Natural Science: Physical Chemistry **F**
The study of waves is followed by an introduction to the quantum theory as applied to atoms and their radiation. The exclusion principle is used to study the chemistry and physics of covalent and ionic binding in molecules and solids. Three hours lecture, one hour recitation, three hours laboratory.

2D. Natural Science: Chemistry **W**
The interactions of atoms and bulk properties of matter are further explored. Elementary thermodynamics, kinetic theory of gases, states of matter, ionic and covalent bonding are developed in more detail, with emphasis on systems of biological interest. Three hours lecture, one hour recitation, one three-hour laboratory.

2DL. Natural Science: Chemistry **W**
Recommended for students intending to major in chemistry and others who wish to acquire some proficiency in the experimental methods of modern chemistry. Students in this course attend the same lecture and classroom sessions as those in Natural Science 2D. The laboratory will include work in qualitative and quantitative analysis, including instrumental methods. Two three-hour laboratory sessions.

2E. Natural Science: Biology **S**
An introduction to the general principles of biology, with emphasis on the cell, heredity, and the chemical and physical bases of living processes. Three hours lecture, one hour recitation.

2F. Natural Science: Chemistry **S**
A further development of the chemical properties of matter; acids and bases; complex ions; oxidation-reduction; electrochemistry; rates of chemical reactions. Three lectures, one recitation, one three-hour laboratory.

2FL. Natural Science: Chemistry **S**
This course bears the same relation to 2F as 2DL does to 2D. The laboratory will include further analytical work, along with other physical measurements, including the study of kinetics. Emphasis will be on precision and accuracy of technique as well as on the theoretical basis of experimental design. Two three-hour laboratory sessions.

SCIENCE

Office: Building 251, Matthews Campus (Provost, Muir College)

These courses are to be used by Muir College students in fulfilling the science requirement of the college.

COURSES

1A-1B-1C. Science **F-W-S**
An integrated sequence intended for students who do not plan to do more specialized work in science. A comprehensive view of scientific methodology and of major facts and concepts drawn from all areas of science; exposure in depth to selected topics. Must be taken in sequence.

1D-1E. Science **F-W**
Continuation of Science 1A-1B-1C. Must be taken in sequence. Prerequisite: completion of 1A-1B-1C.

1FL. Special Laboratory Topic **F,W,S**
A laboratory course in a limited sector of science, to provide experience in laboratory methods of investigation. Examples of possible areas of concentration: electronics, orbital motion, symmetry, the nature of the chemical bond, communication, vision and hearing, fundamental particles. Prerequisite: completion of, or concurrent enrolment in, the Science 1A-1E sequence.

1FR. Research Project **F,W,S**
Individual laboratory work, an opportunity for the student to learn, through personal investigation of a problem of his own choosing, how to formulate questions, design experiments, collect data, and verify and interpret results. Prerequisite: completion of, or concurrent enrolment in, the Science 1A–1E sequence.

2A-2B-2C. Science **W-S-F**
An integrated sequence intended for students with a special interest in the sciences and those needing preparation for advanced courses in Applied Electrophysics and other physical sciences. Must be taken in sequence. Prerequisite: Mathematics 1A or 2A.

2D-2E-2F. Science **W-S-F**
Continuation of Science 2A-2B-2C. Must be taken in sequence. Prerequisite: completion of 2A-2B-2C.

SUBJECT A

Office: to be announced.

REVELLE COLLEGE

The first quarter of Subject A in Revelle College is taught in conjunction with Humanities 1. The sections for Humanities 1/Subject A are constituted so as to allow more individual attention and more writing. A fee of $45 is charged for the additional instruction given in these sections. A student must receive a grade of C or better in Humanities 1/Subject A to satisfy the Subject A requirement. Students who receive a grade of D, F, or I in Humanities 1/Subject A may not continue in the Humanities sequence until they pass the following non-credit course:

Subject A (Fee $45) **F,W,S**

English Composition. Training in correct and competent writing. Must be passed with a grade of C or better before further courses involving English composition (including courses in the Humanities sequence) can be taken. Students who maintain a grade of A may, on the recommendation of the Committee on Subject A, be permitted to withdraw from the course at a date to be determined by the Committee and be given credit for Subject A. Students who fail the course must repeat it until passed.

MUIR COLLEGE

Subject A (Fee $45) **F,W,S**

English Composition. Training in correct and competent writing. Must be passed with a grade of C or better before further courses can be taken in which the writing of themes or papers forms a substantial part of the work. Students who maintain a grade of A in this course may, on the recommendation of the Committee on Subject A, be permitted to withdraw from the course at a date to be determined by the Committee and be given credit for Subject A. Students who fail the course must repeat it until passed.

UCSD's first formal commencement exercise, Urey Hall Plaza, June, 1967

Departments of Instruction

AEROSPACE AND MECHANICAL ENGINEERING SCIENCES (INCLUDING BIOENGINEERING)

Office: 5202 Urey Hall

H. Bradner, *Ph.D., Professor of Engineering Physics and Geophysics*
A. T. Ellis, *Ph.D., Professor of Applied Mechanics*
Y. C. Fung, *Ph.D., Professor of Bioengineering and Applied Mechanics*
P. A. Libby, *Ph.D., Professor of Aerospace Engineering*
S. C. Lin, *Ph.D., Professor of Engineering Physics*
J. W. Miles, *Ph.D., Professor of Applied Mechanics and Geophysics*
W. Nachbar, *Ph.D., Professor of Applied Mechanics*
S. S. Penner, *Ph.D., Professor of Engineering Physics* (Chairman of the Department)
W. Prager, *Eng.D., Sc.D., Professor of Applied Mechanics*
R. E. Roberson, *Ph.D., Professor of Aerospace Engineering*
B. W. Zweifach, *Ph.D., Professor of Bioengineering*
D. B. Olfe, *Ph.D., Associate Professor of Aerospace Engineering*
S. Rand, *Ph.D., Associate Professor of Engineering Physics*
A. M. Schneider, *Sc.D., Associate Professor of Aerospace Engineering*
F. A. Williams, *Ph.D., Professor of Aerospace Engineering*
R. L. Burton, *Ph.D., Assistant Professor of Engineering Physics*
C. H. Gibson, *Ph.D., Assistant Professor of Aerospace Engineering*
G. A. Hegemier, *Ph.D., Assistant Professor of Applied Mechanics*
N. C. Huang, *Ph.D., Assistant Professor of Applied Mechanics*
M. Intaglietta, *Ph.D., Assistant Professor of Bioengineering*
D. R. Miller, *Ph.D., Assistant Professor of Engineering Physics*
S. Nemat-Nasser, *Ph.D., Assistant Professor of Applied Mechanics*
R. F. Pawula, *Ph.D., Assistant Professor of Aerospace Engineering*
C. W. Van Atta, *Ph.D., Assistant Professor of Aerospace Engineering*

* * *

W. J. Rainbird, *Research Associate and Lecturer*
K. G. P. Sulzmann, *Research Engineer*
T. J. Hendricks, *Assistant Research Engineer*
D. R. Kassoy, *Assistant Research Engineer*
J. Lee, *Assistant Research Engineer*
J. L. Way, *Assistant Research Engineer*

The current instructional and research programs emphasize high-temperature gas dynamics, fluid mechanics, bioengineering, solid mechanics and structures, and vehicle guidance and control. The graduate program is characterized by strong interdisciplinary relationships with the Departments of Physics, Mathematics, Biology, and Chemistry, with the Medical School, and with associated University institutes such as the Institute for Geophysics and Planetary Physics, the Institute for Radiation Physics and Aerodynamics, and the Space Sciences Laboratory.

The Undergraduate Program

The Department of Aerospace and Mechanical Engineering Sciences offers three programs of study at the undergraduate level, each leading to the degree Bachelor of Arts (Applied Science). The three programs have common required courses in the junior year so that a student may delay his final choice of program to the end of the junior year. The *applied mechanics program* prepares the student for pre-professional graduate studies in aerospace and mechanical engineering; the *electromechanics program* does the same in those areas of aeronautical and electrical engineering related to guidance, control and systems analysis; the *bioengineering program* prepares the student either for graduate studies in bioengineering or for professional training in the medical school. Students considering a major in applied mechanics or bioengineering are advised to take Mathematics 100 and Natural Science 2F in their sophomore year and those considering a major in electromechanics are advised to take Mathematics 100, 101, and 102 in their sophomore year. The courses required by the Department are to be supplemented by electives in contiguous and noncontiguous areas chosen in consultation with departmental major advisers. Students with superior records are expected to take courses beyond the minimum number—with special emphasis on mathematics, biology, chemistry, physics, and applied electrophysics.

All students in AMES are required to take, in their junior year, courses in continuum and fluid mechanics, thermodynamics, and dynamics, as represented by AMES 100, 101A, 101B, 110, 111, and 120A. Those students who have completed Mathematics 100 in their sophomore year are required to complete Mathematics 120, 121, and 122 in their junior year; those who have not done so are required to complete Mathematics 100 in the first quarter of the junior year.

Senior Year (Applied Mechanics Program)

A student electing to follow the applied mechanics program is required during his senior year to complete his studies of fluid mechanics with AMES 101C and of dynamics with AMES 120B, 120C, and 120D. In addition he is required to study solid mechanics as represented by AMES 130A and 130B.

It is recommended that students complete the noncontiguous minor (Revelle College) during their senior year. Electives necessary to fulfil minimum graduation requirements are generally chosen in physics, and are to be selected in consultation with departmental major advisers. Superior students are encouraged to supplement a minimum program with courses in AMES, mathematics, physical chemistry, and physics.

Senior Year (Electromechanics Program)

A student electing to follow the electromechanics programs is required, during his senior year, to complete his studies of dynamics with AMES 120B, 120C, and 120D, and to complete a sequence of courses devoted

to systems theory—AMES 140A-140B-140C. It is recommended that students complete the noncontiguous minor (Revelle College) during their senior year. Electives necessary to fulfil minimum graduation requirements are generally chosen in either mathematics, physics, or applied electrophysics. Electives are to be selected in consultation with the major advisers.

Senior Year (Bioengineering Program)

A student electing to follow the bioengineering program is required, during his senior year, to take a series of courses in biology, Biology 101A, 101B, 101C, and in chemistry, either Chemistry 100A, 100B, or 140A, 140B. In addition, he is required to take three AMES courses, in fluid mechanics or solid mechanics, to be selected in consultation with his major adviser.

It is recommended that students complete the noncontiguous minor (Revelle College) during their senior year. Electives necessary to fulfil graduation requirements are to be selected in consultation with the major advisers.

Major Program in Applied Mechanics (Recommended Schedule)

	Fall	Winter	Spring
Junior Year	AMES 100	AMES 101A	AMES 101B
	AMES 110	AMES 111	AMES 120A
	Math 120	Math 121	Math 122
	*Math 100		
Senior Year	AMES 120B	AMES 120C	AMES 120D
	AMES 101C	AMES 130A	AMES 130B

*If not completed in the sophomore year.

Major Program in Electromechanics (Recommended Schedule)

	Fall	Winter	Spring
Junior Year	AMES 100	AMES 101A	AMES 101B
	AMES 110	AMES 111	AMES 120A
	Math 120	Math 121	Math 122
	*Math 100		
Senior Year	AMES 120B	AMES 120C	AMES 120D
	AMES 140A	AMES 140B	AMES 140C

*If not completed in the sophomore year.

Major Program in Bioengineering (Recommended Schedule)

	Fall	Winter	Spring
Junior Year	AMES 100 AMES 110 Math 120 *Math 100	AMES 101A AMES 111 Math 121	AMES 101B AMES 120A Math 122
Senior Year	Biology 101A Chem 100A or Chem 140A	Biology 101B Chem 100B or Chem 140B	Biology 101C

*If not completed in the sophomore year.

The Graduate Program

Admission will be in accordance with the general requirements of the Graduate Division. Candidates with bachelor's or master's degrees in mathematics, the physical sciences, or any branch of engineering are invited to apply.

The Department of the Aerospace and Mechanical Engineering Sciences offers graduate instruction leading to the master's and Ph.D. degrees in Aerospace Engineering, Applied Mechanics, Bioengineering, and Engineering Physics.

The instructional and research programs are characterized by strong interdisciplinary relationships with the Departments of Mathematics, Physics, and Chemistry, and with associated campus institutes such as the Institute for Radiation Physics and Aerodynamics, the Institute of Geophysics and Planetary Physics, and the Space Sciences Laboratory.

Master's Degree Program

The Department will award master's degrees (M.S.) in Aerospace Engineering, Applied Mechanics, Bioengineering, and Engineering Physics. Both Plan I and Plan II are offered. (See *Graduate Division: The Master's Degree.*) The Department's specific requirements are as follows:

1. The course of study must be approved by the student's adviser. The courses should generally include six (for Plan I) or nine (for Plan II) quarter courses (numbered 200) offered by the AMES faculty. In special situations, where the departmental adviser is satisfied that the candidate has adequate proficiency in areas to be covered by these courses, other graduate courses may be elected as substitutes.
2. Students must have an average grade of B or higher in the courses taken in fulfilment of requirements for the master's degree.
3. The thesis under Plan I is reviewed by a thesis adviser and two other faculty members nominated by the department chairman.

Doctor's Degree Program

A departmental examination will be given to all Ph.D. candidates prior

to the regular Ph.D. qualifying examination. This departmental examination must be taken by all students during the sixth quarter of graduate work at UCSD. Under exceptional circumstances, particularly when the student holds a master's degree from another institution, the departmental examination may be taken at an earlier date on the recommendation of the adviser.

Students who transfer to AMES from other departments, and who have passed unconditionally a departmental examination administered by another department, will not be required to pass a departmental examination administered by AMES. However, these transfer students must obtain certification from their advisers that they possess professional knowledge of fluid mechanics, solid mechanics, bioengineering, or vehicle guidance and control before taking the Ph.D. qualifying examination.

After satisfactory completion of the departmental examination, graduate students in AMES must pass the usual Ph.D. qualifying examination administered by a Senate Committee, which will consist of five or more members, of whom at least two are members of other departments. The Committee for the qualifying examination is nominated by the department chairman on the basis of recommendations made by the thesis adviser, and is appointed by the Graduate Council.

Doctoral candidates in AMES will be required to demonstrate either (*a*) reading knowledge of two languages: the first must be Russian, German, or French; the second may be any language other than English (non-English–speaking aliens may use proficiency in their native tongue to meet this requirement), *or* (*b*) reading and speaking knowledge of Russian, German, or French. A minimum ETS score of 420 in the chosen languages will meet AMES departmental requirements for reading knowledge.

Successful candidates will be awarded the Ph.D. degree in Aerospace Engineering, Applied Mechanics, Bioengineering, or Engineering Physics. (See *Graduate Division: The Ph.D.*)

COURSES

UPPER DIVISION

100. Continuum Mechanics **F**

Discussion of common foundations of fluid and solid mechanics; stress; instantaneous motion (rates of rotation and deformation); stress rate; constitutive equations (Newtonian fluid, elastic solid); conservation of mass; momentum and energy theorems. Four hours lecture, two hours laboratory. Prerequisites or co-registration: AMES 110, Mathematics 100.

101A. Fluid Mechanics **W**

Potential-flow theory with application to airfoils and wings; compressible-flow theory including generalized one-dimensional flow. Four hours lecture, two hours laboratory. Prerequisites: AMES 100, Mathematics 120, and prerequisite or co-registration in AMES 111.

101B. Fluid Mechanics **S**

Continuation of compressible-flow theory including wave phenomena;

viscous-flow theory including boundary-layer theory. Four hours lecture, two hours laboratory. Prerequisites: AMES 101A, AMES 111, Mathematics 121.

101C. Fluid Mechanics F
Continuation of 101B. Reacting flows; transport phenomena; combustion theory; their applications to propulsion theory. Four hours lecture, two hours laboratory. Prerequisites: AMES 101B, Mathematics 122.

110. Thermodynamics F
First law, second law, selected applications. Introduction to statistical mechanics. Three hours lecture. Prerequisite: junior standing, or consent of the instructor.

111. Thermodynamics W
Extension and applications of 110. Thermodynamic cycles including idealized propulsion systems; electromechanical processes including fuel cells and secondary power units; calculation of thermodynamic functions for ideal gases from spectroscopic data. Three hours lecture. Prerequisite: AMES 110, and prerequisite or co-registration in AMES 101A.

120A. Dynamics of Electromechanical Systems S
Particle Dynamics: conservation laws; work, energy and power; impact and collision; systems of particles; motion in a moving frame, Coriolis and centrifugal forces. Virtual work, D'Alembert's principle, Hamilton's principle, generalized coordinates, Lagrange's equations and applications. Four hours lecture. Prerequisite: Mathematics 121.

120B. Dynamics of Electromechanical Systems F
Linear systems theory. Classical circuit theory. State-variable and frequency domain analysis of linear systems with applications to electrical, mechanical and thermal systems. Four hours lecture. Prerequisites: AMES 120A, Mathematics 122.

120C. Dynamics of Electromechanical Systems W
Rigid-body dynamics. Review of vectors and matrices. Representations of rotations by direction cosines, Euler angles and Euler parameters. Angular velocity and kinematical differential equations. Material systems and inertia matrix. Euler and Lagrange forms of dynamical equations and mass expulsion effects. Torque-free motion of rigid bodies. Gyroscopes. Four hours lecture. Prerequisite: AMES 120B.

120D. Dynamics of Electromechanical Systems S
Continuation of 120 sequence (to be defined at a later date). Four hours lecture. Prerequisite: AMES 120C.

130A. Solid Mechanics W
Discussion of elastic, plastic, viscoelastic and viscoplastic solids in connection with simple static and dynamic problems concerning structural elements and structures (rods, beams, rings, and frames). Four hours lecture, two hours laboratory. Prerequisite: AMES 100.

130B. Solid Mechanics **S**

Discussion of simple problems in two- and three-dimensional elasticity (torsion, flexure, stress concentration at circular holes; plane waves, Rayleigh waves, thermoelasticity). Simple illustrative problems in viscoelasticity and plasticity. Four hours lecture, two hours laboratory. Prerequisite: AMES 130A.

140A. Automatic Control Systems **F**

The classical procedures for feedback control systems: formulation of differential equations and system model from physical description. Use of Laplace transforms; transfer functions; compensation; Bode, Nichols, and root locus plots. Prerequisite or co-registration: AMES 120B. (Not offered 1967–68.)

140B. Automatic Control Systems **W**

Continuation of 140A. Generalized concepts of system performance analysis based on frequency, transient, and error coefficient methods; compensation with lead or lag networks; gain-phase and pole-zero plots; linear sampled-data systems; Z-transforms; control systems incorporating digital computers. Associated laboratory involving analog and/or hybrid computer and automatic control devices. Prerequisite: AMES 140A. (Not offered 1967–68.)

140C. Automatic Control Systems **S**

Introduction to nonlinear systems; quasilinearization; describing functions; phase plane analysis. Introduction to random processes for time-invariant linear systems. Introduction to state-space characterization of dynamic systems. Laboratory. Prerequisite: AMES 140B. (Not offered 1967–68.)

199. Independent Study for Undergraduates **F,W,S**

Independent reading or research by special arrangement with a faculty member.

GRADUATE

205. Graduate Seminar (1) **F,W,S**

The Staff

All graduate students in AMES are expected to attend the biweekly departmental research conference. On alternate weeks, all graduate students should attend a departmental seminar of their choice dealing with current topics in fluid mechanics, solid mechanics, bioengineering, or guidance and control.

206. Physical Principles and Problems (1) **F,W,S**

Mr. Bradner

Principles of applied science illustrated by problems in mechanics, dynamics, electricity, optics, thermodynamics, etc. Presentation of individual research. Preparation of interdepartmental oral examination.

210A-210B-210C. Introductory Fluid Mechanics (3-3-3) **F,W,S**
Mr. Miller, Mr. Van Atta, Mr. Gibson
Kinematics; potential flow; wing theory; surface waves; gas dynamics; Navier-Stokes equations; boundary layers; turbulence. Prerequisites: undergraduate fluid mechanics and thermodynamics, or consent of the instructor.

211A. Propulsion: Air-breathing Engines (3) **F**
Mr. Williams
Propulsion of aircraft, missiles, and boosters by air-breathing engines, including cycle analysis; characteristics of engine components, and matching of engine components to produce an efficient engine. Prerequisites: undergraduate fluid mechanics and thermodynamics, or consent of the instructor.

211B. Propulsion: Chemical Rockets and Mission Analysis (3) **W**
Mr. Miller
Solid- and liquid-propellant rocket engines, combustion processes, motor design and performance; rocket configurations; mission analyses; optimization calculations. Prerequisite: AMES 211A, undergraduate fluid mechanics and thermodynamics, or consent of the instructor.

211C. Propulsion: Electric and Nuclear (3) **S**
Mr. Burton
Principles of thermal, electrothermal, electrostatic, and electromagnetic propulsion; electromagnetic theory and physics of ionized gases; plasma acceleration mechanisms; requirements for specific space missions. Prerequisites: undergraduate fluid mechanics, and electricity and magnetism, or consent of the instructor.

220A. Physical Gas Dynamics (3) **F**
Mr. Rand
Kinetic theory of neutral gases; transport properties; principles and applications of statistical mechanics. Prerequisites: AMES 210A-210B-210C, Mathematics 120-121-122, Physics 140, or consent of the instructor.

220B. Physical Gas Dynamics (3) **W**
Mr. Lin
Principles of electrodynamics and quantum mechanics; theories of atomic and molecular structure; perturbation method in quantum mechanics; semiclassical treatment of radiation; scattering phenomena; transition probabilities; vibrational relaxation; dissociation, ionization, and recombination. Prerequisites: AMES 210A-210B-210C, 220A, Physics 130A-130B, Mathematics 120-121-122, or consent of the instructor.

220C. Physical Gas Dynamics (3) **S**
Mr. Lin
Shock waves and detonation waves; explosions and hypersonic flow; experimental methods in high-temperature gases; shock tubes; atomic and molecular beams; selected topics such as chemical reactions and re-

laxation processes in turbulent flow interaction of radiation with ionized gases and gas lasers. Prerequisites: AMES 210A-210B-210C, 220A-220B, Physics 130A-130B, Mathematics 120-121-122, or consent of the instructor.

221A. Opacity Calculations (3) **F**

Mr. Penner

Basic laws for radiant-energy emission from gases, liquids, and solids; spectral absorption coefficients, line shapes, curves of growth; theoretical and experimental methods for estimating opacities of uniform and non-uniform gases. Prerequisites: consent of the instructor. (Not offered 1967–68.)

221B. Radiative Transfer Theory (3) **W**

Mr. Penner, Mr. Olfe

Fundamental quantities and the equation of transfer; methods of solving radiative transfer problems for gray and non-gray gases; nonstationary problems. Prerequisite: AMES 211A, or consent of the instructor. (Not offered 1967–68.)

221C. Radiation Gas Dynamics (3) **S**

Mr. Olfe

Conservation equations of gas dynamics including a radiation field; the effect of radiative transfer on acoustic waves, shock-wave structure, and boundary layers; radiative cooling in the shock layers of high-velocity reentry vehicles; radiative transfer effects on convection and turbulence. Prerequisites: AMES 211A-211B, or consent of the instructor. (Not offered 1967–68.)

222A-222B-222C. Advanced Fluid Mechanics (3,3,3) **F-W-S**

Mr. Burton, Mr. Olfe, Mr. Rainbird

Contemporary problems in broad areas of fluid mechanics, e.g., surface waves, hydrodynamic stability, boundary layers with mass and heat transfer, turbulent-flow theory, multiphase systems, hypersonic-flow theory, shock-wave structure, theory of reacting flows, etc. Prerequisites: AMES 210A-210B-210C, 211A-211B-211C, Mathematics 120-121-122, or consent of the instructor.

223. Applications of Plasmadynamics (3) **S**

Mr. Rand

Kinetic theory of ionized gases; plasma transport properties; moment equations; interactions of waves with plasma. Prerequisite: AMES 220A, Physics 100A, 100B, 100C, or consent of the instructor.

231A. Foundations of Solid Mechanics (3) **F**

Mr. Nemat-Nasser

Cartesian tensors; specification of stress, instantaneous motion, and infinitesimal strain; conservation principles; typical constitutive equations; specification of finite strain. Prerequisite: AMES 130A, or consent of the instructor.

231B. Elasticity (3) W
Mr. Huang
Basic equations; general boundary value problem and uniqueness of its solution; torsion and flexure; variational principles; numerical methods. Prerequisite: AMES 231A, or consent of the instructor.

231C. Elasticity (3) S
Mr. Nemat-Nasser
Two-dimensional problems and complex variable methods; fundamentals of plate theory; selected three-dimensional problems. Prerequisite: AMES 231B, or consent of the instructor.

232. Matrix Methods in Analysis of Structures and Continua (3) F
Elements of matrix algebra; application of transfer matrix and force and displacement methods to linear and nonlinear problems. Prerequisite: AMES 130B, or consent of the instructor. (Not offered in 1967–68.)

233. Plasticity (3) W
Mr. Prager
Classification of plastic solids; behavior of plastic structures; limit analysis; plastic design; finite plastic deformation, application to technological forming processes. Prerequisite: AMES 231A, or consent of the instructor.

234. Viscoelasticity (3) S
Mr. Huang
Equivalent mathematical representations of stress-strain relations of linear viscoelastic solids. Quasi-static and dynamic stress analysis problems; thermal effects; nonlinear viscoelasticity. Prerequisite: AMES 231B, or consent of the instructor.

235A. Theory of Shells (3) F
Mr. Hegemier
Fundamentals of shell theory; linear membrane and bending theories of shells of revolution; pressure vessels; shallow shells. Prerequisite: AMES 130A, or consent of the instructor.

235B. Theory of Shells (3) W
Mr. Hegemier
Nonlinear membrane and bending theory of finite deflection and small strain of shells of revolution and shallow shells. Prerequisite: AMES 235A, or consent of the instructor.

236. Structural Stability (3) S
Instabilities of structural elements under steady, oscillatory, and impulsive loading. Elastic buckling of compressed plates and shells. Prerequisite: AMES 235A, or consent of the instructor. (Not offered 1967–68.)

237. Dynamics of Structures (3) F
Mr. Prager
Free and forced vibrations of structural elements; approximate methods of determining natural frequencies and modes, and dynamic response of

structures. Prerequisite: AMES 232, or consent of the instructor. (Not offered every year.)

250A. Astrodynamics and Rocket Navigation (3) F

Practical application of celestial mechanics to vehicle analysis; elements of a two-body orbit; elliptical, parabolic, hyperbolic orbits. Coordinate systems; orbit transfer in single-force field and multiple-force field systems; optimal plane change; lunar flights; interplanetary flight; low-thrust vehicles. Prerequisites: basic mechanics, spherical trigonometry, vector and matrix methods, AMES 120A-120B-120C-120D, or consent of the instructor. (Not offered 1967–68.)

251A. Guidance of Aerospace Vehicles (3) W

Survey of guidance problems; definitions, mission phases, guidance requirements, intercept (proportional navigation and homing), explicit and implicit guidance, rendezvous, methods of steering, steering control and stability, introduction to optimal steering laws. Prerequisites: AMES 140A-140B-140C, AMES 250A, or consent of the instructor. (Not offered 1967–68.)

251B. Gyrodynamics and Inertial Navigation Systems (3) S

Behavior of gyros and accelerometers; inertial navigation system equations for cruise and orbiting vehicles; Schuler tuning, error analysis. Alignment; gyrocompassing on fixed and moving vehicles; four-gimbal, three-gimbal, and strapdown systems. Prerequisite: AMES 251A, or 256A. (Not offered in 1967–68.)

253A. State-Space and Time-Domain Approach to Control Theory (3) F

Mr. Schneider

Utility of time-domain methods in control system analysis and design. Matrix polynomials, functions of matrices, matrix differential equations, transfer function matrices, the fundamental (state-transition) matrix, canonical representation of dynamic systems. Controllability, observability. Stability analysis. Prerequisites: AMES 120A–D, Mathematics 101.

255A. Theory of Optimal Control (3) W

Mr. Schneider

Bounded controls. Sets of reachable states. Necessary and sufficient conditions for optimality. Calculus of variations. Pontryagin's maximum principle. Dynamic programming. Existence and uniqueness. Applications to minimum-time and minimum-fuel problems; design of optimal systems using switching curves and surfaces. Optimal linear regulators and tracking systems with quadratic performance criteria. Prerequisite: AMES 253A.

255B. Theory of Optimal Control (3) S

Mr. Schneider

The second variation; optimal feedback control. Computational techniques steepest descent, gradient, Newton-Raphson. Estimation of state from noisy measurements smoothing, filtering, and prediction. Optimal con-

trol with random disturbances and noisy measurements; separation theorem. Kalman filters. Prerequisite: AMES 255A.

256A. Advanced Rotational Dynamics (3) S
Mr. Roberson
Basic dynamics of rigid bodies in three dimensions. Systems of rigid bodies. Stabilization through spinning. Gyrodynamic applications. Prerequisites: AMES 120C, Mathematics 101.

256B. Spacecraft Attitude Control (3) F
The space environment and its role in attitude control of aerospace vehicles. Torques, including gravitational and magnetic. Inertial and optical sensors. Actuators. Design considerations in passive and active control. Prerequisites: AMES 256A. (Not offered in 1967–68.)

264. Filtering and Random Processes in Automatic Control (3) W
Mr. Pawula
Statistical problems of importance to control engineers. Extensive treatment of random processes in linear feedback systems, including optimum design of such systems; estimation theory, Wiener filtering and Kalman filtering. Brief treatment of nonlinear systems in the presence of random noise. Prerequisites: basic feedback control theory and AMES 294A, or consent of the instructor.

271. Bioengineering 1: Structure and Function of Tissues (3) F
Mr. Zweifach
The course is intended for entering students in bioengineering. A general survey of structure-function relationships will be made. Emphasis will be placed on vascular system and related tissues, such as endothelium, erythrocytes, cardiac and smooth muscle, ground substance, basement membranes and nerve cells. Prerequisite: consent of the instructor.

272. Bioengineering 2: Biomechanics and Systems Analysis (3) W
Mr. Fung.
Applications of continuum mechanics and systems analysis to specific problems such as wave propagation in blood vessels, stability theory, pressure-flow relationships, autoregulation, elasticity of red blood cells, mechanics of flow in small blood vessels, and geometry of vessels in relation to their behavior. Prerequisite: consent of the instructor.

273. Bioengineering 3: Transport Phenomena (3) S
Mr. Intaglietta
Microscopic and macroscopic transport phenomena occurring in biological systems treated from the viewpoint of statistical mechanics and fluid dynamics. Exchange at the blood capillary level. Diffusion through biological structures. The mechanisms of membrane action. The application of non-equilibrium thermodynamics to the analysis of biological transport phenomena. Prerequisite: consent of the instructor.

274. Advanced Cell Physiology (3) W
An advanced course in selected areas of cell physiology for bioengineer-

ing, medical, and biology students. Discussion of several special types of cells: endothelium, smooth-muscle cells, lymphocytes, neutrophiles, platelets, macrophages, etc. The ultrastructure and biochemical characteristics of these cell types will be considered. Emphasis will be placed on quantitative measurements and analyses based on mathematical and physical principles. Prerequisite: consent of the instructor. (Not offered 1967–68.)

275. Selected Topics in Bioengineering (3) **W**
The Staff
Discussion of research areas under current investigation in the bioengineering group. Visiting scientists will be invited to cover topics of current interest. Prerequisite: consent of the instructor.

276. Laboratory Projects in Bioengineering (3) **F**
Mr. Intaglietta
Theory of statistical inference, analysis, and design of experiments; data handling by digital computers, video tape recording, etc. Theory and application of optical and electronic instrumentation. The course will consist of lectures, conferences, and demonstrations, as well as the student's own selected laboratory project for study in depth. Prerequisite: consent of the instructor.

294A. Methods in Applied Mechanics (3) **F**
Mr. Pawula
Probability distribution functions; statistical independence; functions of random variables; characteristic functions; correlation functions; time averages; sampling; the central limit theorem; spectral analysis; the Gaussian random process; narrow-band processes, linear systems; random walks, the Fokker-Planck-Kolmogorov equations and Brownian motion. Prerequisites: Mathematics 120-121-122, or consent of the instructor. (Not offered every year.)

294B. Methods in Applied Mechanics (3) **W**
Motion of discrete and continuous conservative systems; boundary-value problems of dynamics; eigenfunctions and eigenvalues; applications of integral transform methods, Green's functions, and calculus of variations. Stability of continuous systems. Prerequisites: Mathematics 120-121-122, or consent of the instructor. (Not offered 1967–68.)

294C. Methods in Applied Mechanics (3) **S**
Continuation of 294B. Diffusion processes and transport phenomena (elliptic and parabolic equations, integral equations). Application of asymptotic expansions and singular perturbation techniques. Prerequisite: AMES 294B, or consent of the instructor. (Not offered 1967–68.)

296. Independent Study (3) **F,W,S**
The Staff

299. Graduate Research (1-6) **F,W,S**
The Staff

ANTHROPOLOGY

A Department of Anthropology is being formed. Courses will be announced as they become available.

APPLIED ELECTROPHYSICS

Office: 7108 Urey Hall

W. Ian Axford, *Ph.D., Professor of Applied Electrophysics*
Henry G. Booker, *Ph.D., Professor of Applied Electrophysics*
(Chairman of the Department)
Kenneth L. Bowles, *Ph.D., Professor of Applied Electrophysics*
(Director of the Computer Center)
Marshall H. Cohen, *Ph.D., Professor of Applied Electrophysics*
Jules A. Fejer, *Ph.D., Professsor of Applied Electrophysics*
Carl W. Helstrom, *Ph.D., Professor of Applied Electrophysics*
Victor H. Rumsey, *D.Eng., Professor of Applied Electrophysics*
Irwin M. Jacobs, *Sc.D., Associate Professor of Applied Electrophysics*
Manuel Rotenberg, *Ph.D., Associate Professor of Applied Electrophysics*
(Assistant Director of the Institution for Radiation Physics and Aerodynamics)
Peter M. Banks, *Ph.D., Assistant Professor of Applied Electrophysics*
George J. Lewak, *Ph.D., Assistant Professor of Applied Electrophysics*
Huey-Lin Luo, *Ph.D., Assistant Professor of Applied Electrophysics*
Robert D. Moore, *Ph.D., Assistant Professor of Applied Electrophysics*

* * *

Gustaf O. S. Arrhenius, *D.Sc., Professor, Scripps Institution of Oceanography*
Seibert Q. Duntley, *Ph.D., Professor, Scripps Institution of Oceanography*
Adolf W. Lohmann, *Ph.D., Senior Lecturer in Applied Electrophysics*
*Joseph B. Earnshaw, *Ph.D., Lecturer in Applied Electrophysics*
†Leo J. Gleeson, *Ph.D., Lecturer in Applied Electrophysics*

*Winter and spring quarters.

†Fall and winter quarters.

The Major Program

The major in Applied Electrophysics is an introductory program designed for students interested in applying physics and mathematics to science and engineering, particularly to the electrical and electronic aspects of science and engineering. Electronic engineering is an area that has undergone and will continue to undergo dramatic changes. Future developments may have little to do with well-established technology, but will certainly be based on well-established laws of physics and mathematics. In order to understand and exploit future technological break-

throughs, students will need adequate training in physics and mathematics. The major in Applied Electrophysics is designed to launch students on an educational program that will equip them to handle new developments as they occur.

The Department plans to provide two options: an applied physics program for students interested primarily in applications of physics, and an information and computer science program for students interested primarily in applications of mathematics. In 1967–68, only the latter will be available.

The recommended schedule below would be typical for a student majoring in Applied Electrophysics with option in Information and Computer Science. It necessitates his taking Math 100 and 101 in the sophomore year and Math 130A in either the sophomore or the junior year. Muir College students intending to major in Applied Electrophysics would take Science 2A-2B-2C-2D-2E in their first two years; Revelle College students would take Natural Sciences 2A-2B-2C-2D-2E.

The Department intends to maintain a flexible curriculum, and a student may, with approval, deviate from the tabulated program. A student majoring in Applied Electrophysics is not required to take more than eighteen upper-division courses in Applied Electrophysics, Physics, and Mathematics.

Major Program in Applied Electrophysics (Recommended Schedule)

	Fall	Winter	Spring
Junior Year	Math 120	Math 121	Math 122
	AEP 101A	AEP 101B	AEP 101C
	AEP 161A	AEP 161B	AEP 161C
	*	*	*
Senior Year	AEP 162A	AEP 162B	AEP 162C
	AEP 164A	AEP 164B	AEP 164C
	**	**	**
	*	*	*

* Spaces marked thus are for Math 130A, for completion of College requirements, including Science 2F, and for electives. The following electives are recommended for consideration: AMES 140A-140B-140C; Economics 120A-120B-120C; Linguistics 101A-101B-101C, 231A-231B-231C; Physics 110A-110B, 130A-130B-130C, 140, 141; Philosophy 110. Graduate courses in Applied Electrophysics may also be selected with special permission.

** Spaces marked thus may be used for mathematics courses. The following are recommended for consideration: Math 110A-110B-110C; Math 141A-141B-141C; Math 126A-126B-126C; Math 130B-130C; Math 144.

Computer Science for Non-Majors

An early introduction to the structure, programming, and general usefulness of the digital computer and to its social, business, and technical implications is provided in AEP 10, a fall-quarter elective, designed for

both humanities and science freshmen.

Upper-division students who desire a more extensive treatment may elect AEP 161A-161B-161C (an introduction to computer science). Prerequisites are purposely kept to a minimum to make this sequence accessible to a wide range of students.

The Graduate Program

The objective of the graduate degree program in the Department of Applied Electrophysics is to exploit electrical and electronic applications of physics and mathematics for the purpose of educating students to the point where they can face novel situations with confidence throughout their lives.

Applications will be considered from students who have taken undergraduate majors in one of the following fields: physics, applied physics, applied electrophysics, mathematics, applied mathematics, engineering physics, engineering science, electrical engineering, computer science. In special circumstances, alternative undergraduate preparation will be considered (e.g., a biology major for a student interested in the application of information and computer science to biological problems). In appropriate cases provision will be made for graduate students to take, without graduate credit, undergraduate courses required to make up deficiencies.

The graduate program in the Department of Applied Electrophysics consists of three main areas:

1. Applied Solid State Physics and Quantum Electronics.

This field includes the study of superconducting, ferroelectric and ferromagnetic materials as possibly related to useful devices. Transistors, masers and lasers, and the propagation of coherent light through solids, liquids, and gases will be studied.

2. Radio Astronomy and Solar System Physics.

This field involves the study of planetary surfaces, atmospheres, ionospheres, and magnetospheres by radio techniques. It includes the study of the solar wind, corona, chromosphere, and photosphere. Galactic and extragalactic radio astronomy will also be studied, but the initial emphasis will be on the solar system. The Department hopes to have available for use, by arrangement, the facilities of several radio astronomical observatories in California and elsewhere. An observatory for studying interplanetary scintillations will soon be under construction in the San Diego area.

3. Information and Computer Science.

Information and computer science is concerned with the processing of data regardless of the discipline from which the data arise. More particularly, information and computer science involves the study of the symbols that constitute the carriers of information and of the relations between them, the study of large switching systems, the study of electronic computers and communication systems, and the study of electromagnetic and quantum signal detection. The program will be concerned with the fundamentals of new aspects of these studies.

Master's and Doctor's Degree Programs

The Department accepts students who wish to study for the M.S. or the Ph.D. degree, but usually recommends financial support only for students who wish to complete studies for the Ph.D. So that a student may be properly advised, he will be given an examination on arrival. In addition to his course work a student will, during the first two years, spend some hours each week in association with a research activity.

For a student entering with a bachelor's degree and interested in information and computer science, a typical first-year program would involve the sequences of courses on information and detection theory (AEP 262A-262B-262C) and on information systems (AEP 264A-264B-264C), together with electives. For electives the following are suggested for consideration: AMES 140A-140B-140C, 253A, 264; AEP 201, 271, 272, 296, 299; Economics 120A-120B-120C; Linguistics 101A-101B-101C, 231A-231B-231C; Mathematics 200A-200B-200C, 210A-210B-210C, 215A-215B, 270A-270B-270C, 280A-280B-280C; Physics 110A, 130A-130B-130C, 140, 141; Philosophy 110; Psychology 220. It is also possible for students to elect courses in library science, biology, neurosciences, and oceanography.

For a student entering with a bachelor's degree and interested in radio astronomy and solar system physics, a typical first-year program would involve Electromagnetic Theory (AEP 201), Physical Optics and Microwaves (AEP 202), Introduction to Plasma Physics (AEP 212), and a sequence of courses on quantum mechanics, together with electives. Electives might be chosen from the following: AMES 210A-210B-210C, 220A-220B-220C, 221A-221B-221C, 222A-222B-222C; AEP 203, 204, 211, 213, 221, 222, 223, 224, 225, 226, 271, 272, 290, 296, 299; Chemistry 200A-200B, 204, 211A-211B; Earth Sciences 200, 201, 233, 240, 241, 242, 244, 245; Mathematics 210A-210B-210C; Oceanography 221, 222A-222B, 223; Physics 200A-200B-200C, 203A-203B, 210A-210B-210C, 212A-212B-212C-212D, 217A-217B-217C, 232A-232B, 235.

No decisions have yet (May, 1967) been made about a graduate program in applied solid state physics and quantum electronics for the academic year 1967–68.

Entering graduate students are expected to have satisfied the equivalent of the undergraduate foreign language requirements in one of the UCSD colleges. Students who have studied a foreign language in college beyond an introductory course, or have learned a foreign language as the result of residence abroad, will normally be excused from further foreign language requirements. Other students will normally be required to take a departmental examination in a foreign language. The examination will be administered by the Department, will last about one hour, and will involve translation of a technical paper.

A student entering without a master's degree should, before he has completed 24 units of work, acquire a faculty research adviser under whom he will write a departmental qualifying thesis. Such a thesis involves at least 6 units of work and should be of the type, quality, and level required for the M.S. degree (Plan I). The thesis should be pre-

sented before the student has completed 54 units of work. The departmental qualifying thesis may be used as a thesis for the M.S. degree, or if not, may be subsequently incorporated in the Ph.D. thesis.

The departmental qualifying thesis will be presented at an oral departmental graduate examination conducted by three faculty members who will also inquire into the student's background knowledge. The examiners may require a written examination in addition to the thesis. If the thesis is to be used as a qualification for the M.S. degree, the three examiners must be appointed by the Vice Chancellor–Graduate Studies and Research.

A student entering with a master's degree should acquire a faculty research adviser during his first quarter of residence. He should present a departmental qualifying thesis at an oral departmental graduate examination to be held before he has completed 27 units of work in the department. A student entering with a master's degree that required a thesis may elect to use that thesis as a departmental qualifying thesis. If he does so, the departmental graduate examination must be held before the end of his first quarter of residence.

The oral qualifying examination for the Ph.D. degree will be given by a doctoral committee appointed by the Graduate Council. In order to be admitted to the oral qualifying examination, a student must have successfully passed the departmental graduate examination and been accepted by a faculty member as a Ph.D. thesis student. At the oral qualifying examination the student will be expected to describe his Ph.D. thesis topic and present preliminary results. A candidate for the Ph.D. is expected to write a dissertation that demonstrates his ability to face and master novel problems and situations in his field. The candidate will defend his dissertation in an oral examination conducted by the doctoral committee. (See *Graduate Division: The Master's Degree; The Ph.D.*)

COURSES

LOWER DIVISION

10. Digital Computers: Their Use and Prospects **F**

Introduction to computers for humanities and science freshmen. Lectures on computer organization and operation; algorithms, flow charts, programming languages. Recitations include FORTRAN programming and two elective three-week seminars on social implications and topics from medicine, librarianship, management, automation, design, music. Two hours lecture, two hours seminar. (This course is intended as a fall-quarter elective for Muir College freshmen.)

UPPER DIVISION

101A-101B-101C. Electromagnetic Theory **F-W-S**

Electrostatics, dielectrics, conductors, magnetostatics, boundary conditions, field energy density; Maxwell's equations, wave equation, transmission lines, plane waves, oblique reflection; radiation from sources, energy flow; applications to optics and microwaves; waves in isotropic plasmas; special relativity. Engineering applications will be emphasized. Four hours lecture. Prerequisites: Mathematics 101; Science 1E or equivalent.

161A-161B-161C. Introduction to Computer Science **F-W-S**
Computer design; implementation of Boolean functions and sequential machines; synthesis of functional modules. Computer/user interface: assemblers; compilers and higher-level languages; symbol-manipulation languages; input/output devices; multiple-user and multiprocessing systems. Applications: information retrieval, process control, artificial intelligence. Three lectures and laboratory. Prerequisite: familiarity with FORTRAN, or consent of the instructor.

162A-162B-162C. Signal Processing **F-W-S**
Elements of linear systems, convolution integrals, exponential transforms, singularity functions; random processes, sampling, correlation functions and spectra; elementary detection of signals in random noise, matched filtering; minimum-mean-square filtering and prediction. Four hours lecture. Prerequisites: Mathematics 122, 130A; or consent of the instructor.

164A-164B-164C. Electronic Circuits and Systems **F-W-S**
Passive circuit elements, circuit analysis, time and frequency domain analysis, control of current flow in solids and in vacuum, solid-state and thermionic active devices, circuit models of active devices, characteristics and design of analog and digital active circuits. Two lectures plus laboratory. Concurrent registration in AEP 162A-162B-162C or consent of the instructor is required.

GRADUATE

201. Electromagnetic Theory (3) **F**
Mr. Lewak
Radiation from relativistic charged particles. Reciprocity and uniqueness theorems associated with Maxwell's equations, and application of Green's function method to radiation problems. Prerequisite: AEP 101A-101B-101C or equivalent.

202. Physical Optics and Microwaves (3) **W**
Mr. Fejer
Foundations of geometrical optics; the eikonal equation; Fermat's principle. Fraunhofer and Fresnel diffraction. Coherence. Prerequisite: AEP 101A-101B-101C or equivalent.

203. Optical Systems (3) **S**
Mr. Duntley
Geometrical, physical, and physiological optics; ultraviolet, visible-light, and infrared optical systems; images; coherence, spatial frequency analysis, modulation transfer functions, spatial filtering, apodization, holography, image reconstruction, resolution, information extraction; lasers, detectors; radiometry, photometry, colorimetry, photographic sensitometry; atmospheric and hydrologic optics; visibility. Prerequisite: consent of the instructor.

204. Antennas (3) **W**
Mr. Rumsey
Fundamentals of antenna theory based on Maxwell's equations; low fre-

quency and high frequency approximations; multimode analysis, periodic structures and arrays; frequency-independent spiral and log-periodic structures; radio astronomy antennas for measurement of brightness distribution and polarization. Prerequisite: AEP 101A-101B-101C or equivalent. (Not offered 1967–68.)

211. Elementary Plasma Waves (3) **W**
Mr. Booker
Linear theory of waves in magnetoplasmas, especially cold magnetoplasmas; propagation at any angle to magnetic field; quasi-longitudinal and quasi-transverse approximations; hydromagnetic, whistler, and radio waves; dispersion and group phenomena; applications to the ionosphere and magnetosphere. Prerequisite: AEP 101A-101B-101C or equivalent.

212. Introduction to Plasma Physics (3) **S**
Mr. Fejer
Charged-particle motions in magnetic field. Fluid description; frozen-field concept. The Vlasov equation. Waves in a plasma. Excitation by a point source. Fluctuations in, and radio wave scattering by, a quiescent plasma. Elements of plasma kinetic theory. Prerequisite: AEP 101A-101B-101C or equivalent.

213. Kinetic Theory of Plasmas (3) **W**
Mr. Lewak
Statistical mechanics of the plasma; the closure problem and closure approximations; collective coordinates; exactly solvable models; weak and strong turbulence; special techniques, generating and probability functionals. Prerequisite: consent of the instructor.

221. Solar Atmosphere and Solar Wind (3) **F**
Mr. Banks, Mr. Axford
The physical structure of the photosphere, chromosphere and corona; solar optical, radio, and particle emissions; the problems of radiative transfer, thermodynamic equilibrium, coronal heating, and the solar wind, with emphasis upon aspects of importance to solar-terrestrial relations. Prerequisite: Physics 130A-130B-130C or equivalent.

222. The Magnetosphere (3) **W**
Mr. Banks, Mr. Axford
A review of current theories and experimental results on the formation of the magnetosphere. Related phenomena concerning plasma shock waves and instabilities, formation and structure of the trapped-particle belts, and charged-particle concentrations and temperature in the exosphere. Prerequisite: Physics 130A-130B-130C or equivalent.

223. The Upper Atmosphere and Ionosphere (3) **S**
Mr. Banks, Mr. Axford
An introduction to the physical processes which determine the structures of the neutral and ionized components of the earth's upper atmosphere. Particle diffusion, heat conduction, chemical aeronomy, charged-particle

reactions. Effect of solar radiations upon atmospheric composition and temperature. Prerequisite: Physics 130A-130B-130C or equivalent.

224. Introduction to Radio and Radar Astronomy (3) **F**
Mr. Cohen
Techniques of observation, limits to measurement. Emission mechanisms, radiative transfer. Active and passive observations of the moon, planets, and sun. Prerequisite: consent of the instructor.

225. Signal Processing in Radar and Radio Astronomy (3) **W**
The measurement of spectrum and correlation functions of observed wave forms; angular spectra; scattering by weak plasma fluctuations; radar signal design; analog and digital processing methods; synthetic antenna apertures and numerical filtering. Prerequisites: AEP 162A-162B-162C, 224, or consent of the instructor. (Not offered 1967–68.)

226. Galactic and Extragalactic Radio Astronomy (3) **S**
Mr. Cohen
A discussion of galactic and extragalactic problems to which radio techniques are applied. Observational characteristics and current theories for the explanation of radio emission from the galaxy, discrete sources and external galaxies; radio continuum and line spectra. Prerequisite: consent of the instructor.

262A-262B-262C. Information and Detection Theory (3-3-3) **F-W-S**
Mr. Helstrom, Mr. Jacobs, Mr. Jacobs
Coding theorem of information theory, digital modulation and coding, some practical coding and decoding systems; source coding; analog modulation systems; detection of signals in non-white noise; estimation of signal parameters; resolution of signals; detection and estimation of random signals. Prerequisite: AEP 162A-162B-162C or equivalent.

264A-264B-264C. Information Systems (3-3-3) **F-W-S**
Mr. Jacobs
Organization of computers and information handling systems, multi-user and multiprocessing; computational models, data structures, algorithms; man-machine interface, assemblers, compilers, interpreters, the conversational mode. Term paper on data processing, information retrieval, heuristic programming, control, translation, computer-aided design or education. Prerequisite: AEP 161A-161B-161C or consent of the instructor. (Not offered 1967–68.)

271. Introduction to Instrument Design (3) **W**
Mr. Moore
Physical limitations to measurement; need for amplification, limitations of amplifiers, definition of noise figure, generalized amplifier noise models. Transducers: evaluation in terms of noise performance, stability, linearity. Absolute versus relative measurements, null methods, frequency and time measurements. Introduction to coherent detection (lock-in amplifiers). Prerequisite: consent of the instructor.

272. Techniques of Instrument Design (3) **S**
Mr. Moore
The designer's dilemma; importance of system approach; the input interface: importance of the physics of the situation, low-noise preamplifier design, tubes versus semiconductors, special methods, use of inverse feedback control. The output interface: digital versus analog, real-time problems. Examples. Prerequisite: AEP 271.

281. Introduction to Automata (3) **W**
Applications of biological strategies to design of automata. Engineering approach: learning machines, adaptive systems, pattern recognition, self-reproducing and self-repairing systems, brain models, automatic language translation. Mathematical approach: neural nets, finite-state machines, Kleene's theorem, Turing machines, computability, Gödel's theorem. Prerequisite: consent of the instructor.

290. Observatory Field Course (1-12) **F,W,S,Su**
The Staff
Methods of measurement, observation, and sampling used at radio, radar, and optical observatories in astronomy and solar system physics; establishment and use of equipment for a current research investigation at an observatory; analysis and interpretation of results with a report. Prerequisite: consent of the instructor.

292. Graduate Seminar in Radio Astronomy and Solar System Physics (1) **F,W,S**
Mr. Axford, Mr. Banks, Mr. Booker, Mr. Bowles, Mr. Cohen, Mr. Fejer, Mr. Lewak
Research topics in radio astronomy and solar system physics.

293. Graduate Seminar in Information and Computer Science (1) **F,W,S**
Mr. Bowles, Mr. Helstrom, Mr. Jacobs, Mr. Moore, Mr. Rotenberg
Research topics in information and computer science.

296. Independent Study (1-6) **F,W,S,Su**
The Staff
Open to properly qualified graduate students who wish to pursue a problem through advanced study under the direction of a member of the staff. Prerequisite: consent of the instructor.

299. Research (1-6) **F,W,S,Su**
The Staff

(Additional graduate courses will be offered in 1967-68 on topics in applied solid state physics and optics.)

BIOLOGY

Office: 2150 Bonner Hall

Warren L. Butler, *Ph.D., Professor of Biology*
Clifford Grobstein, *Ph.D., Professor of Biology*
Dan L. Lindsley, *PhD., Professor of Biology*

Paul D. Saltman, *Ph.D., Professor of Biology* (Provost of Revelle College)
S. Jonathan Singer, *Ph.D., Professor of Biology*
Herbert Stern, *Ph.D., Professor of Biology* (Chairman of the Department)
John A. DeMoss, *Ph.D., Associate Professor of Biology*
Melvin H. Green, *Ph.D., Associate Professor of Biology*
Donald R. Helinski, *Ph.D., Associate Professor of Biology*
Stanley E. Mills, *Ph.D., Associate Professor of Biology*
Silvio S. Varon, *M.D., Associate Professor of Biology*
Stuart Brody, *Ph.D., Assistant Professor of Biology*
Maarten J. Chrispeels, *Ph.D., Assistant Professor of Biology*
Gary L. Freeman, *Ph.D., Assistant Professor of Biology*
Masaki Hayashi, *Ph.D., Assistant Professor of Biology*
Tom D. Humphreys, II, *Ph.D., Assistant Professor of Biology*
William F. Loomis, Jr., *Ph.D., Assistant Professor of Biology*
Thomas F. Roth, *Ph.D., Assistant Professor of Biology*
Herbert M. Schulman, *Ph.D., Assistant Professor of Biology*
Melvin I. Simon, *Ph.D., Assistant Professor of Biology*
Michael Soulé, *Ph.D., Assistant Professor of Biology*

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Theodore H. Bullock, *Ph.D., Professor of Neurosciences*
Susumu Hagiwara, *M.D., Professor of Physiology*
Renato Dulbecco, *Ph.D., Professor in Residence in Biology*
Melvin Cohn, *Ph.D., Professor in Residence in Biology*
Frank J. Dixon, *M.D., Professor in Residence in Biology*
Frank M. Huennekens, *M.D., Professor in Residence in Biology*
Edwin Lennox, *Ph.D., Professor in Residence in Biology*
John Spizizen, *Ph.D., Professor in Residence in Biology*
William O. Weigle, *Ph.D., Research Associate*
Yasuo Hotta, *Ph.D., Associate Research Biologist*

The Major Program

The undergraduate program leading to a Bachelor of Arts in biology reflects the need to integrate the whole of the biological world, and to understand it in terms of the common principles which control living things. The program reflects the striking advances made in biology in recent years and the prospects of revolutionary developments in the future. It emphasizes the basic mechanisms which help to correlate into an integrated whole the enormous diversity of living things.

To aid the student in understanding contemporary biology as a whole, regardless of his chosen field of specialization, a core program is offered. All majors in biology, whether they go on to graduate study (implies all fields of biology and fields of specialization), medicine, teaching or agriculture, take the same basic sequence of courses. The sequence begins in the sophomore year—after an introduction to physics, chemistry, and mathematics—with a general consideration of the nature of the living world and its special characteristics and problems as viewed particularly

from the cellular level. There follows a two-year program in which living phenomena are examined at their various levels of complexity—molecular, cellular, organismal, and populational. Beyond this, certain advanced and graduate courses in biology and such allied fields as physics and chemistry are available for election by the qualified student in his senior year.

Biology majors are required to take the courses listed in the recommended schedule for the upper-division years. They are not required to take the laboratory part of Chemistry 140B. In addition to the courses listed, students must elect two other courses in consultation with their adviser in order to complete the requirements for the Biology major.

Noncontiguous Minor in Biology (Revelle College)

Students majoring in a field outside the natural sciences may complete a noncontiguous minor in biology by taking some such combination as: Biology 101A-101B-101C, 113, 121 and 199. Additional upper-division biology courses will be available, and any six biology courses will complete the minor.

Major Program in Biology (Recommended Schedule)

	Fall	Winter	Spring
Junior Year	Biology 101A Chemistry 100A Chemistry 140A	Biology 101B Chemistry 100B Chemistry 140B	Biology 101C Biology 102
Senior Year	Biology 111A	Biology 111B Biology 112	Biology 113

The Graduate Program

Graduate studies for a Ph.D. degree in the Department of Biology (no master's degree is offered) are oriented mainly to the development of the capacity for independent, imaginative and self-critical research.

There are no inflexible requirements for entrance to graduate study in the Department of Biology, but it is recommended that the student's undergraduate preparation include at least a year of calculus, elementary organic chemistry, and elementary physical chemistry.

Doctor's Degree Program

During his first two years, the student may take any of the formal courses listed in the Biology and Chemistry Departments, or other departments of the University. Although no formal course requirements exist, a program of study will be arranged through consultation with the faculty, according to the background and interests of the individual student. In the first year, students will participate in a laboratory rotation program in which independent research projects are carried out by each student in

various faculty members' laboratories. Much reliance is placed on informal instruction through early and close association of the student with the faculty and research staff, and through regular seminars. After becoming familiar with the research activities of the faculty through the laboratory rotation program, the student will begin work on a thesis research problem of his choice, no later than the end of the first year. At the end of the second year, the student will be required to take a two-part oral examination in order to be admitted to candidacy for the Ph.D. degree. The purpose of these examinations is to have the student demonstrate competence in the field of his major interest and in related fields of biology. The major remaining requirement for the Ph.D. degree will be the satisfactory completion of a dissertation consisting of original research carried out under the guidance of a faculty member. (See *Graduate Division: The Ph.D.*)

Close collaboration with several members of the Departments of Chemistry and Physics is a vital and stimulating aspect of the biology program. Russell F. Doolittle, Martin D. Kamen, Stanley L. Miller, T. G. Traylor and Bruno H. Zimm share many interests with the staff of the Department of Biology, and their physical proximity is a unique feature of this graduate school. Additional strength and breadth in biology is gained by collaboration with the Department of Marine Biology of the Scripps Institution of Oceanography, with the Scripps Clinic and Research Foundation, and with the Salk Institute for Biological Studies. Students may carry out their dissertation research in collaboration with members of these groups.

COURSES

LOWER DIVISION

The Department of Biology cooperates in the teaching and administration of the Natural Sciences sequences for Revelle College students. (See *Interdisciplinary Courses: Natural Sciences.*)

1, 2. Nature of Biology
(Now incorporated in the Natural Sciences sequences. See *Interdisciplinary Courses: Natural Sciences.*)

UPPER DIVISION

101A. Heredity **F**
A study of heredity in organisms. Mitosis, meiosis, Mendelian genetics, cytogenetics and extra-chromosomal heredity will be discussed in relation to the life cycles of certain selected organisms. Three hours lecture and four hours laboratory-recitation.

101B. Developmental Physiology **W**
The development of organisms in relation to their functions and behavior, including the origins of multicellularity, cell-cell interactions, tissue interactions, fields and gradients, hormonal integration, neural integration and regeneration. Three hours lecture and two hours recitation.

101C. Metabolism and Biochemistry **S**
The metabolism of organisms with respect to energetics, biosynthesis and nutrition. Three hours lecture and two hours recitation. Prerequisites: Chemistry 140A-140B.

102. Biochemical Techniques **S**
A laboratory-lecture course in the application of biochemical methods to biological problems. Eight hours laboratory, one hour lecture and one hour recitation. Prerequisite: Biology 101C (may be taken concurrently).

111A. Molecular Biology **F**
Molecular analyses of biological phenomena with special emphasis on genetics and metabolic regulation. Three hours lecture, two hours recitation. Prerequisites: Biology 101C, Chemistry 100A-100B.

111B. Cell Biology **W**
The structural and functional organization of cells, the control of their proliferation and differentiation. Three hours lecture, two hours recitation. Prerequisite: Biology 111A.

112. Techniques in Cell Biology **W**
A laboratory-lecture course in methods of studying cell organization and behavior. Eight hours laboratory, one hour lecture, one hour recitation. Prerequisite: Biology 111A (may be taken concurrently).

113. Population Biology and Evolution **S**
The behavior and flux within groups of organisms, particularly in relation to ecology and evolution. Three hours lecture, two hours recitation. Prerequisites: Biology 101A-101B.

121. Introduction to the Nervous System **F**
Survey of anatomy and physiology of invertebrate and vertebrate nervous integration; methods of study and modern developments in the system aspects of neural function. Three hours lecture. Prerequisite: general biology or general psychology.

123. Analysis of Development **S**
A study of the fundamental problems in developmental biology. Three hours lecture. Prerequisite: Biology 111B.

190. Current Issues in Biology **W**
A special course of invited lectures by prominent biologists to familiarize students with some of the contemporary problems in biology. Two hours lecture. Prerequisite: senior standing in the major program and consent of the instructor.

199. Independent Study for Undergraduates **F,W,S**
Independent reading or research on a problem by special arrangement with a faculty member. Prerequisite: consent of the instructor.

GRADUATE

203A-203B-203C. Laboratory Projects in Biology (3-3-3) **F-W-S**
The Staff
An introduction to contemporary laboratory techniques and research interests through independent, original projects under the direction of individual faculty members. Prerequisite: consent of the instructor.

210. Seminar in Biochemistry (1) **F,W,S**
The Staff
Seminars presented by graduate students which will explore topics in specialized areas of biochemistry and provide opportunities for students to gain experience on the organization, critical evaluation, and oral presentation of information for the literature. Same as Chemistry 210. Prerequisite: consent of the instructor.

211. Biochemical Mechanisms of Energy Storage and Conversion (3) **F**
Mr. Kamen, Mr. Butler
Thermodynamic and kinetic analysis of energy transformation in biochemical processes basic to catabolism, photosynthesis, respiration and fermentation. Same as Chemistry 211. Prerequisite: elementary physical chemistry.

212. Biosynthetic Mechanisms (3) **W**
Mr. DeMoss, Mr. Mills
A discussion of the pathways and mechanisms involved in the biosynthesis of cell components and their integration into the intermediary metabolism of the cell. Same as Chemistry 212. Prerequisite: elementary biochemistry.

213. Chemistry of Macromolecules (3) **S**
Mr. Singer, Mr. Zimm
A quantitative discussion of the structure of biologically important macromolecules and the techniques used in their study. Same as Chemistry 213. Prerequisite: elementary physical chemistry.

220. Seminar in Genetics (1) **F,W,S**
The Staff
Seminars presented by graduate students which will explore topics in specialized areas of genetics and provide opportunities for students to gain experience in the organization, critical evaluation and oral presentation of information for the literature. Prerequisite: consent of the instructor.

221. Genetics (3) **W**
Mr. Lindsley, Mr. Stern
A review of the principles of transmission genetics, cytogenetics and chromosome structure. Discussion of current problems in these areas. (Not offered 1968.) Prerequisites: Biology 101A; Biology 111B or equivalent.

222. Microbial Genetics (3) **S**
Mr. Green, Mr. Helinski
Description of bacterial and viral genetic systems, including the nature of the processes involved in gene duplication, recombination of lysogeny. Prerequisites: Biology 101A; Biology 111A or equivalent.

223. Molecular Genetics (3) **F**
Mr. Hayashi, Mr. Simon
Discussion of the molecular mechanisms involved in the transcription, translation and integration of genetic information. Prerequisites: Biology 101A; Biology 111A or equivalent.

230. Seminar in Developmental Biology (1) **F,W,S**
The Staff
Seminars presented by graduate students which will explore topics in specialized areas of developmental biology and provide opportunities for students to gain experience on the organization, critical evaluation and oral presentation of information for the literature. Prerequisite: consent of the instructor.

231. Regulation in Higher Organisms (3) **F**
Mr. Schulman, Mr. Loomis
A discussion of the molecular basis of control mechanisms in the function of specialized tissues of higher organisms. Prerequisite: Biology 123 or equivalent.

232. Cellular Aspects of Development (3) **W**
Mr. Humphreys, Mr. Stern
The behavior of cells in developing systems with special emphasis on mechanisms of regulation at the subcellular and molecular level. Prerequisite: Biology 123 or equivalent.

233. Morphogenesis and Tissue Interactions (3) **S**
The Staff
Nature and significance of formative processes in relation to cytodifferentiation, with particular emphasis on cell-cell and tissue-tissue interactions and their mechanisms. Prerequisites: Biology 101A; Biology 101B or equivalent.

290. Special Topics in Biology (2)
The Staff
A course to be given at the discretion of the faculty in which integrative or interdisciplinary topics of biological interest will be presented by visiting or resident faculty members.

299. Research in Biology (1-6) **F,W,S**
The Staff

CHEMISTRY

Office: 4422 Physics-Chemistry Building

James R. Arnold, *Ph.D., Professor of Chemistry*
Martin D. Kamen, *Ph.D., Professor of Biochemistry*
Joseph Kraut, *Ph.D., Professor of Chemistry*
Joseph E. Mayer, *Ph.D., Professor of Chemistry*
G. N. Schrauzer, *Ph.D., Professor of Chemistry*
Hans E. Suess, *Ph.D., Professor of Geochemistry*
Harold C. Urey, *Ph.D., Professor-at-Large, Department of Chemistry*
Frederick T. Wall, *Ph.D., Professor of Chemistry*
Bruno H. Zimm, *Ph.D., Professor of Chemistry* (Chairman of the Department)
Stanley L. Miller, *Ph.D., Associate Professor of Chemistry*
Teddy G. Traylor, *Ph.D., Associate Professor of Chemistry*
Alan J. Bearden, *Ph.D., Assistant Professor of Chemistry*
F. Thomas Bond, *Ph.D., Assistant Professor of Chemistry*
Leigh B. Clark, *Ph.D., Assistant Professor of Chemistry*
Russell F. Doolittle, *Ph.D., Assistant Professor of Biochemistry*
Robert C. Fahey, *Ph.D., Assistant Professor of Chemistry*
Robert G. Linck, *Ph.D., Assistant Professor of Chemistry*
Charles L. Perrin, *Ph.D., Assistant Professor of Chemistry*
Robert L. Vold, *Ph.D., Assistant Professor of Chemistry*
Joseph W. Watson, *Ph.D., Assistant Professor of Chemistry*
Kent Wilson, *Ph.D., Assistant Professor of Chemistry*

* * *

Leslie Orgel, *Ph.D., Professor in Residence, Department of Chemistry*
Linus Pauling, *Ph.D., Professor in Residence, Department of Chemistry*
Kurt E. Shuler, *Ph.D., Professor in Residence, Department of Chemistry*
Robert Bartsch, *Ph.D., Associate Research Chemist*
Karl Dus, *Ph.D., Associate Research Chemist*
Bartholomew Nagy, *Ph.D., Associate Research Chemist*

The Undergraduate Program

The undergraduate major in chemistry is intended to enable a student to pursue further studies in chemistry or in related fields of science, engineering, or medicine. The program combines a thorough preparation in the fundamentals of chemistry and related fields with an opportunity for more advanced work in particular areas of chemistry.

The student who is considering a chemistry major in Revelle College is strongly advised to take Natural Science 2DL and 2FL. It is desirable also that the student complete Mathematics 100 or its equivalent before the junior year, but the student may take this course in the first or second quarter of that year.

Transfer students should note that in the first two years of the Revelle College curriculum students take calculus and physics, and that the sophomore chemistry course is concerned with thermodynamics and quantum

theory; organic chemistry is deferred until the junior year. Transfer students should have had a laboratory course equivalent to Natural Science 2DL or 2FL, usually approximated by quantitative analysis.

The departmental course requirements for the Bachelor of Arts degree in chemistry are: Chemistry 100A-100B-100C; Chemistry 120A-120B; Chemistry 140A-140B-140C; five additional upper-division or graduate courses, designated with an asterisk in the schedule below, in chemistry or related fields. The minimum passing grade in these courses is D and a minimum of a C average in the major is required for the degree. Exceptions to these requirements may be made, with written permission of the Department Chairman, for students who wish to pursue programs oriented toward biochemistry, geochemistry or chemical physics. Opportunities for independent work and for research are available to qualified students through enrolment in Chemistry 199.

Major Program in Chemistry (Recommended Schedule)

	Fall	Winter	Spring
Junior Year	Chemistry 100A Chemistry 140A	Chemistry 100B Chemistry 140B	Chemistry 100C †Chemistry 120A Chemistry 140C
Senior Year	* †Chemistry 120B	* *	* *

*Upper-division course in chemistry or related field.
†120A may be offered in the winter quarter and 120B in the spring quarter.

The Graduate Program

The Department accepts students for study toward the M.S. or the Ph.D. The Department usually recommends financial support only for students who are seeking the Ph.D. The doctoral program is designed to encourage initiative on the part of the student and to develop habits of independent study. Advanced courses in the Department are handled in part by the tutorial system. Students with normal preparation start research early. The qualifying examination for admission to candidacy will require the student to present and discuss propositions that he has prepared independently.

In order that he may participate effectively in this program, the entering graduate student will be required to have a mastery of the subjects usually presented in an undergraduate chemistry curriculum: physical, organic, and inorganic (descriptive) chemistry. So that the student may be properly advised, his mastery of these undergraduate subjects will be tested by examination on his arrival. Physical chemists will be expected

to present the equivalent of two years of physics, and mathematics at least through integral calculus. The appropriate background courses in biology or geology are highly desirable for students interested in biochemistry and geochemistry, respectively, but will sometimes be taken after arrival.

In the first year the student will usually take several of the courses listed below. Depending on his special interests, he may also take one or more courses in other departments. In the second year he will usually carry a very light load of formal courses, but will continue to participate in seminars and informal study groups. A reading knowledge of two foreign languages is required for the Ph.D.

The qualifying examination, as far as departmental requirements are concerned, will be conducted as follows:

The candidate will present a major and minor proposition. The major proposition should consist of a statement of an original research problem or scientific idea not closely connected with his doctoral thesis. He should be prepared to discuss in the examination the theory and the experimental techniques that may be involved, the significance of the proposition, and its relation to previous knowledge.

The minor proposition may be similar to the major one, or it may consist of a critical survey of literature in some field of chemistry outside the field of his main interest. The purpose of this prescription is to reveal the ability of the candidate to make a critical survey and an effective, orderly presentation, and also to provide him with a further incentive to broaden his understanding of chemistry.

In special circumstances the doctoral committee may modify the examination at its discretion. For University requirements, see *Graduate Division: The Master's Degree; The Ph.D.*

The Department requires teaching experience for the Ph.D. This requirement is usually met by assisting in the teaching of undergraduate courses for a few quarters during the student's residency.

The interdisciplinary tradition is strong on the San Diego campus. The biochemistry faculty and student body have close ties with the Department of Biology, with many research facilities in common.

Several members of the chemistry faculty are interested in the earth sciences. The ties with oceanography, through marine chemistry and tracer studies of ocean circulation and sedimentation, are also strong. The facilities of the Scripps Institution for marine research are available to all qualified persons at UCSD. A high-speed computer is available for use by graduate students.

Joint Doctoral Program with San Diego State College

The Department of Chemistry at UCSD cooperates with the Department of Chemistry in the Division of the Physical Sciences, San Diego State College, in offering a joint program of graduate study leading to the Ph.D. degree in chemistry.

An applicant for admission to the joint doctoral program must first

be admitted to regular graduate standing in the Graduate Division of the University of California, San Diego, and to classified graduate standing in the Graduate Division of San Diego State College. In seeking admission to the two Graduate Divisions, the applicant must pay all fees required by each institution and comply with the admission procedures stated in this catalog and in the current edition of the Bulletin of the Graduate Division of San Diego State College, where the program is more fully described.

COURSES

LOWER DIVISION

The Department of Chemistry cooperates in the teaching and administration of the Natural Sciences sequences for Revelle College students. (See *Interdisciplinary Courses: Natural Sciences.*)

1A-1B. Elementary Chemistry
(Now incorporated in the Natural Sciences sequences. See *Interdisciplinary Courses: Natural Sciences.*)

UPPER DIVISION

100A. Physical Chemistry **F**
Nuclear chemistry; atomic structure; quantum theory of atoms and molecules; molecular structure and molecular spectroscopy; macroscopic properties of molecules; behavior of ideal and real gases. Three lectures, one hour discussion, two hours computer laboratory. Prerequisites: Natural Science 2D (formerly Physical Science 2D), Mathematics 2C, or consent of the instructor. At the level of *Physical Chemistry*, W. J. Moore, Prentice-Hall (3d edition).

100B. Physical Chemistry (Lecture and Laboratory) **W**
Statistical mechanics; thermodynamics; properties of liquids; properties of solutions; electrochemistry; physical biochemistry. Three lectures, one hour discussion, six hours laboratory. Prerequisites: Natural Science 2FL (formerly Physical Science 2EL), Chemistry 100A, or consent of the instructor. At the level of *Physical Chemistry*, W. J. Moore, Prentice-Hall (3d edition).

100C. Physical Chemistry (Lecture and Laboratory) **S**
Solid state chemistry; interfaces; chemical kinetics; photochemistry; cosmochemistry; resonance techniques in physical chemistry; special topics in modern physical chemistry. Three lectures, six hours laboratory. Prerequisites: Chemistry 100B, Mathematics 100, or consent of the instructor.

120A-120B. Inorganic Chemistry **S-F**
The chemistry of the elements of the periodic table is presented in terms of unifying concepts. The structure of atoms, the influence of atomic properties on the structure of compounds, synthesis of compounds, and the kinetics and mechanisms of chemical reactions are discussed. Thermo-

dynamic aspects of inorganic chemistry and spectral and magnetic properties of compounds are treated. Other topics include: solids, ions in solution, complex ions, solution structure, organometallic compounds. Three lectures, one recitation. Prerequisites: Chemistry 100A and Chemistry 140A, or consent of the instructor.

140A-140B-140C. Organic Chemistry **F-W-S**

Lecture and laboratory work for students majoring in chemistry and related fields such as biology. The lectures will be concerned with (1) structure and properties of covalent molecules, (2) classification of reactions of first-row elements, and (3) reactions of organic compounds, with an introduction to biochemistry. The laboratory will involve (1) separation and purification methods and measurements of physical properties, (2) organic syntheses and product analyses, and (3) advanced synthetic methods and kinetic studies. Must be taken in sequence. Three lectures, one hour discussion, two three-hour laboratories. Prerequisite: Natural Science 2FL (formerly Physical Science 2EL). At the level of *Organic Chemistry*, J. D. Roberts and M. C. Caserio, Benjamin (1964).

141A-141B-141C. Organic Chemistry **F-W-S**

This sequence is Chemistry 140A-140B-140C without laboratory. Students will attend 140A-140B-140C lectures and instead of laboratory work will meet in two one-hour recitations per week and carry out special outside projects. This course is not acceptable as a requirement for chemistry majors. Prerequisite: the equivalent of Natural Science 2F or 2FL (formerly Physical Science 2E, 2EL).

146. Qualitative Organic Analysis **W**

The analytical methods and laboratory procedures used in the identification of organic compounds will be discussed and illustrated in laboratory experiments. Techniques to be covered include: application of class reactions, derivative preparation, vapor phase chromatography, infrared and ultraviolet spectroscopy, and nuclear magnetic resonance spectroscopy. The student will apply these techniques to the identification of unknown samples and mixtures. One lecture, two three-hour laboratories. Prerequisite: Chemistry 140C.

147. Synthetic Organic Chemistry **S**

Advanced methods of organic synthesis will be discussed in lecture and illustrated in laboratory experiments. Students will be introduced to the techniques of catalytic hydrogenation, organo-metallic reactions, photochemical reactions, fractional distillation, chromatography, and other modern synthetic procedures. In the latter part of the course, original projects will be assigned on an individual basis. One lecture, two three-hour laboratories. Prerequisite: Chemistry 140C.

160. General Biochemistry **F,S**

This course will be the same as Biology 111A in the fall quarter 1967 only, and the same as Biology 101C in the spring quarter 1968. For descriptions, see *Departments of Instruction: Biology.*

161. General Biochemistry
Continuation of 160. (Not offered 1967–68.)

190. Mathematical Methods of Chemistry **F**
Calculus, special functions, differential equations; probability and statistics; vectors, matrices and determinants; applications of computers; linear algebra. Three lectures. Prerequisites: Chemistry 100C, Mathematics 100.

195. Chemistry Instruction **W**
Introduction to the teaching of elementary college chemistry. Each student will be responsible for and teach a class section of one of the lower-division chemistry courses. Limited to senior chemistry majors who have maintained a B average or better in their major course work. One meeting per week with instructor, one meeting per week with assigned class section, and attendance at lecture of the lower-division course in which they are participating. Prerequisites: Chemistry 100C, 140C; advanced standing, consent of the instructor.

199. Senior Reading and Research **F,W,S**

GRADUATE

Graduate students may take upper-division courses and be assigned 4 units of credit. In Chemistry 100B and 100C the credit will be reduced to 3 units if the student does not participate in the laboratory.

200A-200B. Molecular Quantum Mechanics (4-4) **W-S**
Mr. Clark
The fundamental concepts and techniques of quantum mechanics which are necessary for the treatment of problems of chemical interest are developed and applied.

202A-202B. Classical and Statistical Thermodynamics (3-3) **F-W**
The Staff
Thermodynamics of chemical systems; first, second and third laws; chemical equilibria; solutions; non-ideal gases; statistical theory; derivation of thermodynamic quantities through partition functions.

203. Molecular Spectroscopy (4) **S**
Mr. Clark, Mr. Vold, Mr. Wilson
The interaction of electromagnetic radiation with molecules will be treated both theoretically and experimentally. Topics to be covered include rotational, vibrational and electronic spectroscopy, electron spin resonance, nuclear magnetic resonance, and structural determination by x-ray diffraction. Prerequisite: Chemistry 200A, 200B, or equivalent. (Not offered 1967–68.)

204. Statistical Mechanics of Chemical Systems (4) **F**
Mr. Mayer
Fundamental derivation of equilibrium statistical mechanics and its use in chemical problems.

209. Special Topics in Physical Chemistry (1-3) **F,W,S**
The Staff
Topics of special interest will be presented by visiting or regular staff members.

210. Seminar in Biochemistry (1) **F,W,S**
The Staff
Seminars presented by graduate students which will explore topics in specialized areas of biochemistry and provide opportunities for students to gain experience on the organization, critical evaluation, and oral presentation of information from the literature. Same as Biology 210. Prerequisite: consent of the instructor.

211. Biochemical Mechanisms of Energy Storage and Conversion (3) **F**
Mr. Kamen, Mr. Butler
Thermodynamic and kinetic analysis of energy transformation in biochemical processes basic to catabolism, photosynthesis, respiration and fermentation. Same as Biology 211. Prerequisite: elementary physical chemistry.

212. Biosynthetic Mechanisms (3) **W**
Mr. DeMoss, Mr. Mills
A discussion of the pathways and mechanisms involved in the biosynthesis of cell components and their integration into the intermediary metabolism of the cell. Same as Biology 212. Prerequisite: elementary biochemistry.

213. Chemistry of Macromolecules (3) **S**
Mr. Singer, Mr. Zimm
A quantitative discussion of the structure of biologically important macromolecules and the techniques used in their study. Same as Biology 213. Prerequisite: elementary physical chemistry.

220. Advanced Inorganic Chemistry (3) **W**
Mr. Schrauzer
Introduction to theoretical inorganic chemistry. Chemistry of typical main group and transition elements; coordination compounds; organo-metallic chemistry; experimental techniques.

229. Special Topics in Inorganic Chemistry (1-3) **F,W,S**
The Staff
Topics of current interest will be presented by visiting or regular staff members.

245. Structure and Properties of Organic Molecules (3) **F**
Mr. Traylor
Introduction to the measurement and theoretical correlation of the physical properties of organic molecules. Topics to be covered include simple molecular orbital theory, bond lengths, bond energies, dipole moments, ionization potentials, infrared and ultraviolet spectra, nuclear magnetic resonance and electron spin resonance.

246. Kinetics and Mechanism of Organic Reactions (3) **W**
Mr. Watson
Methodology of mechanistic organic chemistry: integration of rate expressions, determination of rate constants, transition state theory; catalysis, kinetic orders; isotope effects, substituent effects, solvent effects; linear free energy relationships; product studies, stereochemistry; reactive intermediates; rapid reactions.

247. Mechanisms of Organic Reactions (3) **S**
Mr. Traylor
A detailed study of the mechanisms of various organic reactions; carbonium ion reactions (substitutions, displacements, eliminations, additions, hydrolyses); carbanion reactions (eliminations, substitutions, hydrolyses, condensations); carbene reactions; rearrangements; multicenter reactions; free radical processes. The topics emphasized will vary from year to year.

249. Special Topics in Organic Chemistry (1-3) **F,W,S**
The Staff
Topics of special interest will be presented by visiting or regular staff members.

250. Seminar in Chemistry (1) **F,S**
The Staff
Regularly scheduled seminars by graduate students provide opportunities for practice in seminar delivery and for the exploration of topics of general interest. These seminars are also used to acquaint students with subjects too specialized for general courses.

269. Special Topics in Biochemistry (1-3) **F,W,S**
The Staff
Topics of special interest will be presented by visiting or regular staff members.

299. Research in Chemistry (1-12) **F,W,S**

CONTEMPORARY ISSUES

See *Interdisciplinary Courses.*

DRAMA

Office: Building 251, Matthews Campus (Provost, Muir College)

Michael Langham, *D.Litt., LL.D., Professor of Drama* (Head of Program)

A program of courses in the drama is being developed. The three-course sequence described below will be offered in 1968–69 for students electing to study drama as a means of fulfilling the Humanities and Fine Arts requirement of Muir College. Other drama courses will also be offered.

Though some of these will include technical study of stagecraft, drama will be studied as one of the liberal arts. Students will be encouraged to participate in presenting plays as a rewarding extracurricular activity, and the facilities of the drama program will, as far as possible, be made available to drama groups. Students who aspire to a professional career in drama are urged to take a general undergraduate program with emphasis on liberal education and to defer until after graduation intensive concentration on drama. The theatre being built by the University and the Theatre Arts Foundation of San Diego is scheduled to open in 1969 on a site just south of UCSD campus, and will probably offer opportunities for advanced technical training during the summer and after graduation.

COURSES

LOWER DIVISION

1A-1B-1C. The Nature of Drama **F-W-S**

A sequence of integrated courses on the fundamentals of drama. Study of the physical aspects of the theatre and dramatic action, and how they shape dramatic content; literary study of dramatic texts within a historical and critical orientation. Must be taken in sequence. (This sequence may be used in fulfilling the Muir College Humanities and Fine Arts requirement. Muir College students have priority.) Not offered 1967–68.

EARTH SCIENCES

Office: 1166 Ritter Hall

Gustaf O. S. Arrhenius, *D.Sc., Professor of Marine Geology*
George E. Backus, *Ph.D., Professor of Geophysics*
*Edward C. Bullard, *Sc.D., F.R.S., Professor of Geophysics*
Harmon Craig, *Ph.D., Professor of Geochemistry* (Chairman of the Department)
Albert E. J. Engel, *Ph.D., Professor of Geology*
Freeman Gilbert, *Ph.D., Professor of Geophysics*
Edward D. Goldberg, *Ph.D., Professor of Chemistry*
**Devendra Lal, *Ph.D., Professor of Nuclear Geophysics*
Henry W. Menard, *Ph.D., Professor of Geology*
Walter H. Munk, *Ph.D., Professor of Geophysics*
Russell W. Raitt, *Ph.D., Professor of Geophysics*
Victor Vacquier, *M.A., Professor of Earth Sciences*
Richard A. Haubrich, *Ph.D., Associate Professor of Geophysics*
Manuel Bass, *Ph.D., Assistant Professor of Geology*
James W. Hawkins, *Ph.D., Assistant Professor of Geology*

* * *

Stanley R. Hart, *Ph.D., Visiting Associate Professor of Geology*
James R. Arnold, *Ph.D., Professor of Chemistry*
Hans E. Suess, *Ph.D., Professor of Geochemistry*
Harold C. Urey, *Ph.D., Professor of Chemistry at Large*

*In residence summer quarters only.
**In residence one quarter each year.

On June 1, 1967, the Departments of Earth Sciences, Marine Biology, and Oceanography were combined into the single Department of the Scripps Institution. Admission and curricular requirements, and courses to be offered are expected to remain essentially unchanged for the academic year 1967–68.

The Undergraduate Program

The undergraduate curriculum in earth sciences is principally designed to prepare students for advanced study and research by providing: (1) a strong background in mathematics, physics, and chemistry; (2) a basic knowledge of earth sciences; and (3) an introduction to important areas of present research in the earth and planetary sciences. Prospective majors must have fulfilled their general lower-division college requirements or the equivalent (Revelle students are advised to take the Natural Science 2 sequence). Students are also advised to take Mathematics 100 or the equivalent during the sophomore year—otherwise this course must be taken in the first quarter of the junior year. In addition to Mathematics 100, majors are required to take a total of at least fifteen upper-division courses in the physical and earth sciences and mathematics. Chemistry 100A-100B-100C (physical chemistry), Mathematics 101, at least two additional upper-division elective courses in mathematics, physics, or chemistry, and Earth Sciences 101, 102, 103, and 150 must be included. (Students who wish to concentrate in geophysics may petition the chairman for permission to substitute physics or mathematics courses for the physical chemistry sequence.)

With the exception of these requirements, every effort is made to adjust the curriculum to the student's individual interests, insofar as they are consistent with broad preparation for advanced study. Thus one student may wish to concentrate his studies in mathematics, another in chemistry. Mathematics-science electives may be additional courses in Mathematics, Physics, and Chemistry, or in such departments as Oceanography and Engineering. Seniors may also elect 200-level courses (graduate) with approval of their adviser, the course instructors, and the Vice Chancellor-Graduate Studies and Research.

Occasionally, opportunities arise for students to participate in long-range marine expeditions with members of the Department who are associated with Scripps Institution of Oceanography or the Institute of Geophysics and Planetary Physics. Students actively assist in collecting and analyzing data related to research interests of the staff. Majors may petition the Department to participate in such expeditions; permission is granted on the basis of academic standing and interest.

Major Program in Earth Sciences (Recommended Schedule)

	Fall	Winter	Spring
	Earth Sciences 101	Earth Sciences 102	Earth Sciences 103
Junior	Chemistry 100A	Earth Sciences 120	Earth Sciences 121
Year	*Restricted Elective	Chemistry 100B	Chemistry 100C

	Earth Sciences 122	*Restricted Elective	Earth Sciences 150
Senior Year	*Restricted Elective	*Restricted Elective	*Restricted Elective

*Science or Mathematics

The Graduate Program

The Department of Earth Sciences offers a graduate curriculum leading to the M.S. and the Ph.D. in earth sciences. Two general curricula are offered: geology-geochemistry and geophysics. The programs of study emphasize the application of the analytical, experimental, and theoretical methods of physics and chemistry to fundamental problems in the terrestrial, marine, atmospheric, and planetary sciences.

Geology-Geochemistry Curriculum. A baccalaureate major in one of the physical or earth sciences, mathematics, or engineering is required. The student's preparation should include:

1. Two years of college physics. Physics courses designed specifically for students of medicine, biology, or agriculture will normally not be acceptable for this requirement.
2. Two years of chemistry, including physical chemistry (advanced physics may be substituted for one year of chemistry).
3. Mathematics courses in integral calculus and differential equations.

Geophysics Curriculum. Normally, a bachelor's degree in physics or mathematics will be necessary for admission. The student's preparation should also include introductory courses in geology.

The Department attempts to keep the program flexible and recognizes that many students will have deficiencies. Provisions will be made to allow graduate students to make up deficiencies by taking undergraduate courses.

Master's Degree Program

The Master of Science degree will be offered under Plan II (comprehensive examination). (See *Graduate Division: The Master's Degree.*) All programs must include the basic curriculum of courses described under the doctoral program. A reading knowledge of either French, German, or Russian is required.

Doctor's Degree Program

Students will normally concentrate their work in one of two basic curricula: Geology-Geochemistry or Geophysics.

Geology and geochemistry students will be responsible for the material included in the following courses: Earth Sciences 122, 150, 200, 201, 219, 224, 246A-246B, 250, Oceanography 110, Mathematics 100 and 101, and either Physics 140 or Chemistry 202A-202B. (Students found to be deficient in physical chemistry will be required to take Chemistry 100A-100B-100C as a prerequisite.) These courses constitute the basic curriculum in preparation for the qualifying examination.

Geophysics students will be responsible for the material included in the following courses: Earth Sciences 150, 240 through 247, 250, and two courses chosen from Earth Sciences 200, 201, 212, 219, 224, 226.

Near the end of the second year in residence, a student in either curriculum will normally have completed his basic course work and preparation for the qualifying examination. Before taking the qualifying examination he must pass reading examinations in two foreign languages (normally chosen from German, French, Russian), or a reading and speaking examination in one of these languages.

The qualifying examination for the Ph.D. will concentrate on the student's ability to integrate the material covered in his course work with his knowledge of the basic physical sciences for the analysis of general problems in the earth sciences. A written examination may be administered by the Department in some instances; in all cases an oral examination will be conducted by the student's doctoral committee. The oral examination will be based on the presentation and defense of propositions prepared independently and submitted by the student.

When the student is ready for the qualifying examination he will submit to his adviser two or three propositions, at least one of which must be outside of his major field. The propositions will be statements or conjectures concerning research problems in the earth sciences or allied problems in other fields. Upon acceptance of the propositions by the Department, the doctoral committee will conduct the examination, in which the student will be expected to discuss the significance of the propositions and the experimental and theoretical problems involved in studies designed to prove or disprove the propositions.

Advanced Work for the Doctor's Degree

Advanced study and research for the doctoral thesis may be done in theoretical or experimental geophysics and geochemistry, marine and terrestrial geology, planetary sciences, or other specialized areas of the earth sciences. Students specializing in geochemistry or geophysics will normally take some advanced courses in physics and chemistry, as well as some of the departmental option courses. Other courses available are listed in the oceanography curriculum.

COURSES

UPPER DIVISION

101. Introductory Geology F

The origin and evolution of the earth, especially its crust, and the evolution of life as indicated by the fossil record. Emphasis is on the nature of rocks and minerals, their origin, reconstitution, and decay; the evolution of continents, ocean basins, and mountain belts; processes of vulcanism; and the work of wind, water, and glaciers in modifying the earth's surface, with the aim of creating an awareness in the student of the geological environment in which we live. Three lectures; occasional field trips.

102. Introductory Geochemistry W

The chemistry of the earth and the solar system, and the applications of

physical chemistry and nuclear physics to the study of the origin and geological history of the earth. Cosmic and terrestrial abundances of elements; nucleosynthesis; origin of the earth; mineralogy and chemistry of the earth's crust, mantle, and core; geochronology and the geological time scale; chemistry of the atmosphere and the oceans. Three lectures, one discussion period.

103. Introductory Geophysics **S**

Selected geophysical subjects are treated in some depth. The emphasis is on topics that involve the entire planet earth; the propagation of elastic waves through the earth, oceans and atmosphere; gravity, isostasy and the shape of the earth; oceanic, atmospheric and bodily tides; mountains, earthquakes and the movement of continents. Three lectures.

115. Structural Geology **W**

A descriptive study of geologic structures and an introduction to their interpretation in the light of scale-model studies and experimental work on the mechanical properties and deformation of rocks and minerals. Includes an introduction to the use of descriptive geometry and stereographic projection in the description and understanding of complex structures. Three lectures.

120. Mineralogy **W**

An introduction to mineralogy designed primarily to prepare students of the earth sciences for the study of natural minerals. Lectures and laboratory work on symmetry, morphology, crystal projections, goniometry, crystal structure, elementary x-ray crystallography, physical and chemical properties of minerals. Emphasis is placed on the properties of representative natural materials. Two three-hour periods of laboratory and lectures.

121. Optical Mineralogy **S**

The principles and techniques of the microscopic study of rock-forming minerals. The course is designed to provide an understanding of optical methods utilizing polarized light in the interpretation of crystal structure and identification of minerals. Two three-hour periods of laboratory and lectures. Prerequisite: Earth Sciences 120.

122. Petrology **F**

Techniques learned in Earth Sciences 120 and 121 are applied to the study and identification of mineral assemblages in natural rocks. The chemical, mineralogical, and physical properties of igneous and metamorphic rocks are studied by microscopic and other laboratory methods, and the origin and genetic relations of rocks are interpreted in terms of geologic occurrence and theoretical or experimental data. Two three-hour periods of laboratory and lectures. Prerequisites: Earth Sciences 120, 121; or consent of the instructor.

129A-129B-129C. Topics in Geology **F-W-S**

Reading course, with preparation of written reports, dealing with basic subjects and problems in earth sciences.

133. Radiochemistry with Applications to Geochemistry **W**
Lectures and laboratory work on basic radiochemistry with emphasis on experimental techniques used in geochemical studies. Prerequisites: Chemistry 100A-100B-100C.

150. Field Geology **S or Su**
Detailed field study of the geology of an area in the western United States. Each student will prepare a geologic report accompanied by a geologic map and structural and stratigraphic sections. This course is given either on weekends during the spring quarter or during one summer month; quarter varies from year to year.

199. Independent Study for Undergraduates **F,W,S**
Independent reading or research on a problem by special arrangement with a faculty member. Prerequisite: consent of the instructor.

GRADUATE

200. Geochemistry (3) **W**
Mr. Goldberg
Chemistry of the lithosphere, atmosphere and oceans; the geochemical balance; marine chemistry, geochemical cycles of major and minor elements; geochronology. Prerequisite: Chemistry 202A or Physics 140 (can be carried concurrently). (Offered in alternate years.)

201. Thermodynamics of Natural Processes (3) **S**
Mr. Craig
Applications of thermodynamics to general problems in the earth sciences. Topics include chemical and phase equilibria in heterogeneous multicomponent systems; properties of substances at high temperatures and pressures; models for solid solutions and gaseous mixtures; phase equilibria in silicate melts; adiabatic and pseudo-adiabatic transport; steady-flow systems; closed and open system models of the atmosphere, oceans and solid earth. Prerequisites: Chemistry 202B or Physics 140, Mathematics 100. (Offered in alternate years.)

210. Solids in Nature (3) **S**
Mr. Arrhenius
Experimental and theoretical evaluation of geologically important properties of solids. Characteristic differences between solid types, electronic structure of solids; microscopic significance of thermodynamic concepts. Interaction between matter and radiation, structure of geologically important crystals and glasses, order and disorder. Band and optical properties of solids, with particular consideration of geological systems. Prerequisite: consent of the instructor. (Offered in alternate years.)

211. Experimental Petrology (3) **F**
The Staff
Lectures and discussions on topics related to experimental investigations of petrological systems. Emphasis is placed upon interpretation and evaluation of experimental work on the stability and solubility of minerals of

metamorphic and igneous rocks. Prerequisites: Earth Sciences 122, 201.

212. Igneous Petrology (3) W

Mr. Hawkins

Theoretical aspects of the genesis of igneous rocks are considered in the light of geologic and experimental evidence. Suits of thoroughly investigated and well-described rocks are studied and discussed in detail. Current lines of research in problems of magmatic and volcanic processes are critically reviewed. Prerequisites: Earth Sciences 120, 121, 122 or equivalent, and consent of the instructor. (Not offered 1967–68.)

219. Crustal Evolution (3) W

Mr. Engel

The properties, origin and evolution of the rocks in the earth's crust. Prerequisite: one year of graduate study in Earth Sciences or Oceanography. (Not offered 1967–68.)

220. Seminar in Petrology (3) F,W,S

The Staff

Discussions of current research in petrology and mineralogy.

224. Marine Geology (3) W

Mr. Menard

Introduction to the geomorphology, sedimentation, stratigraphy, vulcanism, structural geology, and geologic history of the marine realm. Prerequisite: Earth Sciences 101 or equivalent, or consent of the instructor.

226. Tectonics (3) S

Mr. Menard, Mr. Bass

The large-scale structural and morphological features of continents and ocean basins, crustal deformation, oceanic rises, mountain building, permanency of continents. (Offered in alternate years.)

230. Seminar in Geology (3) F,W,S

The Staff

Discussions of current research and special topics in geology not treated in the general courses.

231. Nuclear Geology (3) F

Mr. Hart

General principles of radioactive decay; geochronology based on long-lived natural radioactive isotopes with special emphasis on the *K-Ar*, *Rb-Sr* and *U-Th-Pb* systems; use of isotopic tracers in studies of crust-mantle relationships, origin of igneous rocks, and evolution of the continental crust and oceans. Prerequisite: Earth Sciences 200, or consent of the instructor. (Not offered 1967–68.)

232. Nuclear Geochemistry (3) W

Mr. Craig

Geochemistry of stable and radioactive isotopes. Emphasis is on application of recent research to important problems in earth sciences. Topics

include theory of isotope fractionation, separation effects in heterogeneous systems, mixing rates and residence times, cosmic ray production of radioactive isotopes, mixing and exchange studies in the ocean and the atmosphere, the carbon cycle, stable isotope variations in minerals and rocks, geochemistry of volcanic waters and gases, etc. (Not offered 1967–68.)

233. Cosmochemistry (3) S
The Staff

A survey of important properties of the solar system. Abundances of elements in the solar system and the galaxy. Meteorites, especially their histories as determined by various nuclear physical techniques, isotopic anomalies and their interpretations, mineralogy and petrology of the various classes of meteorites, geochemical data and theories of their origin. Implications for galactic nucleosynthesis and deductions on the history of the galaxy. The origin of the earth and its early history. Prerequisites: Earth Sciences 231, 232; or consent of the instructor. (Not offered 1967–68.)

235. Seminar in Geochemistry (3) F,W,S
The Staff

The subject matter will vary from year to year and will normally cover an area of geochemistry not treated extensively in other courses.

240. Topics in Geophysical Continuum Mechanics (3) F
Mr. Backus, Mr. Gilbert

Mathematical foundations, physical limitations, and selected geophysical applications of continuum mechanics. Topics include finite strain; thermodynamics of stress-strain relations; phenomenology and mechanisms of dissipation; continuum theory of dislocations; and generation and propagation of elastic waves in a nearly homogeneous medium. Prerequisites: differential and integral calculus and differential equations.

241. Topics in Geophysical Fluid Dynamics (3) W
Mr. Backus

Effects of viscosity, density gradients, and gravitational and electromagnetic fields on fluid motion. Topics include forced and free convection and percolation, Alfvén waves, and the theory of the origin and secular variation of the earth's magnetic field. Prerequisite: Earth Sciences 240. (Offered in alternate years.)

242. Geophysical Measurements (3) S
Mr. Haubrich

Design of geophysical experiments and analysis of geophysical measurements, interpretation of geophysical time series; wave number filters, theory of arrays, geophysical systems analysis. Prerequisite: elementary complex variables. (Offered in alternate years.)

244. Gravity and Geomagnetism (3) W
Mr. Vacquier

Measurement and analysis of gravitational and magnetic fields of the earth, with emphasis on applications to geologic problems and prospecting. Prerequisites: differential and integral calculus. (Not offered in 1967–68.)

245. Tides and the Rotation of the Earth (3) **W**

Mr. Munk

Kepler's laws, tide-generating potentials, static and dynamic theory of ocean tides; atmospheric tides; Love numbers and bodily tides; tidal friction and the length of day; Chandler wobble, historical variations, figure of the earth. Prerequisites: Earth Sciences 240 and 241, and Physics 200A-200B-200C.

246A-246B. Internal Constitution of the Earth (3-3) **W-S**

Mr. Raitt, Mr. Vacquier

Study of the physical nature of the earth's interior revealed by observations of seismic waves, gravity and geomagnetic fields, electrical conductivity, heat flow, and related information from various geological sciences. Fundamentals of geophysical techniques of observation and analysis. Critical discussion of current knowledge. Prerequisites: calculus and differential equations, basic physics. (Offered in alternate years.)

247. Seismology (3) **S**

Mr. Gilbert

Equation of motion, exact transient solution of canonical problems, interface pulses, geometrical diffraction theory, ray theory and mode theory in plane-layered media, free oscillations of the earth, radiation from moving sources, source determination, aeolotropic and heterogeneous media, dissipation, interpretation problems. Prerequisites: Earth Sciences 240, Physics 200A, Mathematics 210A; prerequisite or concurrent registration in Physics 200B or 200C, Mathematics 210B or 210C. (Not offered 1967-68.)

250. Earth Sciences Summer Field Course (6) **Su**

Mr. Bullard, Mr. Craig, Mr. Goldberg, Mr. Menard

Participation in a department summer expedition for four to six weeks. Field studies in geology, geochemistry and geophysics are conducted at sea and on islands and coastal regions. Areas recently studied include Central America and the Caribbean, Easter Island and the southeastern Pacific, and the western Mediterranean. In 1967 the area studied will be the S.W. Pacific and the Coral Sea.

280. Spring Field Trip (No Credit) **S**

Classical areas of the southwest United States, such as the Colorado Plateau, Mojave Desert, Sierra Nevada and the Peninsular Range, are examined in successive years during six-day field trips. Normally required of all first- and second-year graduate students.

299. Research (1-6) **F,W,S**

The Staff

Geophysics Seminar (No Credit) **F,W,S**

A geophysical seminar given every term in which students, staff and visitors report on recent papers or results of their own work or reading.

ECONOMICS

Office: 3412 Humanities-Library Building

Seymour E. Harris, *Ph.D., Professor of Economics*
John W. Hooper, *Ph.D., Professor of Economics* (Chairman of the Department)
Richard E. Attiyeh, *Ph.D., Associate Professor of Economics* (Director of Undergraduate Studies)
Donald V. T. Bear, *Ph.D., Associate Professor of Economics*
Daniel Orr, *Ph.D., Associate Professor of Economics* (Director of Graduate Studies)
Ramachandra Ramanathan, *Ph.D., Assistant Professor of Economics*
Larry E. Ruff, *Ph.D., Assistant Professor of Economics*

The Major Program

Each student majoring in Economics will be required to take Economics 1A-1B-1C and at least four of the upper-division course sequences. Unless special permission is granted by the Director of Undergraduate Studies, three of the four sequences must be Economics 100A-100B, 110A-110B, and 130A-130B-130C. The fourth may be either 120A-120B-120C or 140A-140B. In addition, the Economics major must take at least one quarter of a seminar (190A-190B-190C), preferably in the senior year.

A Revelle College student majoring in Economics can meet the requirements for a noncontiguous minor by taking courses in the humanities, in mathematics, or in the sciences. By exploiting these noncontiguous electives, the student may be able to write a seminar honors paper in the noncontiguous field. For example, he might study mathematical economic theory, the relation of science to the economy, of research to technological change and growth, of education to growth, of medicine to income and growth, or American literature in the last generation as reflecting American economy. A noncontiguous minor must be approved by the Director of Undergraduate Studies (major adviser) and by the minor adviser in the department in which the noncontiguous minor is concentrated.

With regard to elective courses, the Economics major would be advised to take a few courses in related fields such as political science, psychology, history, and mathematics. Because mathematics and mathematical statistics are important in advanced economic study and in economic research, the student should consider the need for adequate background in these subjects. The courses most appropriate for this purpose are Mathematics 101, 110A-110B, 130A, and 133A-133B.

In planning his upper-division program, the prospective Economics major should consult with the Director of Undergraduate Studies as soon as possible—preferably during the sophomore year. At that time, a tenta-

tive program can be formulated which will include courses in economics, the noncontiguous minor, and electives.

Major Program in Economics (Recommended Schedule)

	Fall	Winter	Spring
Junior Year	Economics 100A Economics 120A or 140A	Economics 100B Economics 110A Economics 120B or 140B	Economics 110B Economics 120C or Departmental Elective
Senior Year	Economics 130A Economics 190A	Economics 130B Economics 190B	Economics 130C Economics 190C

The Honors Program

Students electing the honors program in Economics must have a 3.5 average in their upper-division Economics courses (including seminars) and must take three quarters of the seminar (190A-190B-190C).

The Noncontiguous Minor (Revelle College)

Students majoring in mathematics, humanities, or the sciences who elect Economics as a noncontiguous minor field have two options, depending on the use to which they put Economics 1A-1B-1C:

1. If the 1A-1B-1C sequence is used to satisfy the Revelle College social science requirement, the Economics minor must include six upper-division courses. Of these, four must be Economics 100A-100B and 110A-110B. The other two may be Economics 120A-120B, 130A-130B, or 140A-140B. With departmental approval, one or two quarters of a seminar (Economics 190A-190B) may be substituted for the fifth and sixth courses.

2. If some sequence other than Economics 1A-1B-1C is used to satisfy the Revelle College social science requirement, the noncontiguous minor in Economics may be made up of one of the following six-course groups: Economics 1B-1C, 100A-100B, and 110A-110B; or Economics 1B-1C, 100A, 110A, and 140A-140B; or Economics 1B-1C, 100A, 110A, and 134A-134B.

The Department of Economics is also willing to cooperate with other departments in the formulation of an integrated minor for which the work is done in two or more related disciplines. (See *Revelle College: Noncontiguous Minor.*)

Students who wish to pursue a noncontiguous minor involving the Department of Economics should consult with the Director of Undergraduate Studies (minor adviser) as early as possible.

The Graduate Program

The program of study for the Ph.D. degree normally will entail eighteen courses during two years, prior to departmental qualifying examinations. The program assumes Economics 1A-1B-1C and Mathematics 2A-2B-2C or equivalent courses as part of the background of every entering student.

A program will typically be structured as follows:

	Fall	Winter	Spring
Year I	Mathematics 101 Economics 210A Economics 220A	Economics 200A Economics 210B Economics 220B	Economics 200B Economics 210C Economics 220C
Year II	Economics 200C Economics 230A Elective	Elective Economics 230B Elective	Economics 269 Economics 230C Elective

The course sequences 200, 210, and 230 constitute the background material for the written portion of the departmental qualifying examination. In addition, there is an oral examination which to a large degree is devoted to the candidate's dissertation research specialty. Elective courses and the dissertation seminar (Economics 269) are the developing ground for a research specialty.

No foreign language proficiency examination is prerequisite to candidacy. However, students electing some research specialties for which foreign language sources are important will find it necessary to convince their doctoral committees of adequate command of the relevant languages. Residence and other university-wide requirements are stipulated in the Graduate Division section (see *Graduate Division: The Ph.D*).

A fuller description of the Ph.D. program can be obtained from the Department office. No program for the Master's Degree is contemplated.

COURSES

LOWER DIVISION

1A-1B-1C. Elements of Economics F-W-S

The objective of this survey course is to give students who will not specialize in economics an understanding of how the economy functions. Elementary theories of price-allocation and income-employment are used to analyze policy issues of major significance. Required of all majors and minors in economics. Must be taken in sequence. Two or three lectures, one recitation. (May be used in fulfilling the Revelle College social science requirement.)

UPPER DIVISION

100A-100B. Microeconomics F-W

The theory of consumer behavior and the theory of the firm as foundations of demand and supply. Market structure, distribution theory, and welfare economics. Three lectures. Prerequisite: Economics 1B.

110A-110B. Macroeconomics **F-W**
The theory of income determination; consumption and investment; money, the general price level and the rate of interest; fluctuations in income and employment. Three lectures. Prerequisite: Economics 1A.

115A-115B. The Evolution of Economic Theory and Policy **F-W**
An examination of the evolution of economic theory and policy in western Europe and Great Britain during the eighteenth and nineteenth centuries. While attention is given to the works of such individuals as A. Smith, D. Ricardo, T. R. Malthus, J. S. Mill, K. Marx, J. E. Cairnes, and others, the primary emphasis is on the development of economic analysis as a response to the economic problems of the times. Three lectures. Prerequisites: Economics 1A-1B-1C.

120A-120B-120C. Quantitative Economics **F-W-S**
Mathematical economics, statistics, and econometrics; the elements of the formulation and verification of economic models. Examples will be taken from both the micro and macro areas. Three lectures. Prerequisites: Economics 1A-1B and Mathematics 1C or their equivalents. Students who have taken or are taking Mathematics 130A or 133A-133B will not be admitted to Economics 120B-120C. 120A is not prerequisite to 120B-120C. (120C not offered 1967–68.)

130A-130B-130C. Public Policy **F-W-S**
The application of macroeconomic and microeconomic theory to issues of public policy; the contributions of related disciplines, e.g., political science, sociology, education, history, to the solution of these problems. The student will be required to study one problem intensively. Two lectures, one recitation. Prerequisite: Economics 1C. (130A not offered 1967.)

134A-134B. Economic Development **F-W**
An attempt to deal with economic, political, and scientific aspects of underdeveloped countries. The integration will be through the cooperation of an oceanographer, a physicist, and an economist. Students will prepare papers. Two-hour seminar weekly. Open to undergraduates and graduates. (Not offered 1967–68.)

140A-140B. Economic History **F-W**
A survey of economic history in both Europe and the United States, with major emphasis on the period since 1789 and on the United States. Three lectures. (Not offered 1967–68.)

190A-190B-190C. Seminars and Independent Work **F,W,S**
Seminars which will encourage the student to work on a particular problem intensively, culminating in at least one major paper. Hours by arrangement. (190B-190C not offered 1967–68.)

199. Independent Study **F,W,S**
Individual study. After consultation with the faculty, the student will

write a substantial paper. Prerequisites: consent of the staff; to be arranged with department chairman and instructor.

GRADUATE

It is anticipated that a number of elective courses, primarily intended for second-year graduate students, will be added to these listed. Titles and descriptions of additional courses for 1967–68 are not available as this catalog goes to press.

200A-200B-200C. Price and Allocation Theory (3-3-3) **W-S-F**
The role of theory in economics; demand analysis; the traditional theory of the firm; market structure and welfare; activity analysis and linear programming; dynamic models of the firm; market stability under uncertainty; capital theory and asset management.

210A-210B-210C. Aggregate Economic Analysis (3-3-3) **F-W-S**
The theory of income determination; consumption and investment; money, the general price level and the rate of interest; fluctuations in income and employment.

215A-215B. The Evolution of Economic Theory and Policy (3-3) **F-W**
An examination of the evolution of economic theory and policy in western Europe and Great Britain during the eighteenth and nineteenth centuries. While attention is given to the works of such individuals as A. Smith, D. Ricardo, T. R. Malthus, J. S. Mill, K. Marx, J. E. Cairnes, and others, the primary emphasis is on the development of economic analysis as a response to the economic problems of the times. Three lectures. Prerequisite: graduate standing.

220. Techniques of Economic Research (3) **S**
The construction and application of stochastic models in economics. This includes both single and simultaneous equation models. Prerequisites: Mathematics 130A, 133A.

230A-230B-230C. Public Policy (3-3-3) **F-W-S**
The application of macroeconomic and microeconomic theory to issues of public policy and contributions of related disciplines, e.g., political science, sociology, education, history, to the solution of these problems. The student will be required to study one problem intensively. Two lectures, occasional discussions. Prerequisites: prior course in elementary economics; graduate standing.

240A-240B. Economic History (3-3) **W,S**
An intensive survey of the economic history of both Europe (240A) and the United States (240B). Prerequisites: Economics 200C, 210C, and 220C. (Not offered 1967–68.)

269. Dissertation Seminar (3) **S**
A program of regular reports by second-year students on their progress toward the definition of their dissertation problems, and reports by degree candidates on their research progress. All students are expected to participate during their second year, and during at least one year of their doctoral candidacy.

297. Independent Study (1-6) **F,W,S**

299. Research (1-6) **F,W,S**

FINE ARTS

See *Interdisciplinary Courses.*

HISTORY

Office: 1560 Humanities-Library Building

Samuel Baron, *Ph.D., Professor of History*
Geoffrey Barraclough, *M.A., Professor of History*
Guillermo Cespedes del Castillo, *Ph.D., Professor of History*
John S. Galbraith, *Ph.D., Professor of History* (Chancellor)
†Gabriel Jackson, *Ph.D., Professor of History*
Armin Rappaport, *Ph.D., Professor of History* (Provost of Third College, Acting Chairman of the Department)
Roger de Laix, *Assistant Professor of History*
Edward Peters, *Assistant Professor of History*

* * *

Gerhard Masur, *Ph.D., Visiting Professor of History*
Curtis Wilson, *Ph.D., Visiting Associate Professor of History*
Franz Nauen, *Acting Assistant Professor of History*
Miss Frances Tanikawa, *Acting Assistant Professor of History*
†On leave 1967–68.

The Major Program

Students majoring in the Department of History are required to take a minimum of twelve upper-division courses in history, at least six of which must consist of two- or three-quarter sequences. They must also take six courses in fields related to their historical studies, to be selected in consultation with a Department major adviser. For work in history, the ability to read a foreign language is highly desirable.

Requirement in American History and Institutions

All candidates for the bachelor's degree in the University of California must demonstrate a knowledge of American history and American political institutions. This requirement may be fulfilled in *one* of the following ways:

A. By satisfactory completion of a one-quarter course chosen from the following: History 30, 164, 165.

B. By passing an examination under the direction of the Committee on American History and Institutions. This examination will be conducted twice each year and will be rated "passed" or "not passed." The student will have no more than two opportunities to pass the examination. In the event that a student does not pass the examination on the second attempt, it will be necessary for him to satisfy the requirement by passing one of the designated courses.

C. By presenting proof of satisfaction of the present State requirement as administered at another collegiate institution within the State.

D. A transfer student who has successfully completed a course in either American History or American Government at a recognized institution of higher education will be considered to have met the requirement.

Further information regarding the requirement and examinations may be obtained from the Revelle or Muir College Provost's Office.

The Graduate Program

The Department currently offers graduate work in preparation for the Ph.D., and will by the fall of 1968 have established a complete doctoral program. Students seeking the Ph.D. in history should have a strong undergraduate background not only in history, but in related areas of the humanities and social sciences. They must demonstrate at the beginning of the first quarter of residence a reading knowledge of one foreign language; and by the opening of the second year in residence they are expected to pass a reading examination in a second language.

Candidates for the Ph.D. will be expected to take a minimum of eighteen graduate courses, no more than nine of which may be directed reading courses in preparation for comprehensive examinations. The comprehensive examinations will be taken in three broadly defined fields of history. The following fields of concentration are currently available:

Greece and Rome
Medieval Europe (325–1250)
Western Europe (1250–1648)
Western Europe since 1648
Russia and Eastern Europe since 1613
British History
United States (including colonial era)
Latin America
World History (1870–1967)

The department anticipates the addition of several non-Western fields by 1968.

All students will be required to do some teaching in the course of their training. Normally candidates will devote three years to a combination of course work, part-time teaching, and preparation of their three reading fields. All candidates will be expected to pass comprehensive examinations in their three chosen fields before beginning their work on the doctoral dissertation. The dissertation is to be completed not later than six years from the time of admission to the program. It shall not exceed two hundred pages (60,000 words) in length, notes included. An examination on the dissertation may be required by the Department.

The above description applies specifically to all students who have done no previous graduate work in history. In cases where a candidate has completed substantial graduate-level work in history before entering UCSD, appropriate adjustments in the requirements of course work may be made. Transfer credit may be given for up to six of the eighteen courses re-

quired. All candidates will be expected to read two foreign languages, to pass comprehensive examinations in three fields, and to write a dissertation. In very particular circumstances an advanced knowledge of statistics may be substituted for a second foreign language.

COURSES

LOWER DIVISION

The Department of History cooperates in the teaching and administration of the Humanities sequence for Revelle College students. (See *Interdisciplinary Courses.*) Completion of this sequence or the Muir College lower-division requirements is normally prerequisite to enrolling in upper-division courses in the Department of History. (Transfer students with credit for a two-semester, lower-division history sequence may be admitted to the upper-division courses.)

10A-10B. Introduction to History **F-W**
The nature and uses of history will be explored through the study of the historian's craft, and the critical analysis of historical sources and historical literature. (History 10A-10B, 165 may be used by Muir College students in fulfilling the humanities requirement of the College.)

30. The Emergence of Modern America **W**
The United States from the Reconstruction to the First World War. The impact of industrialization, immigration, growth of cities, and movements for reform. Three hours lecture and discussion. (May be used in fulfilling the University requirement in American History and Institutions.)

UPPER DIVISION

104A-104B. Greece in the Classical Age **F,W**
The political, economic and intellectual history of Greece from the birth of the city-states to the death of Alexander the Great. Three hours lecture and discussion. (Not offered 1967–68.)

105A-105B. The Roman Republic and Empire **F,W**
The political, economic and intellectual history of the Roman world from the foundation of Rome to the death of Constantine. Three hours lecture and discussion.

111A-111B. The Rise of Europe **F-W**
The development of European society from the decline of the Roman Empire to 1250. Three hours lecture.

113. Renaissance Europe: 1348–1517 **F**
The intellectual, political, and economic transformation of late-medieval Europe from the crisis of the Italian civic spirit to the flowering of the Renaissance monarchies. The concurrent evolution of diplomacy, warfare, and political behavior. Three hours lecture.

114. Early Modern Europe: 1517–1688 **W**
The religious crisis, the decline of the Holy Roman Empire and the rise of national states. Intellectual developments, political theory, and prob-

lems of government and citizenship in the seventeenth century. Three hours lecture.

131A-131B-131C. The British Empire since 1783 F-W-S
The political and economic development of the British Empire, including the evolution of colonial nationalism. The development of the commonwealth idea, a survey of Canada, and changes in British colonial policy. Three hours lecture. (Not offered 1967–68.)

135A-135B. Germany 1815–1919 F-W
Emphasis on the political unification and cultural flowering of nineteenth-century Germany; the era of Bismarck, of William II, and the "catastrophe" of 1914-18. Three hours lecture.

145A. Russia: 1533–1800 F
A survey of the development of Russian society and thought from Ivan the Terrible to Alexander I. Emphasis will be on the westernization of Russia. Three hours discussion.

145B. Russia: 1800–1914 W
An examination of Imperial Russia's last century, with special emphasis on currents of social thought and the revolutionary movement. Three hours discussion.

145C. Russia: 1914 to the Present S
The Russian Revolution and the transformation of Russia under the Soviet Regime. Domestic and foreign policies will be considered. Three hours discussion.

150A-150B. Europe: 1789–1914 F-W
The impact of industrialization and the entry of new classes into politics. Effects of political, social, and economic change on both the domestic and the international order of the European states. Three hours lecture.

151A-151B-151C. World History of the Last Century F,W,S
The origins of the contemporary world with emphasis on non-European, as well as Western history. Three hours lecture.

155. History of Science from Antiquity to Newton W
Topics emphasized will be: planetary theories from Ptolemy to Kepler and the science of mechanics from Aristotle through the medieval discussions to Galileo, Descartes, and Newton.

156. History of Science in the Eighteenth and Nineteenth Centuries S
Topics emphasized will be: the emergence of structural chemistry, energetics, field physics, and the theory of biological evolution.

164. American Intellectual History to 1860 W
From colonial times through the pre-Civil-War period; European origins and the development of political, social, economic, and religious thought in the American context. Three hours discussion. (May be used in fulfilling the University requirement in American History and Institutions.)

165. American Intellectual History from 1860 **S**
American thought in the post-Civil-War period, and some major trends in social, economic, political, and religious thought in the twentieth century. Three hours discussion. (May be used in fulfilling the University requirement in American History and Institutions.)

170. The Spanish Civil War **S**
The cultural renaissance of twentieth-century Spain, the political and economic background, the Spanish Republic of 1931–36, the Civil War seen as both a domestic and an international crisis. Three hours discussion. (Not offered 1967–68.)

172A-172B-172C. History of Latin America **F-W-S**
A survey of the evolution of Latin America, covering aboriginal civilizations, Iberian colonizations and development of the modern nations, from prehistory to the present. Emphasis on demographic, economic and social problems. Three hours lecture.

180. China **W**
An introduction to the civilization of China and a survey of China's response to the West in modern times.

181. History of South Africa

GRADUATE

201. Historiography (3) **W**
Mr. Masur
An introduction to historical concepts, methods, and problems.

204. Seminar in Greek and Latin Historiography (3) **S**
Mr. de Laix
A detailed analysis of the philosophies of history and historiographical methods of the leading Greek and Roman historians. (Not offered 1967–68.)

205. Seminar in Greek and Roman Political Institutions (3) **S**
Mr. de Laix
A survey and analysis of the governmental structures of Athens, Sparta, the Greek Leagues, and Rome.

211A-211B. The Rise of Europe (3-3) **F-W**
Mr. Barraclough
The development of European society from the decline of the Roman Empire to 1250. Three hours lecture.

212. The Literature of Medieval History: England 1066–1485 (3) **W**
Mr. Peters
The course will serve to acquaint the graduate student with some of the problems, methods, and sources of medieval English history by means of a study of selected topics based upon primary and secondary source materials through a series of conferences and reports.

220. Spain in the Middle Ages (3) **S**
Spain from the Arab conquest to the unification under Ferdinand and Isabella. Emphasis on the relationships among Moors, Christians, and Jews. Study of the major interpretations by Menendez Pidal, Americo Castro, Sánchez-Albornoz, etc. (Not offered 1967–68.)

240. The Expansion of Europe (3) **W**
Mr. Céspedes
The techniques, economic organization and institutional evolution of European colonizations in Africa, the Far East and the Americas during the fifteenth to seventeenth centuries. The great geographical discoveries and the beginnings of world trade. Emphasis on comparative aspects. Three hours discussion.

245. Readings in Seventeenth- and Eighteenth-Century Russian History (3) **W**
Mr. Baron

251A-251B-251C. World History of the Last Century (3-3-3) **F-W-S**
Mr. Barraclough
The origins of the contemporary world with balanced emphasis on non-European as well as Western history. Three hours lecture.

255. Studies in Nineteenth-Century Scientific Thought (3) **F**
Mr. Wilson
The readings will cover such topics as evolution, geology, thermodynamics, and electromagnetic theory in their relation to the main intellectual currents of the nineteenth century.

261. Topics in U.S. Diplomatic History (3) **F**
Mr. Rappaport
Critical analysis of major works in U.S. diplomatic history; designed to acquaint the student with the historiographic developments in the field. Readings, discussions, and papers will form the basis of the course.

274. Topics in Latin American History (3) **S**
Mr. Céspedes

297. Directed Studies (1-6) **F,W,S**
The Staff
Guided and supervised reading in a broad area of history.

298. Comprehensive Readings **F,W,S**
The Staff
Guided and supervised tutorial reading in preparation for comprehensive examinations.

299. Thesis (1-6) **F,W,S**
The Staff

HUMANITIES

See *Interdisciplinary Courses*.

LANGUAGE

See *Interdisciplinary Courses.*

LINGUISTICS

Office: 1512 Humanities-Library Building

Edward Klima, *Ph.D., Professor of Linguistics*
Leonard Newmark, *Ph.D., Professor of Linguistics*
(Chairman of the Department)
Paul Chapin, *Ph.D., Assistant Professor of Linguistics*
Sige-Yuki Kuroda, *Ph.D., Assistant Professor of Linguistics*
Ronald W. Langacker, *Ph.D., Assistant Professor of Linguistics*
Margaret H. Langdon, *Ph.D., Assistant Professor of Linguistics*
Sanford Schane, *Ph.D., Assistant Professor of Linguistics*

* * *

William Bright, *Ph.D., Adjunct Professor of Linguistics and Anthropology (University of California, Los Angeles)*
Peter N. Ladefoged, *Ph.D., Adjunct Professor of Phonetics (University of California, Los Angeles)*

Broadly speaking, linguistics is simply the study of language *as* language. Like other rapidly developing fields, linguistics resists simple classification into one of the traditional categories of academic disciplines. Considered as one of the humanities, linguistics concentrates on the historical development of a particular language or language family, or on the relation between a language and the literature composed in that language. Considered as a social science, linguistics may be related to anthropology, in describing language as a part of culture; or it may be related to psychology, in describing language as a kind of behavior. One branch of linguistics, phonetics, may even be considered a natural science, related to the physical science of acoustics and the biological sciences of anatomy and physiology. Considered as an engineering science, linguistics has found many applications in fields as far apart as language pedagogy and mechanical translation. Finally, linguistics may be considered a formal science in its own right, related to mathematics and formal logic.

(The Department of Linguistics supervises the teachings of foreign languages. See *Interdisciplinary Courses: Language.*)

The Major Program

An undergraduate major in linguistics is intended to give a student the background that would prepare him best for graduate work in the field of linguistics. Because linguistics shares its object matter—language—with so many other disciplines, this major is unlike many others in that it requires relatively few courses in the Department of Linguistics itself. The major in linguistics consists of twelve courses: four basic required courses in the Department of Linguistics, complemented by eight other courses related directly to the study of language.

All linguistics majors are required to take Linguistics 100 and the sequence 101A-101B-101C. This sequence of courses lays the groundwork for all serious modern study of language. Linguistics 100 may be taken in the lower division or it may be taken in the upper division concurrently with Linguistics 101A. In addition, every linguistics major is required to take at least three one-quarter courses in one or more languages in addition to the one in which he has satisfied minimum college requirements. The remaining courses for the major will be selected with the advice and approval of a departmental undergraduate adviser.

Revelle College. Two major programs in linguistics are offered for Revelle College students: Program A emphasizes linguistics as one of the humanities related to the study of literature; Program B emphasizes linguistics as a formal discipline related to mathematics and formal logic.

For the Program A major, courses to complement the required Linguistics courses will normally be selected from undergraduate offerings in the Departments of Literature and History—or Linguistics 199. For Program B, they will normally be selected from undergraduate offerings in the Departments of Philosophy, Mathematics, and Applied Electrophysics—or Linguistics 199.

If the student elects Program A, his noncontiguous minor must be taken in the social or natural sciences; if he elects Program B, his noncontiguous minor must be taken in the humanities.

Muir College. Major programs in linguistics will also be offered for Muir College students. Students should see an undergraduate adviser in the Department of Linguistics.

Major Program in Linguistics
(Recommended Schedule)

	Fall	Winter	Spring
Junior Year	Linguistics 100 or Elective Linguistics 101A Language *	Linguistics 101B Language *	Linguistics 101C Language *
Senior Year	*	*	*

*Selected from the Departments of Literature and History—or Linguistics 199 (for Program A), or from Philosophy, Mathematics, and Applied Electrophysics—or Linguistics 199 (for Program B).

The Graduate Program

In order to develop scholars capable of original research and effective teaching, the Linguistics faculty has planned a graduate program aimed at imparting: (*a*) a thorough understanding of contemporary linguistic

theory and linguistic analysis, (*b*) a broad knowledge of the major achievements of descriptive and historical linguistics, and (*c*) intensive training in a specialized area of linguistic study within linguistics itself, or in conjunction with related disciplines.

The graduate program in linguistics is essentially a doctoral program, but with the provision for granting the M.A. upon completion of the basic graduate requirements. This provision for an M.A. allows the Department to maintain a coherent plan for graduate education at the highest level, while allowing students with special aims—for example, teachers of foreign languages—to pursue their professional interests in linguistics to the point at which useful applications can be made.

In the student's first year of graduate study, his basic courses will stress: linguistic theory, particularly from the point of view of generative grammar; and linguistic analysis, with particular emphasis on field techniques. In his advanced work, a student will broaden his knowledge of general linguistics and in addition will choose a field of specialization, such as one of the following: formal linguistic theory, Romance linguistics, English linguistics, psycholinguistics, language acquisition, anthropological linguistics. When he has passed the Department's comprehensive examination, the student will be assigned a doctoral committee, which will guide his further specialized work.

Preparation for Admission

Training in foreign languages, as well as in anthropology, literature, mathematics, philosophy, or psychology, is good undergraduate preparation for the graduate student in linguistics. In general, the student intending to enter this graduate program should have a broad liberal education as an undergraduate, as rich as possible in foreign languages, the humanities, behavioral sciences, and mathematics.

Since few institutions offer serious linguistics courses for undergraduates, the student may begin his graduate program here with no previous course work in linguistics proper. In such a case, he will enrol in Linguistics 101A-101B-101C and 211A-211B-211C in his first year.

Master's Degree Program

The Linguistics Department has adopted Plan II for awarding the Master's Degree. (See *Graduate Division: The Master's Degree.*) The total course requirement for the Master of Arts degree in Linguistics is 36 quarter-units, at least 18 of which must be in graduate courses in Linguistics, and 12 more in upper-division or graduate courses. A maximum of 16 units of research credit may be used in satisfaction of these course requirements.

To be eligible to take the comprehensive examination, a candidate for the M.A. must: (1) demonstrate his ability to read French, German, or Russian at a level equivalent to that indicated by a scaled score of at least 500 on the Social Science option of the Graduate School Foreign Language Test given by the Educational Testing Service of Princeton, New Jersey, and (2) demonstrate his knowledge of the structure of an

Indoeuropean language and of a non-Indoeuropean language, either by an acceptable standard of achievement in courses on the structure of the language, or in a descriptive paper accepted by the Department Graduate Committee.

A candidate for the Master of Arts degree in linguistics must pass the Department's comprehensive examination, demonstrating his thorough familiarity with modern descriptive and historical linguistics. As partial preparation for this examination, a student will normally take the basic sequences Linguistics 101A-101B-101C and 211A-211B-211C if he has not had equivalent training elsewhere.

The comprehensive examination, prepared by the Linguistics Department Graduate Committee, may normally be taken no earlier than three quarters and no later than eight quarters after the student begins graduate study. This written examination gauges the student's general familiarity with modern descriptive and comparative linguistics and is weighted as follows: linguistic theory—3 hours; linguistic analysis—3 hours; comparative linguistics (historical, dialectological and typological methods)—2 hours.

Doctor's Degree Program

To be advanced to formal candidacy for the Ph.D. in Linguistics a student must satisfy the general requirements for the degree and pass the qualifying examination. (See *Graduate Division: The Ph.D.*) In order to be eligible for the qualifying examination, the student must have passed the language requirements and the comprehensive examination demanded of candidates for the M.A., as described above. In addition, the prospective Ph.D. candidate must have demonstrated reading knowledge of a second foreign language. If the student has not included a French reading proficiency in qualifying for the M.A., he must do so now in qualifying for the Ph.D. Students who have included French in their M.A. requirements may choose German or Russian for the required second foreign language reading proficiency. In addition, all prospective Ph.D. candidates must demonstrate oral fluency (as determined by the Department Graduate Committee) in a language other than their native one. This language may be one of those in which the student has demonstrated reading proficiency.

The qualifying examination will normally require from six to nine quarters of course preparation at the graduate level. This two-hour oral examination tests the student's knowledge in one or more specialized areas: e.g., formal linguistic theory, psycholinguistics, Romance linguistics, anthropological linguistics, language acquisition, English linguistics. The qualifying examination will be administered by a doctoral committee, appointed by the Graduate Council, after the student has satisfied his language requirements and passed the comprehensive examination. The committee will include at least two members from a department outside of Linguistics.

The candidate will write a substantial dissertation incorporating the results of original and independent research carried on under the supervision of his doctoral committee. He will be recommended for the Doctor of Philosophy degree after he has made a successful oral defense of his dissertation before the doctoral committee.

COURSES

UPPER DIVISION

100. General Linguistics **F,W,S**

An introduction to the study of language. The analytical and descriptive methods and devices of general linguistics; phonological, morphological and syntactic systems; comparative and historical linguistics, psycholinguistics, anthropological linguistics, and their relationships to general linguistics. Three hours lecture, 2 hours discussion, 7 hours reading and exercises. (Open to lower-division students.)

101A-101B-101C. Linguistic Theory **F-W-S**

Introduction to the theory of generative grammar; transformational rules and other rule schemata. Models for syntactic description; formalization of grammars. Advanced problems in syntactic theory; deep and surface grammar; semantic considerations in syntax. Three hours lecture, one hour laboratory. Prerequisite: Language 1A or 2A, or Linguistics 100, or equivalent.

102A-102B-102C. Phonology **F-W-S**

General problems in phonological analysis; morphophonemics, phonemics, and phonetics as phonological levels. Articulatory and acoustic phonetics; the relationship between the various phonetic parameters and their role in phonological theory. Distinctive features and notational conventions; types of phonological processes and universal constraints. Three hours lecture, one hour discussion. Prerequisite: Language 1A or 2A, or Linguistics 100, or equivalent.

199. Advanced Study for Undergraduates **F,W,S**

Under the supervision of a Linguistics Department undergraduate adviser the student will undertake a program of research or advanced reading in linguistics. Under this course title superior students will be allowed to attend courses offered by the Department in its 200-series of graduate courses. May be repeated for credit.

GRADUATE

The following course sequences will be offered by the Department. Within a one-year sequence, the choice of topics and the amount of time devoted to them may vary from year to year; for example, in the sequence in linguistic theory, the distribution of syntax and phonology between quarters of the sequence may vary. The third quarter of a sequence will usually be conducted as a seminar.

Students specializing in linguistic theory, psycholinguistics, and Romance linguistics will be expected to take appropriate courses in the Departments of Philosophy, Psychology, and Literature, respectively, upon the advice of their graduate advisers. As an integral part of their training, all students are required to participate in the teaching of courses offered by the Department.

201A-201B-201C. Linguistic Theory (3-3-3) **F-W-S**

Introduction to the theory of generative grammar; transformational rules and other rule schemata. Models for syntactic description; formalization

of grammars. Advanced problems in syntactic theory; deep and surface grammar; semantic considerations in syntax.

202A-202B-202C. Phonology (3-3-3) **F-W-S**
General problems in phonological analysis; morphophonemics, phonemics, and phonetics as phonological levels. Articulatory and acoustic phonetics; the relationship between the various phonetic parameters and their role in phonological theory. Distinctive features and notational conventions; types of phonological processes and universal constraints.

211A-211B-211C. Linguistic Analysis (3-3-3) **F-W-S**
The techniques of linguistic analysis (phonetics, phonemics, morphology, syntax). Application of these techniques under simulated field conditions to the recording and analysis of a language by direct elicitation from native informants.

221A-221B-221C. History and Structure of English (3-3-3) **F-W-S**
The first two quarters of this sequence survey the phonological, morphological, syntactic and lexical evolution of the English language. The third quarter concentrates on Old English (Anglo-Saxon), and aims at imparting reading skill sufficient to understand the literary documents.

224A-224B-224C. Modern English (3-3-3) **F-W-S**
A detailed study of the syntax, phonology, and semantics of modern English, with particular emphasis on current research on the general theory of grammars, as developed through the study of English.

231A-231B-231C. Formal Linguistics (3-3-3) **F-W-S**
Fundamentals of discrete mathematics for non-mathematicians (first quarter only). Formal properties of grammatical systems. Formalized grammars of natural and artificial languages. Study of mathematical models that relate to linguistic competence and performance.

241A-241B-241C. Romance Linguistics (3-3-3) **F-W-S**
The history and structure of Latin and contemporary Romance languages in the context of generative grammar; comparative Romance. Topics and problems will vary from quarter to quarter.

251A-251B-251C. Historical Linguistics (3-3-3) **F-W-S**
A survey of Indoeuropean phonology and morphology; the techniques of linguistic reconstruction; theory of language change; advanced problems of historical linguistics.

264A-264B-264C. Language Structures (3-3-3) **F-W-S**
Grammatical analysis of individual languages.

271A-271B-271C. Anthropological Linguistics (3-3-3) **F-W-S**
Language and culture; the interrelationships of language and other aspects of human behavior. Areal linguistics: the focal area will vary from year to year; examples, Indian languages of North America, Oceanic languages, etc. Advanced problems in anthropological linguistics.

281A-281B-281C. Psycholinguistics (3-3-3) **F-W-S**
The study of models of language and of language acquisition from the point of view of modern linguistics and psychology.

285. Practicum in Language Teaching (1) **F,W,S**

290. Issues in Contemporary Linguistics (3) **F,W,S**
Discussion of a selected topic drawn from the history of linguistics and general linguistics.

296. Directed Research (1-6) **F,W,S**
Individual research.

298. Special Studies (2-6) **F,W,S**
Advanced seminars.

299. Doctoral Research (1-6) **F,W,S**

LITERATURE

Office: 1003 Humanities-Library Building

*Carlos Blanco-Aguinaga, *Ph.D., Professor of Spanish Literature*
Bernhard Blume, *Ph.D., Professor of German Literature*
Joaquin Casalduero, *Ph.D., Professor of Spanish Literature*
Américo Castro, *Ph.D., Professor in Residence of Spanish Literature and Culture*
Robert C. Elliott, *Ph.D., Professor of English Literature*
*Edwin Fussell, *Ph.D., Professor of American Literature*
Claudio Guillén, *Ph.D., Professor of Spanish and Comparative Literature*
Reinhard Lettau, *Ph.D., Professor of German Literature*
Roy Harvey Pearce, *Ph.D., Professor of American Literaure* (Chairman of the Department)
Gian-Roberto Sarolli, *Ph.D., Professor of Romance Philology and Italian Literature*
John L. Stewart, *Ph.D., Professor of American Literature* (Provost of Muir College)
Andrew Wright, *Ph.D., Professor of English Literature*
Ronald Berman, *Ph.D., Associate Professor of English Literature*
Thomas K. Dunseath, *Ph.D., Associate Professor of English Literature*
Frederic Jameson, *Ph.D., Associate Professor of French Literature*
Jaime Alazraki, *Ph.D., Assistant Professor of Spanish Literature*
Jack Behar, *Ph.D., Assistant Professor of American Literature*
Alain J. J. Cohen, *Ph.D., Assistant Professor of French Literature*
David K. Crowne, *Ph.D., Assistant Professor of English and Comparative Literature*
Abraham Dijkstra, *Ph.D., Assistant Professor of American and Comparative Literature*
Edwin Dolin, *Ph.D., Assistant Professor of Classical and Comparative Literature*

Kenneth E. Lavender, *Ph.D., Assistant Professor of English and Comparative Literature*

Peter C. Marlay, *Ph.D., Assistant Professor of Spanish Literature*

James T. Monroe, *Ph.D., Assistant Professor of Spanish Literature*

George Szanto, *Ph.D., Assistant Professor of German and Comparative Literature*

Martin Wierschen, *Ph.D., Assistant Professor of German Literature and Germanic Philology*

Wai-lim Yip, *Ph.D., Assistant Professor of Chinese and Comparative Literature*

Alexandra Casalduero, *M.A., Lecturer in Literature*

*On Leave 1967–68

The Department of Literature has as its object instruction and research in the various national literatures, taken singly and also in relation to one another. Assuming that there are habits of mind and methods of inquiry peculiar to literary study, whatever the language, the department brings together teachers, scholars and students who would elsewhere be separated, not by their studies, but by the languages in which those studies are pursued. Thus, in the Revelle College Humanities Sequence, in the lower-division genre courses, in the departmental Senior Major Sequence, in the strong second-language requirement both for undergraduates and graduate students who have elected Literature as their field of study, the emphasis is strongly comparatist. There will be an analogous emphasis in the major program for Muir College students.

Lower-Division Preparation: Revelle College

The only prerequisite to upper-division literature courses is completion of freshman-sophomore requirements. However, literature majors who do not elect to take Literature 11 as part of their lower-division program may find that, before enrolling in upper-division foreign literature courses, they must bring their language proficiency up to the expected level by taking such lower-division courses during their junior year. Accelerated lower-division students may take advanced courses by permission of the Department.

Transfer students must demonstrate the same level of competence in a foreign language that is required of UCSD students. First-hand knowledge of some of the major documents of Western Civilization, such as is acquired in the Humanities sequence, is assumed.

The Literature Curriculum: Revelle College

For lower-division students the Department offers courses of two kinds:

A. Courses numbered 11 are intermediate courses of readings and discussions in languages other than English. They are designed to develop language skills beyond the generally required level of proficiency and to introduce the student to the cultural context of the literature concerned. Lower-division language proficiency is a prerequisite for these courses. The courses are not prerequisite to each other; one is given each quarter.

B. Courses numbered 21-30 are introductory courses in which important documents of post-medieval Western literature will be studied by genre: the novel, the drama, lyric poetry. Each genre will be treated in a separate quarter course. Normally all the reading will be done in English, and fictional and dramatic works from literatures other than English and American will be read in translation. Literature sequence 21A-21B-21C is highly recommended for sophomores who are seriously considering Literature as a major.

Upper-division courses are of three types—lectures, seminars, and the Senior Major Sequence. Lecture courses are unlimited in enrolment. Seminars are limited to ten students. In seminars, students will be expected not only to do work connected with the class meetings, but to undertake projects of independent study. They will accordingly be expected to have regular tutorial conferences with their instructors. The Senior Major Sequence (191-192), taken by all majors during the first two quarters of the senior year, is the culmination of the major in Literature. Meeting in small groups, seniors in this course will explore various approaches to literary texts, then focus for study on a well-defined problem in their respective primary literatures; the sequence ends with the presentation of the senior essay. (The Literature major in Revelle College does not require a comprehensive examination.)

The Major Program: Revelle College

The Literature Department expects its majors to take fourteen upper-division courses in the Department. Of these, nine will be in one literature (the "primary" literature); the remaining five will be selected by the student, with the consent of his adviser, with this limitation: every major program must include at least three upper-division courses taught in a language other than English. The upper-division course requirement will, however, be modified for those students who need to take two quarters of Literature 11 in their second language, in order to take upper-division courses in that second language; in such cases, two quarters of Language 11 will count towards the fulfilment of major-program requirements.

In each primary literature, the following courses are required: Literature 101A-101B-101C, 151, and the Senior Major Sequence. Each student's schedule will depend on the primary and secondary literatures he elects. Normally the survey courses (101A-101B-101C) in a given literature are taken in the junior year.

A typical program in Literature, which takes into account all the above requirements, might be composed in the following way for a student who has chosen English for his primary literature and French for his other literature:

Upper-Division courses in English Literature	7 courses
Senior Major Sequence with emphasis in English Literature	2 courses
Literature 11/French	2 courses
Literature 101A-101B-101C/French	3 courses

The total is fourteen courses, nine in the primary literature, five in the second literature. Within this framework many other combinations are possible: each student should work out his program with the help and approval of his major adviser.

The Major Program: Muir College

Details of the Muir College major in Literature will be announced in the 1968–69 catalog.

Noncontiguous Minor: Revelle College

Revelle College students who wish to pursue a noncontiguous minor involving Literature may consult with the Department's minor adviser.

Honors Program

A small group of students majoring in Literature will be admitted to the Department's Honors Program. Honor students will have special privileges and special responsibilities: certain requirements will be waived so that they will have the time and energy to write a thesis of some length in their senior year. Students wishing to try for Honors should talk with the departmental major adviser early in their junior year.

The Graduate Program

Doctor's Degree Program

The Department of Literature offers doctoral programs in English and American Literature and in Spanish Literature. It offers graduate instruction in French, German, Italian, and Classical Literature and in Comparative Literature, and it expects to present Ph.D. programs in these fields soon. The course of study makes explicit provision for a significant amount of independent work. Tutorial work and interdisciplinary study are encouraged. All students are required to do some teaching as an integral part of their training. Formal course requirements are kept to a minimum so that students may proceed toward the Ph.D. (the M.A. is not offered) at whatever rate their academic experience and their competence dictate. The program requires each student to become professionally conversant with the literature of one language. It has also, however, a comparatist emphasis:

Students in the English Literature program are expected to take at least one course in a foreign literature in order to develop a legitimate ability in comparatist study. Through guided independent study they are expected to read a literature or literatures other than, but related to, that of their major doctoral program. For example, a student of the English novel might study the picaresque tale in Spanish.

Qualifying examinations, to be given at the end of the third year, are comprehensive in scope; the dissertation will serve to develop competence in a special field.

Requirements for admission

1. A baccalaureate degree with a major in one of the literatures offered

by the Department, or in another field approved by the Department Graduate Committee.

2. Satisfactory scores on the Graduate Record Examination, including, when available, the advanced examination in the literature of the student's specialty.
3. A working knowledge of one foreign language, to be tested during the first quarter of residence at UCSD.

The Ph.D. program for English and American literatures requires either (*a*) demonstrated fluency in reading, writing, and speaking one language in addition to English, or (*b*) a working knowledge of two languages in addition to English. Students in this program are expected to take at least two courses (or the equivalent independent study) in either philology or modern linguistics.

The Ph.D. program for Spanish literature requires, in addition to the above, a reading knowledge of Latin, to be established by either (*a*) examination upon entrance, or (*b*) a one-year course in the first year of graduate study. A student in this program is expected to minor in another Romance literature and to choose a second minor in a non-Romance literature pertinent to his specialty.

The Department invites inquiry for its "Program of Instruction" brochure, which goes into the requirements in more detail.

COURSES

GENERAL LOWER DIVISION

(See also lower-division courses listed under literature of the various languages.)

The Department of Literature cooperates in the teaching and administration of the Humanities sequence for Revelle College students. (See *Interdisciplinary Courses: Humanities.*)

1A-1B-1C. The Interpretation of Literature **F-W-S**
Taking as its premise the importance of close scrutiny, this sequence will emphasize problems of type and genre in the process of understanding and interpreting particular works and relating them to literary tradition. Fall: Narrative Forms; Winter: Ideas of Tragedy; Spring: Literature and the Self. Prerequisites: 1A for 1B; 1B for 1C. (This sequence may be used in fulfilment of the Muir College humanities requirement. Muir College students have priority.)

21A. Introduction to Literature: The Novel **F**
Prose fiction from the seventeenth century to the present. Lecture and discussion. Three meetings.

21B. Introduction to Literature: The Drama **W**
Dramatic literature from the seventeenth century to the present. Lecture and discussion. Three meetings.

21C. Introduction to Literature: Lyric Poetry **S**
Major forms and modes of lyric poetry. Lecture and discussion. Three meetings.

GENERAL UPPER DIVISION

(Upper-division standing or consent of the instructor is prerequisite to all upper-division courses.)

Lit/Cla 122. The Classical Tradition F
Greek and Roman literature in translation. The texts, varying from year to year, include works of Homer, Greek tragedy and comedy, Plato, Virgil, Ovid and Petronius. Three hours lecture.

Lit/Ch/Tr 151. Masterpieces of Chinese Literature in Translation W
The course will focus on a few representative masterpieces of Chinese literature in its classical age, with emphasis on the formal conventions and the social or intellectual presuppositions that are indispensable to their understanding. Three hours lecture.

Lit/It/Tr 151. Dante in English W
An intensive study of Dante's works, primarily of the *Divine Comedy*. Readings and lectures in English translation. Lecture and discussion. Three hours lecture.

191. The Study of Literature F
A critical survey of the nature of literary understanding and interpretation. As the first element in the two-quarter Senior Major Sequence, required of all majors in Literature and prerequisite to Literature 192 as given in the various literatures. Three hours lecture.

GENERAL GRADUATE

201. General Philology (3) F
Historical introduction to general philology, with emphasis on the Romance languages. Required of Spanish majors. Prerequisite: basic knowledge of Latin. (Conducted in English.)

202. Textual Criticism (3) W
Textual problems in the *Roman de Thebes*. Topic varies from year to year. Offered for repeated registration.

210. Classical Studies (3) S
Analysis of significant works of the Greek and Roman tradition, with attention to their interest for later European literature. Examples: pastoral (Theocritus, Virgil's *Eclogues*, Milton's *Lycidas*), comedy (Aristophanes, Menander's *Dyskolos*, Plautus-Terence, Shakespeare), love poetry (Sappho, Catullus, Virgil, Propertius, Shakespeare's *Sonnets*). Seminar.

261. Studies in Comparative Prosody (3) F
The course will investigate the essentials or "universals" of versification on the basis of examples chosen from various literatures, including an oriental one, as well as the methodological problems that such investigation raises. Seminar.

271. Critical Theory (3) S
Problems of literary analysis; competing schools and major figures in literary criticism. Topic varies from year to year. Offered for repeated registration. Seminar.

274. Genre Studies (3) **W**
Consideration of a representative selection of works relating to a theme, form, or literary genre. Topic varies from year to year. Offered for repeated registration. Seminar.

297. Directed Studies (3 or 6) **F,W,S**
Guided and supervised reading in a broad area of literature or linguistics. Offered in English, French, German and Spanish. Offered for repeated registration.

298. Special Projects (1-6) **F,W,S**
Treatment of a special topic in literature and language. Offered in English, French, German and Spanish. Offered for repeated registration.

299. Thesis (3 or 6) **F,W,S**
Research in English and American or Spanish literature for the dissertation. Offered for repeated registration. Prerequisite: advancement to candidacy for the Ph.D. degree.

English and American Literature

UPPER DIVISION

(Upper-division standing or consent of the instructor is prerequisite to all upper-division courses.)

Lit/En 101A-101B-101C. The Great Tradition **F-W-S**
A chronological study of important English and American writers. Three hours lecture. Required of English majors.

Lit/En 121. The Medieval Period
Major literary works of the Middle Ages as seen against the historical and intellectual background of the period. Three hours lecture.

Lit/En 122. The Renaissance
Major literary works of the Renaissance as seen against the historical and intellectual background of the period. Three hours lecture.

Lit/En 123. The Enlightenment
The intellectual temper of the Age of Reason as reflected in the work of Dryden, Swift, Pope, Fielding, Stone, Johnson, and others. Three hours lecture.

Lit/En 124. The Nineteenth Century **S**
Readings in the Romantics and Victorians; the intellectual background of the age. Three hours lecture.

Lit/En 125. American Literature: Nineteenth Century **W**
A critical study of major American writers of the nineteenth century: Poe, Hawthorne, Melville, Thoreau, and others. Three hours lecture.

Lit/En 126. The Twentieth Century: English and American **S**
A critical study of major American and English writers of our period. Three hours lecture.

Lit/En 131. Studies in Fiction
Historical and critical problems in the art of fiction. Papers and discussion. Two hours, seminar.

Lit/En 132. Studies in Poetry **W**
Historical and critical problems in the art of poetry. Papers and discussion. Two hours, seminar.

Lit/En 133. Studies in Drama
Historical and critical problems in the art of drama. Papers and discussion. Two hours, seminar.

Lit/En 134. Studies in Criticism
The major theories and methods of literary criticism and interpretation. Papers and discussion. Two hours, seminar.

Lit/En 141. History of the English Language
A study of the historical development of the English Language. Papers and discussion. Two hours, seminar.

Lit/En 151. Shakespeare **F**
A study of selected plays. Papers and discussion. Three hours lecture. Required of English majors.

Lit/En 192. Problems in Interpretation **W**
Studies of works, periods, or topics in the primary literature of the student's major. As the second element in the two-quarter Senior Major Sequence, required of all majors in English Literature. Two hours, seminar. Prerequisite: Literature 191.

Lit/En 199. Special Studies **F,W,S**
Tutorial; individual guided reading in an area not normally covered in courses. May be repeated for credit.

GRADUATE

Lit/En 202. Bibliography and Methods of Research (3)
Tools, methods, and standards of scholarly research in literature, including establishment of texts and bibliographical description. Seminar.

Lit/En 211. Old English Literature (3) **W**
Consideration of one or more major figures, texts, or trends in Old English literature. Topic varies from year to year. Offered for repeated registration. Seminar.

Lit/En 214. Middle English Literature (3) **S**
Consideration of one or more major figures, texts, or trends in Middle English literature, including medieval drama. Topic varies from year to year. Offered for repeated registration. Seminar.

Lit/En 221. Sixteenth-Century English Literature (3) **S**
Critical study of one or more major figures, texts, or literary trends in Tudor England. Topic varies from year to year. Offered for repeated registration. Seminar.

Lit/En 224. Seventeenth-Century English Literature (3) **F**
Consideration of one or more major figures, texts, or trends in seven-

teenth-century English literature, including the Metaphysical Poets and the drama. Topic varies from year to year. Offered for repeated registration. Seminar.

Lit/En 226. Shakespeare (3) **W**
Shakespeare's plays in relation to the Elizabethan background; selected major texts. Topic varies from year to year. Offered for repeated registration. Seminar.

Lit/En 231. Restoration and Eighteenth-Century English Literature: 1660–1745 (3) **F**
Consideration of one or more figures, texts, or trends in Restoration and early-eighteenth-century English literature, including Dryden, Pope, Swift, the early novel, satire. Topic varies from year to year. Offered for repeated registration. Seminar.

Lit/En 236. Later-Eighteenth–Century English Literature (3) **W**
Consideration of one or more major figures, texts, or trends in later-eighteenth-century English literature, including Fielding, Johnson, Blake, Jane Austen, the major novelists. Topic varies from year to year. Offered for repeated registration. Seminar.

Lit/En 245. Nineteenth-Century American Sudies (3) **S**
Consideration of some of the principal writers and movements in nineteenth-century American literature. Topic varies from year to year. Offered for repeated registration. Seminar.

Lit/En 246. Victorian Literature (3) **W**
Consideration of one or more major figures or trends in the Victorian period, including Arnold, Tennyson, Ruskin, Pater, Hopkins, James, and the early Yeats. Topic varies from year to year. Offered for repeated registration. Seminar.

Lit/En 251. Twentieth-Century English Literature (3) **S**
Consideration of one or more major figures, texts, or trends in twentieth-century English literature, including Yeats, Hardy, Lawrence, drama. Topic varies from year to year. Seminar.

Lit/En 252. Studies in Modern American Literature and Culture (3) **S**
Consideration of one or more major figures, texts, or trends in American literature, in particular the relationship between literature and culture. Topic varies from year to year. Offered for repeated registration. Seminar.

French Literature

LOWER DIVISION

Lit/Fr 11A-11B-11C. Readings in French Literature and Culture **F-W-S**
Three meetings. Prerequisite: completion of lower-division proficiency in French.

UPPER DIVISION

(Upper-division standing or consent of the instructor is prerequisite to all upper-division courses. The language of instruction is French.)

Lit/Fr 101A-101B-101C. The Great Tradition **F-W-S**
A chronological study of important French writers. Required of French majors.

Lit/Fr 123. The French Novel: Nineteenth Century **F**
A comparative study of the principal novelists, beginning with Balzac, in terms of different forms—such as the social novel, the fantastic narrative, the educational novel—and different themes—such as the novel of objects. Three hours lecture.

Lit/Fr 192. Problems in Interpretation **W**
Studies of works, periods, or topics in the primary literature of the student's major. As the second element in the two-quarter Senior Major Sequence, required of all majors in French Literature. Two hours, seminar. Prerequisite: Literature 191.

Lit/Fr 199. Special Studies **F,W,S**
Tutorial; individual guided reading in areas of French literature not normally covered in courses. May be repeated for credit.

GRADUATE

Lit/Fr 203. History of the French Language (3)
A study of the French language from its origins through the sixteenth century. Prerequisite: basic knowledge of French. (Conducted in English.)

German Literature

LOWER DIVISION

Lit/Ge 11A-11B-11C. Readings in German Literature and Culture **F-W-S**
Three meetings. Prerequisite: completion of lower-division proficiency in German.

UPPER DIVISION

(Upper-division standing or consent of the instructor is prerequisite to all upper-division courses. The language of instruction is German.)

Lit/Ge 101A-101B-101C. The Great Tradition **F-W-S**
A chronological study of important German writers. Required of German majors. Three hours lecture.

Lit/Ge 121. Medieval Literature
Major literary works of the Middle Ages in their historical and intellectual context. Three hours lecture.

Lit/Ge 122. Reformation and Baroque
The important literary and intellectual developments of the sixteenth and seventeenth centuries. Three hours lecture.

Lit/Ge 123. The Classical Drama
Selected plays by Lessing, Goethe, Schiller and Kleist in their historical context. Three hours lecture.

Lit/Ge 124. Romanticism
The fiction, poetry, and criticism of the major Romantic authors. Three hours lecture.

Lit/Ge 131. Studies in the Eighteenth Century
Historical and critical problems in the literature of the eighteenth century. Two hours, seminar.

Lit/Ge 132. Studies in the Nineteenth Century
Historical and critical problems in the literature of the nineteenth century. Two hours, seminar.

Lit/Ge 133. Studies in the Twentieth Century
Historical and critical problems in the twentieth century. Two hours, seminar.

Lit/Ge 151. Goethe
A study of some major works in the context of Goethe's life and milieu. Seminar. Three hours lecture. Required of German majors.

Lit/Ge 192. Problems in Interpretation **W**
Studies of works, periods, or topics in the primary literature of the student's major. As the second element in the two-quarter Senior Major Sequence, required of all majors in German Literature. Two hours, seminar. Prerequisite: Literature 191.

Lit/Ge 199. Special Studies **F,W,S**
Tutorial; individual guided reading in areas of German literature not normally covered in courses. May be repeated for credit.

Greek Literature

LOWER DIVISION

Lit/Gr 11A-11B-11C. Readings in Greek Literature and Culture
Translation and interpretation of classic texts (Homer, lyric poetry, Herodotus, Plato). Prerequisite: a course in elementary Greek, or consent of the instructor.

Italian Literature

GRADUATE

Lit/It 215. Dante (3) **S**
A study of the poet, his cultural background and his political-historical mission. Prerequisite: basic knowledge of Italian. (Conducted in English.)

Latin Literature

LOWER DIVISION

Lit/La 11A-11B-11C. Readings in Roman Literature and Culture **F-W-S**
Translation and interpretation of classic texts (Catullus, Virgil, Horace, Cicero, Sallust). Prerequisite: a course in elementary Latin, or consent of the instructor.

Russian Literature

LOWER DIVISION

Lit/Ru 11A-11B-11C. Readings in Russian Literature and Culture **F-W-S**
Three meetings. Prerequisite: completion of lower-division proficiency in Russian.

UPPER DIVISION

Lit/Ru 199. Special Studies **F,W,S**
Tutorial; individual guided reading in areas of Russian literature not

normally covered in courses. Prerequisite: upper-division standing or permission of the Department.

Spanish Literature

LOWER DIVISION

Lit/Sp 11A-11B-11C. Readings in Spanish Literature and Culture **F-W-S**
One lecture (given by a faculty member) on a literary or cultural topic and two section meetings (led by teaching assistants) each week. In section meetings texts will be discussed and language instruction given as needed. Students with slighter preparation will enter this sequence and may change to the 12-sequence after one quarter. Prerequisite: student must have passed the lower-division proficiency test in Revelle College.

Lit/Sp 12A-12B-12C. Readings in Spanish Literature and Culture **F-W-S**
One lecture and two section meetings, as in Spanish 11. Readings are at a more advanced level of difficulty. Prerequisites: passing of the lower-division language proficiency test in Revelle College with a score of 30 or higher on the reading section, usually the equivalent of 3 years or more of high school Spanish; or completion of one quarter of Spanish 11 with a grade of C or better.

UPPER DIVISION

(Upper-division standing or consent of the instructor is prerequisite to all upper-division courses. The language of instruction is Spanish.)

Lit/Sp 101A-101B-101C. The Great Tradition **F-W-S**
A chronological study of important Spanish writers. Required of Spanish majors. Three hours lecture.

Lit/Sp 121. Medieval Literature
Major literary works of the Middle Ages in their historical and intellectual context. Three hours lecture.

Lit/Sp 122. Golden Age Drama
The major dramatists of the sixteenth and seventeenth centuries. Three hours lecture.

Lit/Sp 123. The Nineteenth-Century Novel **F**
Spanish fiction during the post-Napoleonic age. Three hours lecture.

Lit/Sp 124. The Generation of '98 **S**
The renaissance of Spanish letters at the turn of the twentieth century. Three hours lecture.

Lit/Sp 131. Studies in Golden Age Prose (except Cervantes)
Historical and critical problems in sixteenth- and seventeenth-century prose. Two hours, seminar.

Lit/Sp 132. Studies in Golden Age Poetry **W**
Historical and critical problems in sixteenth- and seventeenth-century poetry. Two hours, seminar.

Lit/Sp 133. Studies in the Eighteenth and Nineteenth Centuries
Historical and critical problems in the literature of the eighteenth and nineteenth centuries. Two hours, seminar.

Lit/Sp 134. Studies in Twentieth-Century Literature
Critical and cultural problems in contemporary literature. Two hours, seminar.

Lit/Sp 151. Cervantes **S**
General survey of the major works of Cervantes. Three hours lecture. Required of Spanish majors.

Lit/Sp 192. Problems in Interpretation **W**
Studies of works, periods, or topics in the primary literature of the student's major. As the second element in the two-quarter Senior Major Sequence, required of all majors in Spanish Literature. Two hours, seminar. Prerequisite: Literature 191.

Lit/Sp 199. Special Studies **F,W,S**
Tutorial; individual guided reading in an area of Spanish literature not normally covered in courses. May be repeated for credit.

GRADUATE

Lit/Sp 203. History of the Spanish Language (3)
Conducted in Spanish. A study of Latin and its development into Vulgar Latin and ultimately into the Peninsular vernacular speech, tracing the differentiation of the major languages and dialects, concentrating on Castillian. Attention will be given to Sephardic, Andalusian and American Spanish. Prerequisites: elementary knowledge of Spanish and Latin.

Lit/Sp 212. Introduction to Hispano-Arabic Literature (3) **S**
The course will deal particularly with poetry, its development in pre-Islamic Arabia and its flowering in Andalusia. Hispano-Arabic poetry and its possible relation to medieval European lyricism will be discussed. Representative texts available in translations will be read and commented upon. Topic varies from year to year. Offered for repeated registration.

Lit/Sp 224. Golden Age Studies (3) **S**
Consideration of one or more major figures, texts, trends, or problems in Spanish Golden Age studies. Topic varies from year to year. Offered for repeated registration.

Lit/Sp 226. Cervantes (3)
A critical reading of the *Quijote*. Prerequisite: knowledge of Spanish.

Lit/Sp 241. Romanticism in Spain (3)
A historical review of Spanish Romanticism, with special attention to certain basic works. Prerequisite: knowledge of Spanish.

Lit/Sp 248. Nineteenth-Century Theater (3) **F,W**
The nineteenth-century dramatic vision will be studied, with emphasis on new characters, new environment, and new elements in the structure of society. Three hours seminar.

Lit/Sp 254. Modern Spanish Poetry (3) **W**
A historical approach to modern Spanish poetry with special attention to some of the major poets: Unamuno, Machado, Juan Ramon Jimenez, Lorca, Salinas. Prerequisite: knowledge of Spanish.

MARINE BIOLOGY

Office: 1166 Ritter Hall, SIO

Andrew A. Benson, *Ph.D., Professor of Biology*
(Chairman of the Department)
Denis L. Fox, *Ph.D., Professor of Marine Biochemistry*
Susumu Hagiwara, *M.D., Professor of Physiology*
H. T. Hammel, *Ph.D., Professor of Physiology*
Francis T. Haxo, *Ph.D., Professor of Biology*
Ralph A. Lewin, *Ph.D., Professor of Biology*
Per F. Scholander, *M.D., Ph.D., Professor of Physiology*
Benjamin E. Volcani, *Ph.D., Professor of Microbiology*
Claude E. ZoBell, *Ph.D., Professor of Marine Microbiology*
Nicholas D. Holland, *Ph.D., Assistant Professor of Marine Biology*
Richard Rosenblatt, *Ph.D., Assistant Professor of Marine Biology*
Reuben Lasker, *Ph.D., Associate Professor of Marine Biology in Residence*

* * *

Theodore H. Bullock, *Ph.D., Professor of Neurophysiology*
Edward W. Fager, *Ph.D., D.Phil., Professor of Biology*
Carl L. Hubbs, *Ph.D., Professor of Biology Emeritus*
Martin W. Johnson, *Ph.D., Professor of Marine Biology Emeritus*
William A. Newman, *Ph.D., Assistant Professor of Oceanography*

* * *

Theodore Enns, *Ph.D., Research Physiologist, Lecturer in Marine Biology*

* * *

Charles R. Schroeder, *D.V.M., Research Associate*
Thomas W. Whitaker, *Ph.D., Research Associate*

On June 1, 1967, the Departments of Earth Sciences, Marine Biology, and Oceanography were combined into the single Department of the Scripps Institution. Admission and curricular requirements, and courses to be offered, are expected to remain essentially unchanged for the academic year 1967-68.

The Department of Marine Biology offers a program of graduate studies leading to the M.S. or Ph.D. The program emphasizes experimental as well as some areas of descriptive biology of marine organisms. The studies at present include microbiology, cellular and comparative physiology and biochemistry, physiological ecology, systematics and life histories, genetics and evolution.

Students who intend to specialize in marine biology should have broad general preparation in biology and training in at least one specific discipline, e.g., microbiology, animal or plant physiology, biochemistry, invertebrate or vertebrate zoology. Students in the Department of Marine Biology are encouraged to supplement their training with courses in related

disciplines such as oceanography, the biological sciences, the earth sciences, and chemistry. Qualified students in the Department of Marine Biology may, with the approval of each department concerned, pursue their research under joint guidance of an adviser in the Marine Biology Department and an adviser in another department.

Provisions can also be made for certain students working on marine plants, animals, or microorganisms to complete some of their requirements or to pursue some of their research under the supervision of an adviser on another UC campus.

The Graduate Program

(No undergraduate major in Marine Biology is offered.)

Requirements for Admission

1. A baccalaureate degree with a major in one of the biological sciences, or substantially equivalent preparation. Basic preparation in botany and zoology is required.
2. A one-year course in each of the following: English, mathematics (including calculus), and physics with laboratory.
3. At least a one-year course in chemistry and a course in organic chemistry; biochemistry, and physical chemistry are recommended, especially for students in physiological biology.
4. Preparation in two foreign languages (one for the M.S. degree), chosen from the following: German, French, Russian.

Master's Degree Program

Both Plan I (30 units and thesis) and Plan II (36 units and comprehensive examination) are offered. (See *Graduate Division: The Master's Degree.*) Unit requirements may be satisfied by approved selections from courses listed in Marine Biology, Oceanography and other departments, and must include Oceanography 110, 112, and 114. A total of 18 units in graduate courses, including seminar work (e.g., Marine Biology 252 or Oceanography 253) is required during at least two quarters in each year of residence. Research (Marine Biology 299) units may aggregate a maximum of 8 units under Plan I and a maximum of 6 units under Plan II. A reading knowledge of German, French, or Russian is required.

Doctor's Degree Program

The requirements for the Ph.D. include, ordinarily, the required courses listed above for the M.S. degree. Reading knowledge of German and either French or Russian is required (to be demonstrated before the end of the second year). The student should pass the departmental examination during his second year, and the qualifying examination by the end of the first quarter of his third year. The independent study and research for the thesis may be done under Marine Biology 299 and in such fields as those named above.

COURSES

UPPER DIVISION

199. Special Studies F,W,S
Prescribed reading, laboratory or field studies, oral or written reports in any of the listed areas of marine biology; or any combination of such assignments as issued by the student's supervisory instructor. Prerequisite: consent of the instructor.

GRADUATE

221. Marine Microbiology (3) W
Mr. ZoBell
Ecology, biochemical activities, and methods of studying bacteria and allied microorganisms in the sea, with particular reference to their effects on other organisms and as geochemical agents. Prerequisites: preparation in general microbiology, bacterial physiology, and biochemistry. Oceanography 110, 112, 114 are recommended.

224. Biology of Algae (2) F
Mr. Haxo, Mr. Lewin
Systematics and ecology of shore algae with emphasis on comparative physiology. Integrated lecture, laboratory, and field instruction. Prerequisite: consent of the instructor.

225. Physiology of Marine Algae (3) F
Mr. Haxo
Lectures and laboratory in comparative physiology of algae with emphasis on marine problems. Prerequisites: basic courses in biology and chemistry.

226. Marine and Comparative Biochemistry (3) W
Mr. Fox
Chemistry of living matter; osmotic adaptation in the hydrosphere; marine colloids; comparative biochemical and physiological activities of aquatic organisms, biochemical cycles in the sea; animal pigments. Prerequisites: preparation in biology, organic chemistry, and biochemistry or physiology; consent of the instructor. Oceanography 112, 114 are recommended.

227. Biological Chemistry of Marine Organisms (3) S
Mr. Benson
Biochemistry of major products of marine organisms with emphasis on carbohydrates and lipids. The current concepts of their structural and physiological function will be presented and discussed. Prerequisites: organic chemistry required, physical chemistry and biochemistry recommended.

235. Biology of Fishes (4) W
Mr. Rosenblatt
The comparative evolution, morphology, physiology and ecology of fishes. Special emphasis on local and deep-sea and pelagic forms in laboratory. Prerequisite: consent of the instructor.

240A-240B. Physiology of Marine Animals (3-3) **W-S**
Mr. Holland
Physiology of marine animals at various levels of biological organization, with particular reference to cellular and organismal functions. In the laboratory, students will undertake individual research projects. Prerequisites: basic courses in biology and chemistry; consent of the instructor.

252. Seminar in Experimental and Comparative Biology (2) **F,W,S**
The Staff

253. Seminar: The Species (2) **W**
Mr. Lewin
The use and misuse of the species concept and the diverse mechanisms of speciation will be considered in relation to various groups of plants and animals and the special problems presented by each.

255. Marine Biology Seminar (1) **F,W,S**
Mr. Lewin and Staff
A seminar dealing with various topics in the biological sciences. Lectures given by visiting scientists and resident staff and students.

260. Seminar in Advanced Ichthyology (2) **F,S**
Mr. Hubbs, Mr. Rosenblatt

270. Cellular Structure and Biochemical Function (3) **S**
Mr. Volcani
Lectures and laboratory studies of subcellular structures and their function in cell metabolism. Experiments involving techniques for isolation and biochemical assay with special reference to marine organisms. Prerequisites: preparation in biology and biochemistry; consent of the instructor. Marine Biology 227 and Biology 201 are recommended as background.

275A-275B. Shore Microbiology (3-3) **W-S**
Mr. Lewin
Field and laboratory investigations of the ecology, physiology and metabolic activities of marine littoral microorganisms: algae, bacteria, fungi and protozoans. Special methods of isolating and culturing selected organisms, individual research projects. Prerequisites: preparation in biological sciences, including physiology or microbiology. Introductory courses in chemistry and biology of the sea are recommended.

285. Laboratory in Physiology (2-4) **S**
Mr. Scholander
Research techniques and problems in selected areas of environmental physiology.

286. Isotope Tracer Techniques in Physiology (2) **S**
Mr. Enns
Physiological transport and related processes as determined by isotope tracers. Radiation physics and the quantitative detection of radioactive and stable isotopes. Prerequisite: physical chemistry recommended.

299. Research (1-6) **F,W,S**

The Staff

Research in such fields as comparative biochemistry or physiology of marine plants and animals, biophysics, microbiology, phycology, vertebrate and invertebrate zoology, genetics and evolution. Research reports are submitted at the end of each term.

MATHEMATICS

Office: 3234 Urey Hall

Errett A. Bishop, *Ph.D., Professor of Mathematics*
Theodore T. Frankel, *Ph.D., Professor of Mathematics*
Adriano M. Garsia, *Ph.D., Professor of Mathematics*
Ronald K. Getoor, *Ph.D., Professor of Mathematics*
Jacob Korevaar, *Ph.D., Professor of Mathematics*
†Helmut Röhrl, *D.Sc., Professor of Mathematics*
Murray Rosenblatt, *Ph.D., Professor of Mathematics*
(Chairman of the Department)
Stefan E. Warschawski, *Ph.D., Professor of Mathematics*
Hubert Halkin, *Ph.D., Associate Professor of Mathematics*
Burton Rodin, *Ph.D., Associate Professor of Mathematics*
Stephen A. Andrea, *Ph.D., Assistant Professor of Mathematics*
Barry G. Eke, *Ph.D., Assistant Professor of Mathematics*
Richard L. Faber, *Ph.D., Assistant Professor of Mathematics*
John B. Ferebee, *Ph.D., Assistant Professor of Mathematics*
Jay P. Fillmore, *Ph.D., Assistant Professor of Mathematics*
Carl H. FitzGerald, *Ph.D., Assistant Professor of Mathematics*
William B. Gragg, Jr., *Ph.D., Assistant Professor of Mathematics*
John A. R. Holbrook, *Ph.D., Assistant Professor of Mathematics*
Patrick J. Ledden, *Ph.D., Assistant Professor of Mathematics*
Eugene Lee, *Ph.D., Assistant Professor of Mathematics*
Alfred B. Manaster, *Ph.D., Assistant Professor of Mathematics*
Michael J. Sharpe, *Ph.D., Assistant Professor of Mathematics*
Donald R. Smith, *Ph.D., Assistant Professor of Mathematics*
Frank B. Thiess, *Ph.D., Assistant Professor of Mathematics*
Stanley G. Williamson, *Ph.D., Assistant Professor of Mathematics*
†On leave 1967–68.

* * *

Morton Brown, *Ph.D., Visiting Professor of Mathematics*
Roland Bulirsch, *D.Sc., Visiting Associate Professor of Mathematics*
Josef Stoer, *D.Sc., Visiting Associate Professor of Mathematics*
Luis Baéz-Duarte, *Ph.D., Visiting Assistant Professor of Mathematics*
Paul Léonard, *D.Sc., Visiting Assistant Professor of Mathematics*
Masao Nagasawa, *D.Sc., Visiting Assistant Professor of Mathematics*
George H. Senge, *Ph.D., Lecturer in Mathematics*

The Undergraduate Program

The upper-division curriculum provides programs for mathematics majors as well as courses for students who will use mathematics as a tool in the physical and behavioral sciences and the humanities. A major is offered in Revelle and in Muir College.

The student majoring in mathematics will take, in addition to the basic calculus sequence (Mathematics 2A-2B-2C), at least fifteen one-quarter courses in the upper division. The program will normally include a basic course in differential equations and vector analysis (Mathematics 100), matrices and linear transformations (Mathematics 101), and an introduction to analysis (Mathematics 102), as well as a one-year sequence in linear algebra and group theory (Mathematics 110A-110B-110C). The remaining nine courses shall be chosen from areas in analysis, geometry, algebra and applied mathematics, fitted to the interests of the student, with the approval of the major adviser. The Department recommends that students include the "Functions of Several Variables" (Mathematics 150A-150B-150C) or the "Introduction to Analysis and Topology" (Mathematics 155A-155B) in their program.

In *Revelle College*, in accordance with the general requirements for the B.A. degree, the student will take six one-quarter courses in a noncontiguous minor field as approved by his major adviser. In addition the student will take three one-quarter courses in an area in which mathematics plays a basic role (restricted elective). With a judicious choice of program the student will still have three (unrestricted) electives to choose in completing the requirements for the B.A. degree.

Foreign languages recommended for mathematics majors are German, French, and Russian.

Students who at the end of their freshman year expect to major in mathematics should use the three electives in the sophomore year to take Mathematics 100, 101, and 102. This will enable them to complete a strong major curriculum in the most orderly fashion as far as preparation and continuity are concerned.

Students who do not decide on a major until their junior year may satisfy one-half the requirements for the noncontiguous minor (Revelle College) by a proper choice of electives in the sophomore year. In this way they can complete all of the above requirements for the B.A. degree in the normal period of four years.

In *Muir College* the student majoring in mathematics must comply with the general educational requirements of the College.

Students will be encouraged to progress at a rate commensurate with their abilities. They will be able to accelerate their work by independent study and special seminars and to demonstrate their progress by proficiency examination in place of taking courses.

Major Program in Mathematics (Recommended Schedule)

	Fall	Winter	Spring
Junior Year	Math 110A	Math 110B	Math 110C
	*	*	*
	**	**	**
Senior Year	*	*	*
	†	†	†

*Choices from: Mathematics 150A-150B-150C
Mathematics 155A-155B plus 160A or 166
Mathematics 120, 121, 122
Mathematics 123, 124A-124B
Mathematics 126A-126B-126C
Mathematics 130A-130B-130C
Mathematics 130A, 133A-133B
Mathematics 141A-141B-141C
Mathematics 160A-160B-160C

**Three electives in an area in which mathematics plays a major role.

†Any course sequence in the above list not previously taken, or a basic graduate course.

The Graduate Program

The Department of Mathematics offers a graduate program leading to the M.A. and Ph.D. degrees.

Admission to the graduate program is in accordance with the general requirements of the Graduate Division of the University of California. Students with a bachelor's degree and a background in mathematics comparable to the requirements for the undergraduate major in mathematics at this university may apply for admission.

Master's Degree Program

Requirements for the Master of Arts degree are to be met according to Plan II (comprehensive examination). (See *Graduate Division: The Master's Degree.*) Students will be expected to have at least 18 units in graduate courses in mathematics, 9 units of graduate courses in mathematics or a related field approved by the Department, and 9 units of graduate or upper-division courses. The latter may be in mathematics or in a related field, subject to approval by the Department. No research units may be used in satisfying the requirements for the master's degree. The comprehensive examination will cover basic topics in two of the following six areas, to be selected by the candidate from two of the following three lists:

1. Algebra; topology
2. Real analysis; complex analysis

3. Applied mathematics; numerical analysis and computer sciences

A detailed list of the depth requirements in each of these areas, with literature references and approved courses, is available in the office of the Mathematics Department.

A reading knowledge of one foreign language (French, German, or Russian) is required. In exceptional cases other languages may be substituted upon petition to the Graduate Division.

Doctor's Degree Program

During the first two years the student will acquire a general background in mathematics and prepare himself for the departmental qualifying examinations. Written examinations must be taken in four areas:

1. Algebra
2. Real analysis
3. Topology
4. One field chosen by the student from the following: complex analysis, differential geometry, ordinary or partial differential equations, applied mathematics, numerical analysis and computer sciences, probability and mathematical statistics.

A detailed list of the depth requirements in each of these areas, with literature references and approved courses, is available in the office of the Mathematics Department.

After satisfactory completion of the departmental examinations, a doctoral committee appointed by the Graduate Division will conduct the student's oral qualifying examination. Before taking the oral qualifying examination the student must demonstrate a satisfactory reading knowledge of two foreign languages (chosen from French, German, or Russian). In exceptional cases other languages may be substituted.

Successful passing of the oral qualifying examination advances the student to candidacy for the doctor's degree. The student will subsequently devote himself to study and research for his doctoral dissertation. After completion of the dissertation he will take the final examination, which is conducted by his doctoral committee. The examination is oral and deals primarily with the dissertation and its relationship to the general field in which the subject lies.

COURSES

LOWER DIVISION

As part of the general program of the lower division in Revelle and Muir Colleges, all students take a one-year sequence of courses in mathematics.

1A. Elements of Mathematical Analysis **F,W**

Review of topics in algebra and trigonometry. Differentiation and integration of algebraic functions; applications; basic analytic geometry in the plane. Three lectures, two recitations. Prerequisite: two units of high school mathematics.

1B. Elements of Mathematical Analysis **W,S**

Differentiation and integration of trigonometric functions, the logarithm

and the exponential function. Three lectures, one recitation. Prerequisite: Mathematics 1A.

1C. Elements of Mathematical Analysis **S,F**
Definite integral and its applications; partial derivatives, multiple integrals; elements of linear algebra. Three lectures, one recitation. Prerequisite: Mathematics 1B.

2A. Calculus and Analytic Geometry **F,W**
Differential and integral calculus of functions of one variable: limit, continuity; differentiation of algebraic and trigonometric functions; applications. Definite integral, primitive functions, fundamental theorem of the calculus. Elements of analytic geometry as needed in the development of the calculus. Three lectures, two recitations. Prerequisites: three or more units of high school mathematics; one-half unit of trigonometry is desirable.

2B. Calculus and Analytic Geometry **W,S**
Continuation of calculus of functions of one variable: differentiation and integration of logarithm, exponential functions, Taylor's formula. Parametric representation. Applications of integration. Elements of linear algebra; analytic geometry in three-space. Three lectures, one recitation. Prerequisite: Mathematics 2A.

2C. Calculus and Analytic Geometry **S,F**
Calculus of functions of several variables: partial differentiation; directional derivative; total differential. Maxima and minima of functions of several variables. Lagrange multipliers, multiple integration. Infinite series, series with constant terms, power series. Three lectures, one recitation. Prerequisite: Mathematics 2B.

5A. Introduction to Mathematics **F**
Review of high school geometry. Topics in Euclidean geometry. Projective geometry. Three lectures, two recitations. Prerequisites: two units of high school mathematics.

5B. Introduction to Mathematics **W**
Sets and logic. Axiomatic method. Properties of real numbers. Coordinate geometry. Three lectures, two recitations. Prerequisite: Mathematics 5A.

5C. Introduction to Mathematics **S**
Basic notions of calculus: functions, differentiation of elementary functions, applications. Definite and indefinite integral and applications. Three lectures, two recitations. Prerequisite: Mathematics 5B.

(Mathematics 5A-5B-5C may be used in fulfilling the Muir College mathematics requirement.)

10. Topics in Mathematics
A series of one-quarter courses on various areas in mathematics (see below). Three lectures, one recitation. Prerequisite: four units of high school mathematics, or permission of the Department. (Three "Topics"

courses will fulfil the Muir College lower-division mathematics requirement.)

10A. Probability and Statistics **F**
Probability, random walk, sample surveys, simple random sampling, population sampling, finite state Markov chains, Monte Carlo.

10B. Elementary Topology **W**
Theory of graphs, bridge problems, knots, braids, polyhedra in three-space and Euler formula, orientability, Möbius strips, coloring problems, tiling problems for the plane, surfaces in three-space with self-intersections.

10C. Elementary Number Theory **S**
Division algorithm, greatest common divisor, least common multiple, primes, fundamental theorem, congruences and residues, Wilson's theorem, simultaneous linear congruences, polynomial congruences, primitive roots, quadratic residues, Legendre symbol, reciprocity law.

Other topics which may be offered:
Computer Sciences
Theory of Games
Groups in Geometry
Projective Geometry
Elementary Logic and Set Theory

40. Topics in Elementary Analysis **F,W**
Partial derivatives, line integral. Differential equations: equations of first order, integrating factor, linear equations with constant coefficients. Elements of probability and statistics. A terminal course for students who desire training in mathematics beyond Mathematics 1A-1B-1C. Three lectures, one recitation. Prerequisite: Mathematics 1C.

UPPER DIVISION

100. Differential Equations and Vector Analysis **F,W,S**
Linear differential equations, equations with constant coefficients, solutions by series. Line, surface, and volume integrals, theorems of Stokes and Green. Three lectures and one recitation. Prerequisite or co-registration: Mathematics 2C.

101. Matrices and Linear Transformations **F,W,S**
Linear equations, matrices, vector spaces, linear transformations, determinants, eigenvalues, orthogonal and unitary transformations, quadratic forms. Systems of differential equations, exponential of a matrix. Three lectures and one recitation. Prerequisite or co-registration: Mathematics 100.

102. Introductory Analysis **S**
The real number system, topology of Euclidean n-space, properties of continuous functions, Riemann integral. Uniform convergence. Three lectures. Prerequisite: Mathematics 100.

109. Undergraduate Seminar F,W,S
Reports by students on assigned reading material and/or discussion of assigned problems in areas compatible with the students' background. Designed to develop insight and originality as well as mathematical techniques. Three periods. Prerequisite: permission of the Department.

110A. Linear Algebra and Group Theory F
Fields, vector spaces, direct products and sums, basis theorems, homomorphisms and matrices, dual spaces, transpose, subspaces and quotient spaces, induced endomorphisms, isomorphism theorems, exact sequences and splitting, invariant subspaces, trace. Three lectures. Prerequisite: Mathematics 2C.

110B. Linear Algebra and Group Theory W
Multilinear mappings with symmetry properties; tensor, symmetric and alternating products of vector spaces and homomorphisms; splitting theorems and basis theorems; determinants, forms. Three lectures. Prerequisite: Mathematics 110A.

110C. Linear Algebra and Group Theory S
Groups, homomorphisms, subgroups, quotients groups, homomorphism theorems, abelian groups, classification of finitely generated abelian groups, permutation groups. Groups operating on vector spaces, classical groups, tensor representation of classical groups. Three lectures. Prerequisite: Mathematics 110B.

120, 121, 122. Advanced Mathematics for Physical Science Majors
(See below.)

120. Complex Variables W
Complex numbers, complex valued functions, analytic functions. Cauchy-Riemann equations, elementary functions and conformal mapping, basic concepts of two-dimensional potential theory, complex integration, Cauchy's theorem, Cauchy's formula, power series, residue theory and applications. Ordinary differential equations in the complex plane. Four lectures. Prerequisite or co-registration: Mathematics 100.

121. Introduction to Ordinary and Partial Differential Equations F
Bessel, Hermite, Legendre and other special functions. Orthogonal expansions, eigenvalue problems, Sturm-Liouville theory. Some partial differential equations of mathematical physics. Boundary value problems, separation of variables. Four lectures. Prerequisite: Mathematics 100.

122. Integral Transforms S
Additional topics on Fourier series. Fourier, Laplace and other transforms. Applications to ordinary and partial differential equations. Three lectures. Prerequisites: Mathematics 120, 121.

123. Ordinary Differential Equations F
Existence and uniqueness of solutions of differential equations and of

systems. Linear systems with constant and variable coefficients; solutions in matrix form. Local and global theorems of continuity and differentiability. Autonomous systems. Stability: Lyapounov's theorem. Three lectures. Prerequisites: Mathematics 100, 101.

124A-124B. Introduction to Control Theory **W-S**
State space, dynamical system, control system. Optimal control problems; Pontryagin's maximum principle; the linear problem; the bang-bang principle and extensions; nonlinear problems; relations with calculus of variations and dynamic programming; Lyapounov's stability; numerical methods in system optimization. Applications to aeronautical engineering, electrical engineering and economics. Stochastic optimal control and programming under uncertainty. Three lectures. Prerequisites: Mathematics 100, 101, 102, or consent of the instructor.

126A. Elements of Partial Differential Equations and Integral Equations **F**
Basic concepts and classification of partial differential equations. First order equations, characteristics. Hamilton-Jacobi theory, Laplace's equation, wave equation, heat equation. Separation of variables, eigenfunction expansions, existence and uniqueness of solutions. Three lectures. Prerequisite: Mathematics 121.

126B. Elements of Partial Differential Equations and Integral Equations **W**
Relation between differential and integral equations, some classical integral equations, Volterra integral equations, integral equations of the second kind, degenerate kernels, Fredholm alternative, Neumann-Liouville series, the resolvent kernel. Three lectures. Prerequisite: Mathematics 126A.

126C. Elements of Partial Differential Equations and Integral Equations **S**
Maximum-minimum problems, method of Lagrange, classical problems in the calculus of variations, general formulation of a variational problem, special methods of solution. Euler-Lagrange equations, applications to physics: Fermat principle, Lagrangean and Hamiltonian formulation of mechanics, theorem of E. Noether. Three lectures. Prerequisite: Mathematics 126B.

130A. Introduction to Probability **F,S**
Probability spaces, independence and conditional probability, random variables, distributions, expectations, joint distributions, law of large numbers, central limit theorem. Three lectures. Prerequisite: Mathematics 2C.

130B. Introduction to Probability **W**
Random walk, generating functions, runs and recurrent events, discrete fluctuation theory; Markov chains with discrete state space. Three lectures. Prerequisite: Mathematics 130A.

130C. Introduction to Probability **S**
Markov chains with continuous state space, simple diffusion-processes, stationary processes, fluctuations and queuing theory. Three lectures. Prerequisite: Mathematics 130B.

133A. Introduction to Statistics W
Random samples, linear regression, least squares, testing hypotheses and estimation. Neyman-Pearson lemma, likelihood ratios. Three lectures. Prerequisite: Mathematics 130A.

133B. Introduction to Statistics S
Goodness of fit, special small sample distribution and use, nonparametric methods, Kolmogorov-Smirnov statistic, sequential analysis. Three lectures. Prerequisite: Mathematics 133A.

140. Programming of Computers W
Logical design of computers, number representations, machine languages, problem-oriented languages, flow diagrams, iterative algorithms, program organization, debugging methods and symbol manipulation. Three lectures. Prerequisite: Mathematics 101 or consent of the instructor.

141A. Numerical Analysis F
Numerical approximations, interpolation, roots of equations and systems of linear equations, linear eigenvalue problems. Three lectures. Prerequisite: Mathematics 101.

141B. Numerical Analysis W
Difference equations, numerical differentiation and integration, numerical solution of ordinary differential equations, stability and error propagation. Three lectures. Prerequisite: Mathematics 141A.

141C. Numerical Analysis S
Selected special topics such as: extreme values, linear programming, Monte Carlo methods, introduction to numerical analysis of partial differential equations. Three lectures. Prerequisite: Mathematics 141B.

144. Mathematical Programming F,W,S
Elementary topological properties of Euclidean spaces. Convex sets, separation theorems. Simplexes, Sperner lemma, Brouwer fixed-point theorem. Duality, linear programming. Constrained maxima, Kuhn-Tucker theorem, mathematical programming. Three lectures. Prerequisites: Mathematics 100, and 101 or 110A.

150A-150B-150C. Functions of Several Variables F-W-S
Differentiable functions, implicit and inverse function theorems. Integration in Euclidean n-space. Manifolds, exterior differential forms and their integrals, Stokes theorem. Three lectures. Prerequisites: Mathematics 101, 102.

155A. Introduction to Analysis and Topology F
Set theory, Zorn's lemma, metric spaces, continuous mappings, completions, fixed-point theorems, Baire's theorem, compactness, Lebesgue number, connectedness. Four lectures. Prerequisite: Mathematics 102.

155B. Introduction to Analysis and Topology W
Uniform convergence on subsets, function algebras, Ascoli's theorem,

Stone-Weierstrass theorems, structure of function algebras. Four lectures. Prerequisite: Mathematics 155A.

160A. Introduction to Geometry **F or S**
Review of vector spaces, bilinear forms, inner-product geometry, affine geometry, projective geometry, quadrics. Grassmanians. Three lectures. Prerequisite or co-registration: Mathematics 110A.

160B. Introduction to Geometry **W**
Dilatations and translations, coordinates, affine geometry associated with a field, theorems of Desargue and Pappus, projective geometry. Three lectures. Prerequisite: Mathematics 160A.

160C. Introduction to Geometry **S**
Algebraic curves in the complex plane, regular and singular points, Bezout's theorem, local parametrization, Plücker's formulas, Lüroth's theorem. Three lectures. Prerequisite: Mathematics 160B.

166. Differential Geometry **F or S**
Curvature and torsion of space curves, Fenchèl's theorem. Surfaces in space, Gaussian and mean curvature, minimal surfaces. Intrinsic geometry of surfaces, geodesics, parallel displacement, Jacobi fields, Gauss-Bonnet theorem. Prerequisites: some knowledge of matrices and quadratic forms, and consent of the instructor.

199. Independent Study for Undergraduates **F,W,S**
Independent reading in advanced mathematics by individual students. Three periods. Prerequisite: permission of the Department.

GRADUATE

200A-200B-200C. Algebra (3-3-3) **F-W-S**
Mr. Fillmore
Algebraic structures, Jordan-Holder theorem, Sylow theorems, rings and ideals, principal ideal rings, algebraic field extensions, Galois theory, transcendental field extensions, simple and semi-simple modules, Wedderburn theory, representation of finite groups, places and valuations, polynomial and power series rings. Prerequisites: Mathematics 110A-110B-110C, or consent of the instructor.

202A-202B-202C. Commutative Algebra (3-3-3) **F-W-S**
Mr. Röhrl
Noetherian rings and modules; theory of multiplicity; local and semi-local rings; regular local rings; completions; spectrum of a ring; schemes. Prerequisites: Mathematics 110A-110B-110C, 200A-200B-200C, 290A.

203A-203B-203C. Algebraic Geometry (3-3-3) **F-W-S**
The Staff
Places. Hilbert nullstellensatz. Varieties; product of varieties; correspondences; normal varieties. Divisors and linear systems; Riemann-Roch theorem; resolution of singularities of curves. Grothendieck schemes; cohomology. Hilbert schemes; Picard schemes. Prerequisites: Mathematics 110A-110B-110C, 160C, 200A-200B-200C.

204A-204B-204C. Categorical Algebra (3-3-3) **F-W-S**
Mr. Röhrl
Categories; functors; presentable functors; limits and continuous functors; adjoint functors; Abelian categories; homological algebra. Prerequisite: Mathematics 200A or consent of the instructor.

205A-205B-205C. Lie Algebras (3-3-3) **F-W-S**
Mr. Faber
Universal enveloping algebra, cohomology, solvable and nilpotent Lie algebras, theorems of Engel and Lie, semi-simple Lie algebras, representations, Levi decomposition, reductive algebras, Cartan subalgebra, root space decomposition and Weyl group, classification. Prerequisites: Mathematics 110A-110B-110C or consent of the instructor.

208. Seminar in Algebra **F,W,S**
The Staff
Prerequisite: consent of the instructor.

211A-211B-211C. Applied Complex Analysis and Special Functions (3-3-3) **F-W-S**
Mr. Thiess
Complex function theory with special emphasis on applications: two-dimensional potential theory, dispersion relations, etc. Differential equations and special functions. Series expansion, generating functions, integral representations and asymptotic behavior. Prerequisite: Mathematics 102 or equivalent.

212A. Mathematical Methods in Physics and Engineering (4) **F**
Mr. Korevaar
Vector spaces and linear transformations, eigenvalue problems, tensor algebra. Metrics, norms, completeness, the spaces L^p and C, distributions, Delta sequences. Properties of Lebesgue integrals, Stieltjes integrals, line integrals. Prerequisites: Mathematics 100, 101, 102 or advanced calculus.

212B. Mathematical Methods in Physics and Engineering (4) **W**
Mr. Korevaar
Scalar products, orthogonal series in Hilbert space, best approximation. Compact symmetric operators, expansions in eigenvectors. Applications to matrices, quadratic forms, integral equations. Regular and singular Sturm-Liouville problems, Green's functions. Prerequisite: Mathematics 212A or consent of the instructor.

212C. Mathematical Methods in Physics and Engineering (3) **S**
Mr. Korevaar
Fourier transforms of functions and distributions, Laplace transforms, applications to boundary value problems. Simple second order elliptic, hyperbolic and parabolic partial differential equations. Uniqueness theorems, maximum principles. Spherical harmonics. Wave propagation. Prerequisite: Mathematics 212B or consent of the instructor.

214A. Asymptotic Methods in Analysis (3) **F**
Mr. Korevaar

Euler-MacLaurin sum formula; Poisson sum formula; Laplace method; saddle-point method; method of stationary phase; asymptotic expansions; asymptotic solution of differential equations. Prerequisites: Mathematics 210A-210B-210C, or consent of the instructor.

215A-215B. Mathematical Theory of Process Optimization (3-3) **F-W**

Mr. Halkin

Optimal control problems for systems described by nonlinear differential equations: necessary conditions, sufficient conditions; existence theorems; applications to classical calculus of variations and to problems in electrical and aerospace engineering. Optimal control problems for systems described by nonlinear difference equations, applications to the theory of optimal economic growth. Prerequisites: Mathematics 240A-240B-240C or 210A-210B-210C, or consent of the instructor.

220A-220B-220C. Complex Analysis (3-3-3) **F-W-S**

Mr. Warschawski

Complex numbers and functions. Cauchy theorem and its applications, calculus of residues, expansions of analytic functions, analytic continuation, conformal mapping and Riemann mapping theorem, harmonic functions, Dirichlet principle, Riemann surfaces. Prerequisites: Mathematics 155A-155B, or consent of the instructor.

221A-221B-221C. Several Complex Variables (3-3-3) **F-W-S**

The Staff

Formal and convergent power series, Weierstrass preparation theorem; Cartan-Rückert theorem; analytic sets; mapping theorems; domains of holomorphy; proper holomorphic mappings; complex manifolds; modifications. Prerequisites: Mathematics 200A, 220A-220B-220C, or consent of the instructor.

225A-225B-225C. Conformal Mapping (3-3-3) **F-W-S**

Mr. Warschawski

Riemann's mapping theorem; behavior of the mapping function at the boundary, including discussion of prime ends. Analytic functions of class H_p. Mapping of multiple connected domains onto canonical domains, variational techniques in conformal mapping; univalent functions; constructive methods; uniformization. Prerequisites: Mathematics 220A-220B-220C.

227A-227B-227C. Topics in Complex Analysis (3-3-3) **F-W-S**

Mr. Eke

Prerequisite: consent of the instructor.

228. Seminar in Complex Analysis **F,W,S**

The Staff

230A-230B-230C. Ordinary Differential Equations (3-3-3) **F-W-S**

The Staff

Existence and uniqueness theorems. Linear systems with constant and periodic coefficients. Sturm-Liouville theory. Eigenfunction expansions. Stability and asymptotic behavior of nonlinear systems. Poincaré-Ben-

dixon theorem. Linear systems in the complex domain and their singularities. Control ,theory. Equations in Banach space. Prerequisites: advanced calculus and consent of the instructor.

231A-231B-231C. Partial Differential Equations (3-3-3) **F-W-S**
The Staff
Existence and uniqueness theorems, Cauchy-Kowalewski theorem, first order systems, Hamilton-Jacobi theory, initial value problems for hyperbolic and parabolic systems, boundary value problems for elliptic systems, Green's function, eigenvalue problems, perturbation theory. Prerequisites: Mathematics 126A-126B, or consent of the instructor.

232A-232B-232C. Calculus of Variations (3-3-3) **F-W-S**
Mr. Halkin
Euler-Lagrange equation, theory of fields, Hamilton-Jacobi theory, sufficient conditions, Weierstrass E test. Mayer, Lagrange and Bolza problems. Optimal control, Pontryagin's Maximum Principle, existence theorems, sufficient conditions. Carathéodory's approach to calculus of variations. Prerequisites: Mathematics 240A-240B-240C or 210A-210B-210C, or consent of the instructor.

240A-240B-240C. Real Analysis (3-3-3) **F-W-S**
Mr. Williamson
Lebesgue integral and Lebesgue measure; Fubini theorems; functions of bounded variation; Stieltjes integral; derivatives and indefinite integrals; the spaces L and C; equi-continuous families; continuous linear functionals; general measures and integration. Prerequisites: Mathematics 155A-155B, or consent of the instructor.

241A-241B-241C. Functional Analysis (3-3-3) **F-W-S**
Mr. Holbrook
Metric spaces and contraction mappings; topological vector spaces; continuous linear operators; open mapping theorem; closed graph theorem; uniform boundedness principle; Hahn-Banach theorem; representation of continuous linear functionals; conjugate space; weak topologies; extreme points; Krein-Milman theorem; fixed-point theorems; Riesz convexity theorem; Banach algebras. Prerequisites: Mathematics 240A-240B-240C or 210A-210B-210C, or consent of the instructor.

243A-243B-243C. Fourier Analysis (3-3-3) **F-W-S**
Mr. Garsia
Convergence and summability of Fourier series. Fourier transform, Hilbert transform. Trigonometric approximation and interpolation. Tauberian theorems, prime number theorem. Applications of Fourier analysis to probability theory: characterization of infinitely divisible and stable laws. Prerequisite: Lebesque integration, or consent of the instructor.

244B-244C. Distributions (3-3) **W-S**
Mr. Korevaar
Various definitions of distributions; derivatives and antiderivatives;

structure of distributions; spaces of test functions and distributions; multiplication and convolution Fourier transforms; division problems; generalized functions; applications. Prerequisites: 210A-210B-210C or 240A-240B-240C.

248. Seminar in Real Analysis (3) **F,W,S**
Mr. Bishop
Prerequisite: consent of the instructor.

250A-250B-250C. Differential Geometry (3-3-3) **F-W-S**
Mr. Frankel
Differential manifolds, Sard theorem, tensor bundles, Lie derivatives, DeRham theorem, connections, geodesics, Riemannian metrics, curvature tensor and sectional curvature, completeness, characteristic classes. Differential manifolds immersed in Euclidean space. Prerequisites: Mathematics 110A-110B-110C, 166, or consent of the instructor.

260A-260B-260C. Mathematical Logic (3-3-3) **F-W-S**
Mr. Manaster
Propositional calculus and quantification theory. Completeness theorem; theory of equality; compactness theorem. Skolem-Lowenheim theorems; Vaught's test; Craig's lemma. Elementary number theory and recursive function theory. Undecidability of true arithmetic and of Peano's axioms. Church's thesis; set theory; Zermelo-Frankel axiomatic formulation. Cardinal and ordinal numbers. The axiom of choice and the generalized continuum hypothesis. Incompleteness and undecidability of set theory. Relative consistency proofs. Prerequisite: consent of the instructor.

270A-270B-270C. Numerical Analysis (3,3,3) **F-W-S**
Mr. Stoer
Approximation of functions; numerical methods of solving algebraic equations, inverting matrices, computing eigenvalues; finite difference methods; numerical solutions of ordinary and partial differential equations; convergence and stability; numerical solutions of integral equations. Prerequisites: advanced calculus, or Mathematics 101, 102, 110A, and consent of the instructor.

274A-274B-274C. Numerical Aspects of Differential Equations (3-3-3) **F-W-S**
Mr. Bulirsch
Ordinary differential equations: one-step methods for initial value problems; extrapolation methods for initial value problems; multi-step methods for initial value problems; boundary value problems. Partial differential equations: initial value problems for systems of quasilinear hyperbolic differential equations. Prerequisites: Mathematics 121, 122, 123 or consent of the instructor.

280A-280B-280C. Probability Theory (3-3-3) **F-W-S**
Mr. Rosenblatt
Probability measures; Borel fields; conditional probabilities; sums of independent random variables; limit theorems; zero-one laws. Prerequi-

sites: advanced calculus and consent of the instructor.

281A-281B-281C. Mathematical Statistics (3-3-3) **F-W-S**
Mr. Rosenblatt
Testing and estimation; sufficiency; regression analysis; sequential analysis; statistical decision theory; non-parametric inference. Prerequisite: advanced calculus and consent of the instructor.

282A-282B-282C. Stationary Processes and Prediction Theory (3-3-3) **F-W-S**
Mr. Garsia
Ergodic theorems; Fourier analysis of Gaussian processes; prediction theory. Combinatorial identities and the Szegö theorems. Entropy. The fundamental theorems of information theory. The Kolmogorov-Sinai theorem. Prerequisite: Lebesgue integration.

286A-286B-286C. Topics in Probability Theory (3-3-3) **F-W-S**
Mr. Getoor
Prerequisite: consent of the instructor.

290A-290B-290C. Topology (3-3-3) **F-W-S**
Mr. Bishop
Topological spaces; filters and limits; Hausdorff spaces; compact and locally compact spaces; uniform spaces; function spaces; singular homology and cohomology *CW* complexes; duality theorems; the cohomology ring, axiomatic homology and cohomology theory; homotopy of mappings; homotopy groups; homotopy sequences. Prerequisites: Mathematics 155A-155B or 290A for 290B-290C.

297A-297B-297C. Topics in Topology (3-3-3) **F-W-S**
Mr. Brown
Advanced material in special areas of topology to be selected by instructor. Prerequisite: Mathematics 290A-290B-290C or consent of the instructor.

298. Seminar in Topology **F,W,S**
The Staff
Prerequisite: consent of the instructor.

299. Reading and Research (1-6) **F,W,S**
The Staff
Independent study and research for the doctoral dissertation. One to three credits will be given for independent study (reading), and one to six for research. Prerequisite: consent of the instructor.

MUSIC

Office: Building 235, Matthews Campus

Robert Erickson, *M.A., Professor of Music*
Wilbur Ogdon, *Ph.D., Professor of Music* (Chairman of the Department)
John Silber, *Ph.D., Professor of Music*
Rosalyn Tureck, *M.A., Professor of Music*

Thomas Nee, *M.A., Associate Professor of Music*

* * *

James Campbell, *M.A., Lecturer in Music*
Pauline Oliveros, *B.A., Lecturer in Music*
Harry Partch, *Regents Professor*, 1967–68

Undergraduate courses offered by the Department of Music in 1967–68 will serve various purposes:

1. Enable students to begin a major consisting of from twelve to fifteen courses, according to the students' previous preparation.
2. Enable Muir College students to incorporate music courses into a special project undertaken in lieu of a major.
3. Provide a sequence of courses acceptable as a noncontiguous minor in Revelle College.
4. Enable students to satisfy the fine arts requirements of both Muir and Revelle Colleges.
5. Allow a choice of elective courses to all students, with or without prior music training.

Students who wish to go on to graduate work in music but have not had extensive training before undertaking the major may be obliged to elect music courses beyond the number required for a liberal arts major in order to be adequately prepared for graduate study.

Prerequisite to acceptance into a curriculum program leading to a B.A. with a major in music is a demonstrated level of reasonable competence in the reading and hearing of pitch and rhythmic relations. Until such proficiency is demonstrated, the student can either enrol without credit in musicianship courses suggested by the Department or prepare for such proficiency demonstration with the help of faculty counseling.

Music courses taken as electives may or may not require prerequisite musical abilities. If they do, the student will be asked to request the consent of the instructor prior to enrolment. Other opportunities for musical performance include participation in the University-Civic orchestra and vocal or instrumental ensembles.

COURSES

LOWER DIVISION

1A-1B-1C. The Nature of Music **F-W-S**
Development of music perception and discrimination through participation projects in tape music composition and small-group improvisation, and through critical observation of the preparation and performance of selected ensemble literature by experienced musicians. Prerequisites: 1A for 1B; 1B for 1C; or consent of the course committee.

2A-2B. Music Fundamentals and Basic Musicianship **F-W**
An introduction to music symbols and their meaning. Practice in elementary pitch recognition, simple rhythmic relationships, intensity, timbre, and density discriminations. Prerequisite: for 2B—2A or proficiency certified by course committee.

3A. Music Reading S
An intensive course in the reading of music presenting progressively more problematic relationships of pitch, rhythm, and other factors. Prerequisite: Music 2B or its equivalent by examination.

3B. Advanced Music Reading F
Intensive practice in the reading and conducting of closed and open scores in real time. Prerequisite: Music 3A or equivalent certified level of proficiency.

4. Applied Acoustics and Basic Recording Techniques W
An introduction to the physical nature of sound as it affects the making of music. Techniques and theories of recording and playback electronics.

5. A Comparative Introduction to the Parameters of Music S
A comparative study of pitch, time, density, timbre, and intensity as found in selected works from various historical style periods. Prerequisites: Music 2, equivalent proficiency, or consent of the instructor.

UPPER DIVISION

101A-101B-101C. Music Theory and Practice F-W-S
Integrated studies in music theory, composition and styles study through analysis and performance. Must be taken in sequence. Prerequisite: Music 3A or equivalent certified proficiency.

102A-102B-102C. Advanced Music Theory and Practice F-W-S
Must be taken in sequence. Prerequisite: Music 101C or equivalent certified proficiency.

113. Studies in Opera F
A critical study of representative operas. At least one opera discussed will be selected because of the opportunity to see it in staged performance.

114. Music of the Twentieth Century F
Music since 1950. An exploration of materials and methods used in music of our time. (Not offered 1967–68.)

115. Bach W
A study of the art of J. S. Bach with particular attention to problems of style and structure. Prerequisite: ability to read music or consent of the instructor.

123. The Orchestra and Its Literature S
A study of the instruments of the orchestra: their resources, tonal effects; their use by major composers; methods of writing for modern instruments; analysis of representative scores. Three hours lecture. Prerequisite: ability to read music.

130A-130B-130C. Seminar in the Literature and Performance of Music for Small Ensemble F-W-S
Prerequisites: proficiency on a musical instrument and consent of the instructor.

199. Independent Study **F,W,S**
Independent reading, research, or creative work under the direction of a faculty member. Prerequisite: consent of the instructor. (May be repeated for credit.)

GRADUATE

201A-201B-201C. Advanced Problems and Projects in Conducting and Performance (4-4-4) **F-W-S**
Mr. Nee, Mr. Silber, the Staff

202A-202B-202C. Advanced Problems and Projects in Recording, Editing, and the Specialized Use of Electronics in Performance (3-3-3) **F-W-S**
Mr. Campbell, Miss Oliveros

203A-203B-203C. Advanced Projects in Composition (5-5-5) **F-W-S**
Mr. Erickson, Mr. Ogdon

204. Seminar in Electronic Sound (4) **F**
Miss Oliveros
Established and experimental techniques of electronic sound generation and its modification.

205. Seminar in the Study of Timbre (4) **W**
Mr. Erickson

206. Seminar in Theoretical Studies (3) **F**
Mr. Partch
Theories of tunings, new instruments, and the work of Harry Partch. Prerequisite: consent of the instructor.

213. Opera Studies **F**
Mr. Ogdon
A detailed and comparative analytic study of selected operas in production in San Diego, Los Angeles, or San Francisco.

215. Seminar in Bach and Related Studies (4) **W**
Mme Tureck
A study of content and structure in selected compositions of J. S. Bach. Prerequisite: consent of the instructor.

216. Seminar Studies in Late Medieval and Early Renaissance Music (4) **S**
Mr. Silber
Problems of style and performance in selected music of the thirteenth, fourteenth, and fifteenth centuries. Prerequisite: consent of the instructor.

223. Studies in Opera (3) **F**
Mr. Ogdon

299A-299B-299C. Advanced Research Projects (2-2-2) **F-W-S**
The Staff

NATURAL SCIENCES

See *Interdisciplinary Courses.*

OCEANOGRAPHY

Office: 1166 Ritter Hall, SIO

Robert S. Arthur, *Ph.D., Professor of Oceanography*
Charles S. Cox, *Ph.D., Professor of Oceanography*
Edward W. Fager, *Ph.D., D. Phil., Professor of Marine Ecology*
Douglas L. Inman, *Ph.D., Professor of Oceanography*
John D. Isaacs, *B.S., Professor of Oceanography*
Fred B Phleger, *Ph.D., Professor of Oceanography*
Milner B. Schaefer, *Ph.D., Professor of Oceanography* (Director of the Institute of Marine Resources)
Fred N. Spiess, *Ph.D., Professor of Oceanography* (Director of the Marine Physical Laboratory, Associate Director of Scripps Institution of Oceanography)
Warren S. Wooster, *Ph.D., Professor of Oceanography* (Chairman of the Department)
Michael Longuet-Higgins, *Ph.D., F.R.S., Senior Lecturer*
Joseph R. Curray, *Ph.D., Associate Professor of Oceanography*
Charles D. Keeling, *Ph.D., Associate Professor of Oceanography*
John A. McGowan, *Ph.D., Associate Professor of Oceanography*
Melvin N. A. Peterson, *Ph.D., Associate Professor of Oceanography*
†Edward L. Winterer, *Ph.D., Associate Professor of Geology*
James T. Enright, *Ph.D., Assistant Professor of Oceanography*
Myrl C. Hendershott, *Ph.D., Assistant Professor of Oceanography*
Ferren MacIntyre, *Ph.D., Assistant Professor of Oceanography*
Michael M. Mullin, *Ph.D., Assistant Professor of Oceanography*
William A. Newman, *Ph.D., Assistant Professor of Oceanography*
†On leave 1967–68

* * *

Benton B. Owen, *Ph.D., Research Chemist and Lecturer*
Rudolph W. Preisendorfer, *Ph.D., Research Mathematician and Lecturer*
Joseph L. Reid, Jr., *Research Oceanographer and Lecturer*
William R. Riedel, *M.S., Research Geologist and Lecturer*
George G. Shor, Jr., *Ph.D., Research Geophysicist and Lecturer*
John D. H. Strickland, *Ph.D., Research Oceanographer and Lecturer*
Tjeerd H. van Andel, *Ph.D., Research Geologist and Lecturer*
Frederick H. Fisher, *Ph.D., Associate Research Physicist and Lecturer*

* * *

Milton N. Bramlette, *Ph.D., Professor Emeritus*
Carl H. Eckart, *Ph.D., Professor of Geophysics*
Edward D. Goldberg, *Ph.D., Professor of Chemistry*
Francis T. Haxo, *Ph.D., Professor of Biology*
Carl L. Hubbs, *Ph.D., Professor of Biology Emeritus*

Martin W. Johnson, *Ph.D., Professor of Marine Biology Emeritus*
George E. McEwen, *Ph.D., Professor of Oceanography Emeritus*
Henry W. Menard, *Ph.D., Professor of Geology*
Walter H. Munk, *Ph.D., Professor of Geophysics*
Norris W. Rakestraw, *Ph.D., Professor of Chemistry Emeritus*
Roger Revelle, *Ph.D., Professor of Oceanography Emeritus*
Francis P. Shepard, *Ph.D., Professor of Submarine Geology Emeritus*

On June 1, 1967, the Departments of Earth Sciences, Marine Biology, and Oceanography were combined into the single Department of the Scripps Institution. Admission and curricular requirements, and courses to be offered, are expected to remain essentially unchanged for the academic year 1967-68.

The Department of Oceanography offers a program of graduate studies designed to reveal the interdependence of the biological, chemical, geological, and physical processes operating in the oceans. Students are required to gain a general knowledge of all these fields. Although most students will specialize in one, the Department encourages qualified students to become competent in any appropriate combination of these fields.

Biological studies in the Department of Oceanography include systematics, life histories, and geographical distribution of zooplankton, distribution patterns, behavior, population dynamics, and community relationships of marine invertebrates; ecology and population dynamics of marine fishes.

Chemical studies in the Department of Oceanography include the use of chemical techniques in the effort to understand the behavior of the ocean; the part that the ocean plays in general geochemistry; the distribution of the chemical elements; the chemical processes that go on within the ocean and in the exchanges between the ocean, the atmosphere, and the sea bottom.

Geological studies in the Department of Oceanography include marine micropaleontology; mechanics of sedimentation; petrology of sediments; and the structure, history, and morphology of the ocean floor and the continental margins.

Physical studies in the Department of Oceanography include observation, analysis, and theoretical interpretation of problems of general circulation and the distribution and variation of properties in the ocean; interchange of kinetic and thermal energy across the ocean surfaces; propagation of sound and light and other electromagnetic energy in the ocean; and the properties of ocean waves.

The Graduate Program

(No undergraduate major program is offered.)

Requirements for Admission

1. A baccalaureate degree in one of the physical, biological, or engineering sciences, or in mathematics with a minor in science.
2. Mathematics through differential and integral calculus.
3. Geology, one semester (or equivalent).
4. Physics, chemistry, and biology—one year of each with laboratory.
5. An additional year of either physics or chemistry. If chemistry is

selected, a portion of the course should deal with the fundamentals of physical chemistry or organic chemistry; if physics is selected, the course should stress the fundamentals of mechanics, electricity and magnetism, optics, thermodynamics, or a combination of these topics.

6. Preparation in at least one foreign language chosen from the following: German, Russian, a Romance Language.

Students intending to specialize in biological oceanography should ordinarily have an undergraduate major in biology. Courses in limnology or ecology, invertebrate zoology, general or comparative physiology, and genetics or evolution are recommended.

Students intending to specialize in chemical oceanography should ordinarily have an undergraduate major in chemistry and be well prepared in physical, organic, and inorganic chemistry. Those intending to specialize in physical and geological aspects of marine chemistry should have the equivalent of two years of college physics. Those intending to specialize in biological aspects of marine chemistry should have one year of physics and an additional year of organic chemistry or biochemistry.

Students intending to specialize in marine geology should ordinarily have an undergraduate major in geology, including courses in physical geology, historical geology, structural geology, paleontology, optical mineralogy, petrology, and a field course in geology.

Students intending to specialize in physical oceanography should ordinarily have an undergraduate major in physics, including three years of physics, and mathematics through differential equations; vector analysis is recommended.

Students may be admitted with a single deficiency (other than mathematics), on condition that they make it up during their first year in residence. Students with only a minor in their intended field of specialization may be admitted if their preparation and records are considered satisfactory by the Department.

Master's Degree Program

The Department does not encourage students who wish to proceed only to the master's degree. Special arrangements can be made, however, if circumstances warrant it.

Doctor's Degree Program

All students are required to obtain experience at sea in a research vessel and to satisfactorily complete a departmental examination. This examination will usually be taken at the beginning of the second year of study. It will be primarily oral, but written parts may be included if the departmental examining committee so recommends. The examination will require the student to bring together knowledge from the several fields of oceanography and to show an understanding of the interaction of the physical, chemical, biological, and geological factors and processes in the ocean and an ability to discuss them conceptually, quantitatively and analytically. All students will be responsible for the material included in the following courses: Oceanography 110, 111, 112, 113 and 250. In addi-

tion, each student will be responsible for some more advanced material (selected from courses 210-219) in at least two fields of oceanography, as well as for any material that would ordinarily be included in an undergraduate curriculum in his major field.

After the student has passed the departmental examination, completed an appropriate period of additional study, and satisfied the language requirements (reading ability in two of the following: German, Russian, a Romance language) the Department will recommend appointment of a doctoral committee. This committee will determine the student's qualifications for independent research and will supervise the performance and reporting of the research.

Interdepartmental Programs

Graduate programs can be arranged which combine studies in the Department of Oceanography and another department at UCSD. For example, a doctoral program in Engineering Science with emphasis on Ocean Technology is being planned jointly by the Departments of Oceanography and Aerospace and Mechanical Engineering Science.

Such interdepartmental programs will require successful completion of major parts of the normal graduate programs of both departments.

COURSES

UPPER DIVISION

110. Introduction to Physical Oceanography **F**

Physical description of the sea; physical properties of seawater, methods and measurements with demonstration at sea, boundary processes, regional oceanography. Prerequisites: the mathematics and physics required for admission to the graduate curriculum in oceanography (see text), or consent of the instructor.

111. Marine Geology **W**

Introduction to the geomorphology, sedimentation, stratigraphy, vulcanism, structural geology, and geologic history of the marine realm. Prerequisites: the physics and geology required for admission to the graduate curriculum in oceanography, or consent of the instructor.

112. Biological Oceanography: Environment and Organisms **F**

An introduction to the biota and life zones of the open ocean; description of the physical, chemical, and biological factors of this environment; discussion of the influence of these factors on oceanic populations. Prerequisites: the biology and chemistry required for admission to the graduate curriculum in oceanography, or consent of the instructor.

112L. Marine Organisms **F**

Laboratory and discussion of the phylogeny; comparative morphology; life histories and taxonomy of marine organisms. Emphasis will be placed on planktonic groups. Prerequisite: Oceanography 112 (or concurrent registration), or consent of the instructor.

113. Introduction to Chemical Oceanography **W**
Chemical description of the sea; the distribution of chemical species in the world oceans, and their relation to physical and biological processes. Prerequisites: the mathematics, physics, and chemistry required for admission to the graduate curriculum in oceanography, or consent of the instructor.

118A-118B. Statistics **W-S**
Methods of statistical analysis, including both parametric and non-parametric procedures; sampling and design of experiments, with emphasis on those procedures particularly useful in marine studies. Prerequisite: the mathematics required for admission to the graduate curriculum in oceanography, or consent of the instructor. (Offered in alternate years.)

119. Special Studies **F,W,S**
Prerequisite: consent of the instructor.

GRADUATE

210. Introduction to Dynamical Oceanography (3) **W**
Mr. Arthur, Mr. Cox
Mechanics of fluids on a rotating earth; Navier-Stokes equations, boundary-layer phenomena, turbulent flow, and wave motion with oceanographic applications. Prerequisites: Oceanography 110 and consent of the instructor.

211. Introduction to Wind Waves (3) **W**
Mr. Cox
Wind waves, swell and surf; propagation of energy, the spectrum of waves; methods of observation; long waves, internal waves. Prerequisite: Oceanography 210, or consent of the instructor.

212. Biological Oceanography: Processes and Events (3) **W**
Mr. McGowan, Mr. Mullin
An analysis of the concepts and theories used to explain the biological events observed in the ocean. Prerequisites: Oceanography 110, 112; or consent of the instructor.

212L. Laboratory in Biological Productivity (2) **W**
Mr. Mullin
Introduction to techniques, especially those usable at sea, for measuring the standing crop and productivity of marine communities. Prerequisites: Oceanography 212 (or concurrent registration), and consent of the instructor.

213. Chemical Oceanography (3) **W**
Mr. Keeling
Extension of the topics of Oceanography 113; the chemistry of seawater with emphasis on transport and exchange processes. Prerequisite: Oceanography 113, or consent of the instructor.

214. Marine Sediments (3) F
Mr. van Andel, Mr. Peterson
Processes of sediment supply to the oceans; distribution, composition, and genesis of marine sediments; marine sedimentary facies, with special regard to sediments of the continental margins; trends in sediment research. Prerequisite: consent of the instructor.

215. Mechanics of Marine Sedimentation (3) S
Mr. Inman
Mechanics of sediment transportation by water, wind, waves, and density flows; energetics of sediment transport. Prerequisite: Oceanography 210, or equivalent.

216. Marine Stratigraphy (3) S
Mr. Winterer, Mr. Riedel
Principles of stratigraphy as applied to marine environments; laboratory study and interpretation of microfossils in oceanic sediments. Prerequisite: Oceanography 111, or consent of the instructor.

218A-218B. Marine Ecology (3-3) W-S
Mr. Fager
Single-species population dynamics and interspecific relationships in communities; theory, observation, and interpretation. Behavior, environmental factors, and productivity as they relate to the distribution and abundance of organisms. Prerequisite: Oceanography 112. (Offered in alternate years.)

219. Physical Oceanography (General) (3) F
Mr. Arthur
Dynamics of ocean currents; transport phenomena; turbulent processes and the air-sea boundary layer. Prerequisites: differential equations and consent of the instructor.

220. Special Topics in Oceanography (1-4) F,W,S
The Staff
Within the next few years the following subjects will be covered: principles of oceanographic research systems, sound and light in the sea, comparative regional oceanography, advanced methods of fisheries research, numerical analysis, studies of turbulence and waves.

221. Ocean Waves (2) S
Mr. Cox
Mechanisms of generation, transformations of energy and momentum in surface and internal waves, effects of earth rotation on waves. Prerequisite: Oceanography 211, or consent of the instructor.

222A-222B. Hydrodynamics (3-3) W-S
Mr. Eckart
Applications of hydrodynamics to the motion of stratified fluids, such as the atmosphere and oceans. Internal waves, steady currents, and related phenomena. Prerequisite: consent of the instructor. (Offered in alternate years.)

223. Wind-Driven Ocean Circulation (2) **S**
Mr. Arthur
Wind currents, theories of ocean circulation, boundary currents. Prerequisites: Oceanography 219 and consent of the instructor.

226A-226B. Advanced Invertebrate Zoology (3-3) **F-W**
Mr. Newman
The natural history, zoogeography, taxonomy, and phylogeny of selected invertebrate groups. Emphasis will be on the broader aspects of current research. Two special problems will be undertaken; original problems will be encouraged. Prerequisite: consent of the instructor.

228. Population Dynamics (3) **F**
Mr. Schaefer
Theories and mathematical models of growth and dynamics of single-species populations, interspecific competition, predator-prey relationships, dynamics of exploited marine populations and other animal associations. Prerequisite: Oceanography 218A, or consent of the instructor. (Offered in alternate years.)

229. Oceanic Zoogeography (3) **S**
Mr. McGowan
The patterns of distribution and abundance of oceanic organisms; the nature of oceanic habitats; the relation of zoogeography to paleoceanography. Lectures, student reports, and discussions. Prerequisite: Oceanography 212; Oceanography 111 recommended. (Offered in alternate years.)

230. Sedimentary Petrology (3) **W**
Mr. Winterer
Characteristics and origin of sediments and sedimentary rocks. Prerequisite: consent of the instructor.

231. Minerals and Mineral Assemblages of Sediments (3) **F**
Mr. Peterson
Origin and distribution of minerals and mineral assemblages of sediments; important mineral groups, clays, zeolites, feldspars, etc., considered by crystal structure and composition. Laboratory in instrumental methods, x-ray diffractometry and spectroscopy. Prerequisite: consent of the instructor.

234A-234B. Marine Micropaleontology (3-3) **W-S**
Mr. Phleger
Introduction to the ecology of Foraminifera, with applications to problems of oceanography and paleoceanography. Prerequisites: Oceanography 111, or consent of the instructor for 234A; 234A for 234B.

235. Sedimentary Processes (2) **W**
Mr. Inman
Application of principles of sedimentary mechanics to selected environments, including the littoral; the transportation of sediment and the formation of sedimentary structures by waves and currents; methods of

measurement. Prerequisite: Oceanography 215, or consent of the instructor. (Offered in alternate years.)

250. Seminar in Oceanography (1) **F,W,S**
The Staff

251A-251B. Problems in General and Physical Oceanography (2-2) **W-S**
Mr. Isaacs
Presentation of reports, review of literature, and discussion of various regions and aspects of the ocean, oceanography, and related fields. Seminar.

253. Problems in Biological Oceanography (2) **F**
The Staff
Presentation of reports, review of literature and discussion of current research in biological oceanography. Seminar.

255. Problems in Marine Geology (2) **F**
The Staff
Origin and structure of ocean basins and continental margins, and their physiographic features; origin, distribution, interpretation, and methods of study of marine sediments. Seminar.

280. Oceanography Field Course (2-4) **F,W,S,Su**
The Staff
Methods of measurement, observation, and sampling used at sea; oceanic cruise dealing with problems of current interest; analysis and interpretation of results with a report. Prerequisites: Oceanography 110, 111, 112, 113.

299. Research (1-6) **F,W,S**
The Staff
Research in one or more of the oceanographic sciences.

PHILOSOPHY

Office: 3112 Humanities-Library Building

Paul Henry, *S.J., Doct. es Lett., D.D., Professor of Philosophy*
Herbert Marcuse, *Ph.D., Professor of Philosophy*
Stanley Moore, *Ph.D., Professor of Philosophy*
Richard H. Popkin, *Ph.D., Professor of Philosophy* (Chairman of the Department)
†Jason L. Saunders, *Ph.D., Professor of Philosophy* (Graduate Adviser)
††Avrum Stroll, *Ph.D., Professor of Philosophy*
Piero Ariotti, *Ph.D., Assistant Professor of Philosophy* (Undergraduate Adviser)
Ronald Kirkby, *Ph.D., Assistant Professor of Philosophy*
Rudolf Makkreel, *Ph.D., Assistant Professor of Philosophy*
††David Fate Norton, *Ph.D., Assistant Professor of Philosophy* (Undergraduate Adviser)

* * *

Thomas A. McCarthy, *M.A., Lecturer in Philosophy*
Roger Ruffin, *LL.B., Lecturer in Philosophy*
Stanley Malinovich, *Ph.D., Visiting Assistant Professor of Philosophy*
Abraham I. Melden, *Ph.D., Adjunct Professor of Philosophy* (Chairman of the Department, University of California, Irvine)

†On leave spring quarter, 1968
††On leave 1967–68

The Undergraduate Program

Students who wish to major in philosophy must have satisfied the general lower-division requirements. No specific sophomore courses are recommended.

The members of the Department of Philosophy believe that an undergraduate major in philosophy should acquaint himself with the achievements and methods of other academic disciplines, since these are in part the subjects of philosophical inquiry. The background thus acquired should be complemented by a relatively small number of required courses in philosophy itself. The required courses, about half of which are concerned with the history of philosophy, are meant to introduce the student to a large number of philosophical issues and traditions. The pursuit of highly specialized concerns should be deferred until the student has begun graduate study.

The following courses are required of philosophy majors:

1. Philosophy 101-106 (History of Philosophy).
2. Philosophy 110 (Symbolic Logic) *or* 112 (Philosophy of Science).
3. Two courses from the following four: Philosophy 120 (Political Philosophy), 121 (Aesthetics), 122 (Philosophy of Religion), 123 (Ethics).
4. Philosophy 131 (Contemporary Anglo-American Philosophy) *or* 132 (Contemporary European Philosophy).
5. Four upper-division courses from one or more of the following fields: History, Linguistics, Literature.

The total is fourteen courses—ten in philosophy, four in related fields. Requirements can be met by examination. In upper-division courses, students may be expected to read materials in foreign languages, usually French or German.

Major Program in Philosophy (Recommended Schedule)

	Fall	Winter	Spring
	Philosophy 101	Philosophy 102	Philosophy 103
Junior Year	*Philosophy 110	*Philosophy 123	*Philosophy 122
	†	†	†

Senior Year	Philosophy 104 *Philosophy 120 †_____	Philosophy 105 *Philosophy 121 or 130 †_____	Philosophy 106 *Philosophy 112 or 131 _____

*If student elects to meet major requirements with this course.
†Upper-division course in History, Linguistics, or Literature.

The Graduate Program

The Department of Philosophy offers programs in many fields of philosophical study leading to the Master of Arts and Ph.D. degrees. Courses of study for the individual student are arranged according to his needs, interest, and previous work in philosophy: there is no established sequence of required courses in the graduate program.

The members of the Department of Philosophy hold the view that an adequate program of studies in philosophy should provide the student with a thorough training in the history of philosophy, in the systematic study of philosophical issues, and in varying approaches to these issues. The intent of the graduate program is, thus, to give the student a depth of understanding of divergent philosophical traditions and to aid in his development as a philosopher in his own right.

Master's Degree Program

The Master of Arts in Philosophy is offered under Plan II (comprehensive examination). (See *Graduate Division: The Master's Degree.*)

The student will be required to take 36 quarter-units of upper-division and graduate work, of which at least 14 must be in graduate courses in the major field. Of the remaining 22, 10 units must be in graduate courses, and 12 units in graduate or upper-division courses. Candidates for advanced degrees in Philosophy are required to have passed one foreign language examination (Greek, Latin, French or German) prior to attempting the written qualifying examination. The comprehensive examinations will be identical with the written portion of the qualifying examination for the Ph.D. This will consist of written examinations in each of the following three areas:

1. History of philosophy: ancient, medieval, Renaissance, early modern, modern and nineteenth century.
2. Metaphysics: epistemology, logic, philosophy of science, contemporary philosophy.
3. Value theory: ethics, aesthetics, philosophy of religion, political and social philosophy.

Each examination will take three hours.

Doctor's Degree Program

During the period between admission to graduate standing and advancement to candidacy, a graduate student will normally be required in each academic year of residence to take at least 6 units in philosophy courses chosen from those numbered 201-299, inclusive. Ordinarily the

course of study for the Doctor of Philosophy will include the course requirements for the Master of Arts, or their equivalent.

After having successfully completed the written examinations, as described above for the Master of Arts, the student will be required to submit a prospectus of his dissertation and to pass an oral examination focusing on the area of his dissertation.

Students will be required to demonstrate a satisfactory reading knowledge of two foreign languages chosen from the following: classical Greek, Latin, French, German, and such other languages as the student's research may require, subject to the approval of the Graduate Council.

Under the supervision of his doctoral committee, each candidate will write a dissertation demonstrating a capacity to engage in original and independent research.

The candidate will defend his thesis in an oral examination by the doctoral committee.

COURSES

LOWER DIVISION

The Department of Philosophy cooperates in the teaching and administration of the Humanities sequence for Revelle College students. (See *Interdisciplinary Courses: Humanities.*)

10. The Nature of Philosophy **F**
An introduction to metaphysics and the theory of knowledge, dealing with such matters as the ultimate constituents and structure of the world, the nature of the mind, knowledge and truth. Three lecture-discussions.

11. The Nature of Philosophy **W**
An introduction to value theory, dealing with questions about morality, politics, religion and art. Three lecture-discussions.

12. Introduction to Logic **S**
An inquiry into the nature of argument, inference and proof, fallacies, etc. Three lecture-discussions.

20. Theories of Society I **F**
A course dealing with the development of social and political thought and institutions in ancient Greece and Rome. Three hours lecture.

21. Theories of Society II **W**
A course dealing with the development of social and political thought and institutions in the Middle Ages and Renaissance. Three hours lecture.

22. Theories of Society III **S**
A course dealing with the development of social and political thought and institutions in modern times. Three hours lecture.

(Philosophy 20-21-22 may be used in fulfilling the Revelle College social science requirement.)

UPPER DIVISION

101. History of Philosophy F
Greek philosophy to Aristotle. Examination of original materials in Greek philosophy, including those of the Pre-Socratics, Plato, and Aristotle. Two or three lecture-discussions.

102. History of Philosophy W
Greek and Roman philosophy after Aristotle. Examination of original material of Hellenistic philosophy, including those of the Socratic schools down through the Stoic, Epicurean, Skeptic and Neo-Platonic. Two or three lecture-discussions.

103. History of Philosophy S
Medieval and Renaissance philosophy. Examination of original materials in medieval and Renaissance philosophy, including those of medieval Christian, Jewish, and Moslem philosophers and representative figures of the later humanistic tradition.

104. History of Philosophy F
Sixteenth- and seventeenth-century philosophy. Examination of original materials in early modern philosophy. From the late Renaissance and Reformation to Descartes, Leibniz, Spinoza and Locke. Two or three lecture-discussions. (Not offered 1967–68.)

105. History of Philosophy W
Eighteenth-century philosophy. Examination of original materials of eighteenth-century philosophy, including such writers as Bayle, Berkeley, Hume and Kant. Two or three lecture-discussions. (Not offered 1967–68.)

106. History of Philosophy S
Nineteenth-century philosophy. Examination of original materials of nineteenth-century philosophy, including such writers as Hegel, Schopenhauer, and Nietzsche. Two or three lecture-discussions. (Not offered 1967–68.)

110. Symbolic Logic F
Introduction to mathematical logic. Three lecture-discussions.

112. Philosophy of Science S
The development and systematic methods of epistemology in the light of the historical development of science. Two or three lecture-discussions.

120. Political Philosophy F
An examination of problems and theories concerning the nature of the state, society, and government. Three lecture-discussions.

121. Aesthetics W
An inquiry into the nature of human artistic experience and works of art. Three lecture-discussions.

122. Philosophy of Religion S
An examination of the nature of the religious experience, the nature of faith, and the role of reason in religion. Three lecture-discussions.

123. Ethics W
An inquiry into the nature of human conduct. Three lecture-discussions. (Previously numbered 111.)

131. Contemporary Anglo-American Philosophy W
Some main problems found in the literature of recent and contemporary Anglo-American philosophy. Two or three lecture-discussions.

132. Contemporary European Philosophy S
Some main problems found in the literature of recent and contemporary European philosophy. Two or three lecture-discussions.

199. Individual Study F,W,S
Prerequisite: permission of departmental adviser.

GRADUATE

201. Advanced Symbolic Logic (3)
An intensive examination of propositional and quantificational logic as a basis for further deductive development. (Not offered 1967–68.)

202. Topics in the History of Philosophy (3)
A course of studies designed to prepare students for advanced work in seminars. (Not offered 1967–68.) †

203. Topics in Contemporary Epistemology and Metaphysics (3) W
A course of studies designed to prepare students for advanced work in seminars. †

204. Topics in Moral and Political Philosophy (3) F
A course of studies designed to prepare students for advanced work in seminars. †

250. Seminar in Contemporary Analytic Philosophy (3) S
An analysis of some important problems in recent and contemporary Anglo-American philosophy as illustrative of major movements of thought.

251. Seminar in Contemporary European Philosophy (3)
An analysis of some important problems in recent and contemporary Continental philosophy as illustrative of major movements of thought. (Not offered 1967–68.)

252. Seminar in Ancient Philosophy (3) F
An examination of typical problems and philosophic issues found in the study of Greek and Roman philosophers: e.g., the origin and development of Greek philosophical concepts; the philosophic schools from the beginnings of Stoicism, Epicureanism, Skepticism down through Neo-Platonism. †

253. Topics in Philosophy of Logic (3)
A study of major topics included in the scope of logical theory, together with a close examination of contributions by different philosophical schools to the analysis of central issues in philosophy of logic.

254. Seminar in Social and Political Philosophy (3) S
An analysis of social philosophies and ideologies as they emerge from basic types of social structure. †

255. Seminar in Medieval Philosophy (3)
The medieval development of the Western philosophical tradition. Representative writings of Greek Gnosticism and the rise of the Latin Western Christian tradition: Clement of Alexandria, Tertullian, Philo, Augustine, Erigena, Bonaventura, Arabian and Jewish authors, Anselm, Thomas Aquinas and William of Ockham. (Not offered 1967–68.) †

256. Seminar in Aesthetics (3) F
An exploration of problems in philosophy of art, aesthetic experience and aesthetic judgment within the context of a critical survey of some current aesthetic theories and their illustrative application in the various fields of art.

257. Seminar in Philosophy of Religion (3) W
A study of the philosophical foundations of religious experience, including such problems as belief and knowledge, faith and reason, the nature of God, the character and meaning of religious commitment.

258. Seminar in Ethics (3)
An examination of the nature of moral problems, judgments and principles, with emphasis on recent developments in moral philosophy and classic formulations of ethical theories. (Not offered 1967–68.)

260. Seminar in Renaissance Philosophy (3) W
Philosophical and intellectual currents of the Renaissance, with reference to the origins and development of classical humanism and medieval scholasticism and the emergence of a Renaissance philosophy of man.

261. Seminar in Seventeenth- and Eighteenth-Century Philosophy (3) S
An examination of the origins and development of early modern philosophy, together with its philosophical and intellectual foundations, including a study of such authors as Descartes, Malebranche, Spinoza, Leibniz, Newton, Locke, Bayle, Berkeley, Hume and Kant. †

262. Seminar in Philosophy of Science (3) W
An examination of such problems as concept formation, the explanation of law, the role of logic and mathematics in the sciences.

263. Seminar in Theory of Knowledge (3) F
An examination and critique of representative theories of mind, reality, knowledge and perception.†

264. Seminar in Philosophy of History (3)
An examination of basic concepts, categories, and presuppositions of historical experience in the context of representative philosophies of history. (Not offered 1967–68.)

265. Seminar in Nineteenth-Century Philosophy (3) W
A study of representative philosophical movements of the nineteenth cen-

tury, as found in the writings of such authors as Hegel, Schopenhauer, Comte, Mill and Nietzsche. †

269. Departmental Colloquium (1-3)
Special topics submitted by visiting philosophers for critical appraisal by staff and students.

270. Seminar on Special Topics (1-3) **F,W,S**
A seminar for examination of a specific philosophical problem. †

280. Independent Study (1-6)
Open to properly qualified graduate students who wish to pursue a problem through advanced study under the direction of a member of the staff. †

299. Thesis Research† (1-6)

† May be repeated for credit as topic changes.

PHYSICAL EDUCATION

Office: Temporary Gymnasium, Building 269, Matthews Campus

Theodore W. Forbes, *Ed. D., Supervisor* (Chairman of the Department)
Walter W. Hackett, *M.A., Assistant Supervisor*
Howard F. Hunt, *M.A., Assistant Supervisor*
Richard N. Johnson, *B.A., R.P.T., Assistant Supervisor*
Neale R. Stoner, *B.A., Assistant Supervisor*
Elizabeth Ann Dale, *B.A., Junior Supervisor*
J. Charles Millenbah, *B.S., Junior Supervisor*

The Department of Physical Education offers a variety of programs, including scheduled activity classes, intramural and intercollegiate athletics, and recreational activities. Undergraduate students in Revelle and Muir Colleges are thus afforded an opportunity to participate in a variety of ways commensurate with their abilities and interests.

The faculty considers physical exercise and recreation essential and complementary to the sustained intellectual pursuits of the students, and departmental programs are designed to enable all students to develop physical skills in accordance with their individual abilities. All undergraduates are encouraged to engage in some form of continuing physical activity. Intercollegiate and intramural activities at various levels of proficiency will be encouraged.

Intramural Sports

The program of intramural sports constitutes an important phase of the comprehensive physical education program. Opportunities are provided for all students to experience, on a voluntary basis and under actual game conditions, the activities in which they receive instruction in the basic program of physical education.

The intramural program is intended primarily for students who would not normally find it possible to participate in intercollegiate athletics.

Participation in intramural sports is rewarding not in terms of academic credit or material awards, but in terms of health, social and moral benefits, and enjoyment of the sport for itself. Teams are formed within the dormitories and by special-interest groups and clubs. Team and individual champions represent UCSD each year at the annual All-University Intramural Sports Day.

Recreation

Recreation programs offer all students an opportunity to participate in individual or group activities. A variety of activities are offered, including archery, angling, baseball, basketball, bicycling, boating, bowling, cross-country running, football, handball, mountaineering, riflery, sailing, SCUBA diving, skiing, skin diving, squash, swimming, surfing, tennis, volleyball, weight training, and wrestling. There are, in addition, many popular sports clubs bringing together students with a common interest in a particular activity.

A variety of facilities will be available to students, including a natatorium and sundeck, and a new gymnasium to be opened in February, 1968.

COURSES

Note: No academic credit is earned in the following physical education activities but satisfactory completion is recorded on the student's transcript of record.

1. Weight Training and Physical Conditioning (Men) **F,W,S**
Participation in individual exercise routines, running, weight and strength exercises to increase general physical fitness, endurance and muscular efficiency. Classes are offered in advanced, intermediate, and beginning sections.

2. Women's Conditioning **F,W,S**
Designed to meet the individual needs of each woman enrolled in the class through personal evaluation, diet, measurements, and exercise.

3. Swimming **F,W,S,**
Instruction designed to permit students to gain or improve swimming strokes, techniques, and aquatic skills on an individual basis. Classes are offered in beginning, intermediate, and advanced sections.

4. Synchronized Swimming for Women **S**
Designed for advanced swimmers. Fundamentals in individual and group water ballet. Opportunity for public presentations.

5. Skin Diving **F,S**
Skin diving techniques, pool and ocean. Underwater skills, knowledge through exploration of the underwater world. The course is designed to provide an opportunity for students to learn a new set of nature's rules and laws which are not encountered on the surface.

6. Lifesaving **F,W**
The American Red Cross Senior Lifesaving Certificate will be awarded to students who satisfactorily complete the course. Emphasis is placed upon

the knowledge and skills which will prepare a student to save his own life or the life of another in an emergency. Prerequisite: advanced swimming or consent of the instructor.

7. Water Safety **S**
Standard American Red Cross course designed to train authorized water safety instructors to teach A. R. C. swimming and lifesaving courses thereafter. Only holders of the A. R. C. Senior Lifesaving Certificate are eligible to register. Students must pass Part I (12 hours) in order to qualify for Part II (15 hours). Examinations.

8. Sailing **F,S**
Fundamentals of small-boat sailing. Course covers identification and nomenclature of sailboats, sailing terms, aerodynamics and navigation. Emphasis is placed upon the ability to maneuver a boat safely, maintenance, competitive sailing rules and tactics.

9. Tennis **F,W,S**
Instruction in the fundamentals of the serve, strokes, volley, rules, scoring, tactics, and court strategy. Classes are offered in beginning, intermediate, and advanced sections.

10. Golf **F,W,S**
Instruction and practice in the fundamentals of golf. Emphasis is placed upon the golf swing and techniques of using all clubs under varying conditions. Classes are offered in beginning and intermediate sections.

11. Tumbling and Trampolining (Women) **F,W,S**
Emphasis on skills of an elementary nature in tumbling and the fundamentals of trampolining. Progressive instruction for the individual from simple tumbling and trampolining skills to the intermediate level. Emphasis is placed upon form for proper coordination and execution.

12. Gymnastics (Men) **S**
Designed for the student of beginning and intermediate ability. The fundamentals of gymnastics, including instruction in the use of apparatus and in simple tumbling routines.

13. Rhythmic Gymnastics **F**
Exercise routines to music with an emphasis on body control, skill and precision of execution.

14. Modern Dance **F,W,S**
Opportunities in dance techniques. Pattern variations will be discovered in time, space, and design. These, together with the technical skills, will produce a means of communication through body control.

15. Volleyball **F,W,S**
An emphasis on fundamental skills in serving, spiking, blocking, and teamwork techniques. Opportunity for team competition. Classes are offered in men's, women's, and coed sections.

16. Handball **F,S**
Instruction in fundamentals of the serve, volley and court strategy. Opportunity for singles and doubles competition. (Not offered 1967–68.)

17. Karate **F,W,S**
Instruction and training in the fundamentals of Sho-to-kan Karate, emphasizing: (1) basic stances and techniques; (2) "kata," ancient stylized sequences of defensive and counteroffensive movements; (3) sparring, a graded progression from strictly controlled defense and counterattack situations to free sparring for competition.

18. Wrestling **F,W**
Fundamentals of wrestling, with emphasis on takedowns and counters, escapes, and pinning combinations. Students will learn timing and execution of a limited number of holds and maneuvers.

19. Techniques of Officiating **F,W,S**
Designed to give a thorough knowledge and mastery of rules, field layout, and scorekeeping under actual game conditions. A prerequisite for student employment in officiating at intramural athletic contests.

25. Intercollegiate Athletics **F,W,S**
A large variety of intercollegiate sports activities are offered to all undergraduate students. The program is designed for those possessing a high degree of proficiency in sport skills. Competition with other colleges and universities is scheduled. Teams include: basketball, baseball, cross country, crew, golf, track, wrestling, tennis, Rugby, volleyball, sailing, swimming, and water polo.

PHYSICS

Office: 3426 Physics-Chemistry Building

William Ian Axford, *Ph.D., Professor of Physics*
Keith A. Brueckner, *Ph.D., Professor of Physics*
E. Margaret Burbidge, *Ph.D., Professor of Astronomy*
Geoffrey R. Burbidge, *Ph.D., Professor of Astrophysics*
George Feher, *Ph.D., Professor of Physics*
William R. Frazer, *Ph.D., Professor of Physics*
Walter Kohn, *Ph.D., Professor of Physics*
Norman M. Kroll, *Ph.D., Professor of Physics*
Leonard N. Liebermann, *Ph.D., Professor of Physics*
Ralph H. Lovberg, *Ph.D., Professor of Physics*
John H. Malmberg, *Ph.D., Professor of Physics*
George E. Masek, *Ph.D., Professor of Physics*
Bernd T. Matthias, *Ph.D., Professor of Physics*
Maria Goeppert Mayer, *Ph.D., Professor of Physics*
Carl E. McIlwain, *Ph.D., Professor of Physics*
William A. Nierenberg, *Ph.D., Professor of Physics*

Oreste Piccioni, *Ph.D., Professor of Physics*
Harry Suhl, *Ph.D., Professor of Physics* (Chairman of the Department)
William B. Thompson, *Ph.D., Professor of Physics*
John C. Wheatley, *Ph.D., Professor of Physics*
David Y. Wong, *Ph.D., Professor of Physics*
Herbert F. York, *Ph.D., Professor of Physics*
John M. Goodkind, *Ph.D., Associate Professor of Physics*
Francis R. Halpern, *Ph.D., Associate Professor of Physics*
Kazumi, Maki, *Ph.D., Associate Professor of Physics*
Laurence E. Peterson, *Ph.D., Associate Professor of Physics*
Sheldon Schultz, *Ph.D., Associate Professor of Physics*
Robert A. Swanson, *Ph.D., Associate Professor of Physics*
William C. Black, Jr., *Ph.D., Assistant Professor of Physics*
Barry Block, *Ph.D., Assistant Professor of Physics*
Joseph C. Y. Chen, *Ph.D., Assistant Professor of Physics*
Donald R. Fredkin, *Ph.D., Assistant Professor of Physics*
Robert J. Gould, *Ph.D., Assistant Professor of Physics*
William G. Mathews, *Ph.D., Assistant Professor of Physics*
Werner A. W. Mehlhop, *Ph.D., Assistant Professor of Physics*
Thomas M. O'Neil, *Ph.D., Assistant Professor of Physics*
Herbert B. Shore, *Ph.D., Assistant Professor of Physics*
Wayne Vernon, *Ph.D., Assistant Professor of Physics*
Nguyen-Huu Xuong, *Ph.D., Assistant Professor of Physics*

The Major Program

Students who expect to major in physics are strongly advised to take Mathematics 100, Mathematics 101, and Natural Science 2F in the lower division. Also, if they plan to do graduate study in physics, they should choose German, Russian, or French (preferably German or Russian) for meeting the language requirement.

Required courses for physics majors are Physics 100A-100B-100C, 101A-101B, 110A-110B, 112, 130A-130B-130C, 131A-131B, 140, 141.

The upper-division program is intended to provide basic education in several principal areas of physics, with some opportunity for study in neighboring areas in the form of restricted electives. Provision is made, both in the main course and in the elective subjects, for some training in a few of the more technological aspects of physics.

In the junior year the emphasis is on macroscopic physics; the two principal physics subjects are electromagnetism and mechanics. The mathematics background required for the physics program is completed in this year.

In the senior year a sequence of courses in quantum physics provides the student with the modern view of atomic and some aspects of subatomic physics, and teaches him the principal analytical methods appropriate in this domain. The relation of the microscopic to the macroscopic world is the subject of courses in thermodynamics and statistical physics,

with illustrations drawn from gas dynamics and solid state physics. The quantum physics sequence aims at an integrated, descriptive and analytical treatment of those areas of physics in which quantum effects are important, particularly atomic and nuclear physics and elementary particles.

Mathematics. For the restricted elective in mathematics in the junior year, Mathematics 120 is strongly recommended.

Students entering the upper division with a deficient mathematics background will have to make up this deficiency in the junior year. For example, a student who failed to take Mathematics 100 and 101 will be required to take these courses in the junior year in place of the noncontiguous minor. Such a student may find it necessary to use some or all of his senior-year free electives to complete the noncontiguous minor.

Chemistry. The Department of Physics considers that a knowledge of the fundamentals of chemistry is essential for the study and practice of physics. Consequently, Natural Science 2F, or equivalent, or an upper-division chemistry course with associated laboratory, is required for the B.A. degree in physics.

Restricted Electives. The restricted electives in mathematics are discussed above. The other restricted electives may be chosen from upper-division or graduate courses in physics, chemistry, biology or mathematics, subject to the approval of the Physics Department.

Major Program in Physics (Recommended Schedule)

	Fall	Winter	Spring
Junior Year	Physics 110A Physics 100A Restricted Elective (Math) Free Elective	Physics 110B Physics 100B Physics 101A Math 121	Physics 112 Physics 100C Physics 101B Restricted Elective
Senior Year	Physics 130A Physics 131A Physics 140 Free Elective	Physics 130B Physics 131B Physics 141 Free Elective	Physics 130C Restricted Elective Free Elective Free Elective

Noncontiguous Minor in Physics (Revelle College)

Students majoring in fields other than the sciences may arrange noncontiguous minor programs in physics by consulting with the Physics Department. Examples of such programs are the following:

1. Mathematics 100, 121; Physics 110A, 130A-130B-130C
2. Mathematics 100, 121; Physics 110A, 130A, 160, 161
3. Mathematics 100, 101; Physics 100A-100B-100C, 112, plus 101A-101B
4. Mathematics 100, 101; Physics 110A-110B, 140, 141

Because of the large number of mathematics prerequisites required for physics courses, students who elect noncontiguous minors in the field of

physics may find it desirable to supplement the noncontiguous minor by devoting some of their free elective time to additional courses in physics.

The Graduate Program

The Department of Physics offers curricula leading to the Master of Science and Doctor of Philosophy degrees.

The entering graduate student will be required to have a sound knowledge of undergraduate mechanics, electricity and magnetism, and to have had senior courses or their equivalent in nuclear physics, atomic physics, thermodynamics and statistical physics. Upper-division courses numbered 130 or higher are available for students who have minor deficiencies in undergraduate training.

Master's Degree Program

Requirements for the Master of Science degree may be met according to Plan I (thesis) or Plan II (comprehensive examination). (See *Graduate Division: The Master's Degree.*) Plan I is available, however, only in very special circumstances, and it is expected that nearly all the M.S. degrees conferred will be earned through Plan II. No student should enter UCSD expecting to undertake a master's thesis in physics unless special arrangements have been made with the Physics Department. A detailed specification of the Physics Department course requirements together with a list of approved courses is available in the Physics Department office.

Doctor's Degree Program

Upon a student's admission to the Department, the Chairman of the Department will appoint an adviser to assist the student in planning his program and in preparing for the qualifying examination.

During the first two years, the student will take a number of courses and spend a few hours each week in association with some departmental research activity in preparation for the general departmental examination. Although there are no specific course requirements, the following courses are usually taken:

First Year

Mathematics 210A-210B-210C. Mathematical Methods
Physics 200A-200B-200C. Theoretical Mechanics
Physics 203A-203B. Advanced Classical Electrodynamics
Physics 212A-212B. Quantum Mechanics

Second Year

Physics 210A-210B-210C. Statistical Mechanics and the Properties of Matter
Physics 212C-212D. Quantum Mechanics
Physics 213A-213B. Theoretical Nuclear Physics
Physics 215. High Energy Nuclear Physics

The general departmental examination is offered in April and September of each year and is normally taken after two years of graduate work. The examination consists of a written and an oral part.

In order to be admitted to the oral qualifying examination for candidacy for the doctor's degree, a graduate student must first pass the general departmental examination, be accepted by a faculty member as a thesis student, and pass the language examinations. To satisfy the language requirement, a student has the option of a reading knowledge of two languages (one language must be German or Russian; the second may be German, Russian, French, Italian or Spanish) or a reading and speaking knowledge of one language (German, Russian, French, Italian or Spanish; English will be acceptable for foreign students, on the approval of the Department).

After admission to candidacy, the student will engage in his thesis research as well as take some of the advanced graduate courses. The normal duration of the entire Ph.D. program is four years, but shortening of this period is possible for the exceptional student.

COURSES

LOWER DIVISION

The Department of Physics cooperates in the teaching and administration of the Natural Science sequences for Revelle College students. (See *Interdisciplinary Courses: Natural Sciences.*)

UPPER DIVISION

100A. Electromagnetism F

Coulomb's law, electric fields, electrostatics; conductors and dielectrics; steady currents, elements of circuit theory. Four hours lecture. Prerequisite or co-registration: Mathematics 100.

100B. Electromagnetism W

Magnetic fields and magnetostatics, magnetic materials, induction; AC circuits; displacement currents; development of Maxwell's equations. Three hours lecture. Prerequisites: Physics 100A; prerequisite or co-registration, Mathematics 101; co-registration, Physics 101A.

100C. Electromagnetism S

Electromagnetic waves, radiation theory; application to optics; motion of charged particles in electromagnetic fields; relation of electromagnetism to relativistic concepts. Four hours lecture. Prerequisites: Physics 100B; co-registration, Physics 101B.

101A. Electricity and Magnetism Laboratory W

Experiments with AC and DC circuits and electromagnetic phenomena in general; magnetism. Four hours. Co-registration: Physics 100B. Required of Physics majors. (No course credit will be given toward graduation.)

101B. Electricity and Magnetism Laboratory S

Microwaves, electrodynamics; electrical and electronic measurements and test equipment; construction and testing of active circuits. Four hours. Prerequisites: Physics 101A; co-registration, Physics 100C. Required of Physics majors. (No course credit will be given toward graduation.)

110A. Mechanics F
Mechanics of systems of particles; planetary motion; Lagrange's and Hamilton's equations; statics and dynamics of rigid bodies; relativistic mechanics. Four hours lecture. Prerequisite or co-registration: Mathematics 100.

110B. Mechanics W
Theory of small vibrations; elasticity; elements of fluid mechanics. Four hours lecture. Prerequisites: Physics 110A; prerequisite or co-registration, Mathematics 101.

112. Electronics Laboratory S
Electrical networks, vacuum tube and transistor circuit analysis and design, with emphasis on applications to physical research. Two hours lecture, four hours laboratory. Prerequisites: Physics 100B, 110B, 101A.

130A. Quantum Physics F
Atomic physics in the nineteenth century; radioactivity, Rutherford experiments; Bohr model, optical spectra, x-ray spectra, electron spin, vector model. Three hours lecture. Prerequisites: Mathematics 121, Physics 110A; co-registration, Physics 131A.

130B. Quantum Physics W
Atomic structure according to wave mechanics; Schrodinger equation for hydrogen-like atoms; Pauli principle, Heisenberg principle; particle in a periodic potential. Three hours lecture. Prerequisites: Physics 130A; co-registration, Physics 131B.

130C. Quantum Physics S
Elementary nuclear physics; quantum mechanics of radiation; elementary particles and scattering. Four hours lecture. Prerequisites: Physics 100C, 130B.

131A. Modern Physics Laboratory F
Experiments in atomic physics, optics, physical electronics, fluid dynamics, surface physics, etc. Four hours. Co-registration: Physics 130A. Required of Physics majors. (No course credit will be given toward graduation.)

131B. Modern Physics Laboratory W
Continuation of Physics 131A. Experiments in radioactivity, x-rays, atomic physics, resonance physics, solid state physics, etc. Four hours. Prerequisites: Physics 131A; co-registration, Physics 130B. Required of Physics majors. (No course credit will be given toward graduation.)

140. Thermodynamics F
Classical thermodynamics including the first, second and third laws; thermodynamic potentials; phase transitions; applications to low temperature physics, radiation, and chemical reactions. Four hours lecture. Prerequisite or co-registration: Mathematics 100.

141. Statistical Physics W
Elementary statistical mechanics, probabilistic interpretation of entropy,

fluctuation phenomena, transport phenomena. Four hours lecture. Prerequisites: Physics 140, 110A.

150. Continuum Mechanics F
Mechanics of continuous media; waves, instabilities, applications to earth sciences, oceanography, and aerodynamics. Three hours lecture. Prerequisite: Physics 110B.

152. Solid State Physics S
Crystal symmetry, free electron gas, band structure, properties of insulators, semiconductors and metals; atomic diffusion, alloys, electronic transport phenomena. Four hours lecture. Prerequisites: Physics 130B, 141.

160. Survey of Astronomy and Astrophysics F
Introduction to modern astronomy and astrophysics. Three hours lecture. Prerequisite: Physics 110A.

161. Astrophysics W
The physics of stars, interstellar matter, and stellar systems. Three hours lecture. Prerequisites: Physics 160, 130A.

162. Astrophysics S
Continuation of Physics 161. Three hours lecture. Prerequisites: Physics 161, 130B, 141.

170. Advanced Laboratory (Half Course) S
Experimental study of a special problem in optics, cryogenics, resonance physics, nuclear physics, etc., using existing apparatus or developing new apparatus, or both. Hours by arrangement. Prerequisites: Physics 101A-101B, 131A-131B.

171. Advanced Electronic Laboratory F
Electrical networks, vacuum tube and solid state electronics, analysis and design, and components. Power supplies. Amplifiers, noise and feedback, oscillators, digital and logic circuits, microwaves and special topics. Emphasis on applications to physical research. Six hours. Prerequisite: Physics 112.

172. Computer Laboratory
Computer solution of practical problems in science and engineering; mathematics of approximation methods, computer programming. Students will use the University computer to solve specific problems. Four hours. Prerequisite: Mathematics 121.

199 Special Project F,W,S
Independent reading or research on a problem by special arrangement with a faculty member. Four hours. Prerequisite: consent of the instructor.

GRADUATE

200A. Theoretical Mechanics (3) F
Lagrangian and Hamiltonian theory and its application to the motion of mass points and rigid bodies. Prerequisites: undergraduate mechanics, advanced calculus or partial differential equations.

200B. Theoretical Mechanics (3) W
The motion of a particle according to the special and general relativity theories. The N-particle problem and its relation to continuum mechanics. The generation of entropy, and empirical dissipative laws; viscosity. Prerequisite: Physics 200A.

200C. Theoretical Mechanics (3) S
Hydrodynamics, in Eulerian and Lagrangian form. Shock waves; theory of solid substances: deformation and distortion, elasticity and plasticity, magnetohydrodynamics. Prerequisite: Physics 200B.

203A. Advanced Classical Electrodynamics (3) F
The boundary value problems of electrostatics and the electrostatics of macroscopic media, magnetostatics and the properties of magnetic materials, currents in extended media, macroscopic properties of superconductors, electromagnetic induction and quasi-static phenomena, Maxwell theory and wave propagation. Prerequisite: Physics 100C or equivalent.

203B. Advanced Classical Electrodynamics (4) S
Applications of Maxwell's equations to radiating systems and boundary value problems, such as wave guides and diffraction phenomena; relativistic electrodynamics; radiation by moving charges; classical electron theory; nonlinear phenomena. Prerequisites: Physics 100C or equivalent, Physics 203A.

210A-210B-210C. Statistical Mechanics and the Properties of Matter (3) F,W,S
Systems of weakly interacting elements; general ensemble theory; applications to systems with interactions such as imperfect gases, plasma, liquids, order-disorder transitions; fluctuations, irreversible processes. Principles of the dynamics of ions and electrons in solids; applications to electric, magnetic and thermal properties. Prerequisites: Physics 140, 141, 152 or equivalent; Physics 212B.

212A. Quantum Mechanics (3) W
Physical basis of quantum mechanics, the Schrödinger equation and the quantum mechanics of one-particle system, matrices and the transformation theory of quantum mechanics, approximation methods for discrete stationary states. Prerequisite: Physics 130B or equivalent.

212B. Quantum Mechanics (3) S
Translational and rotational invariance, angular momentum and spin, the formal theory of scattering. Prerequisite: Physics 212A.

212C. Quantum Mechanics (3) F
Approximation methods in the continuum and for time-dependent problems; identical particles and the quantum theory of atomic structure; the statistical matrix and the quantum mechanical theory of measurement. Prerequisite: Physics 212B.

212D. Quantum Mechanics (3) W
Relativistic one-particle theory; quantization of the electromagnetic field

and particle fields; nonrelativistic interaction of the quantized electromagnetic field with atomic systems. Prerequisite: Physics 212C.

213A-213B. Theoretical Nuclear Physics (3) F,W
Nuclear forces, two-nucleon system, interaction of nucleons with the electromagnetic field, Beta transformation of nucleons; nuclear systematics, models of nuclear structure, nuclear transformations and reactions. Prerequisites: Physics 130C or equivalent; co-registration, Physics 212C and 212D.

214. Advanced Quantum Mechanics (3) S
Covariant perturbation theory, mass and charge renormalization of quantum electrodynamics, radiative corrections to scattering and atomic energy levels, introduction to dispersion theory. Prerequisite: Physics 212D.

215. High Energy Nuclear Physics (3) S
An introduction to the elementary particles with particular emphasis on the invariance principles by which they are classified. Prerequisites: Physics 212D, 213B.

217A. Astrophysics (3) F
Stellar spectroscopy (line, molecular, and continuum), stellar atmospheres, determination of abundances of elements in stars. Prerequisites: Physics 130C; Physics 141 or equivalent.

217B. Astrophysics (3) W
Stellar structure, degenerate matter, stellar evolution (theoretical and empirical), nuclear energy and nucleosynthesis. Prerequisite: Physics 217A.

217C. Astrophysics (3) S
Galactic structure, stellar populations, star cluster, interstellar medium, radio emission from galaxies. Prerequisite: Physics 217A.

220. Group Theoretical Methods in Physics (3) F
Study of the representations and applications of groups to problems in physics, particular emphasis on the permutation of unitary groups. Prerequisite: Physics 212C.

230. Advanced Solid State Physics (4) F
A selection of advanced topics such as electrical and thermal transport phenomena, cooperative magnetic phenomena, nuclear and electron magnetic resonance, superconductivity. Prerequisite: Physics 210C.

231. Collision Theory (3) S
Collision theory and its application to atomic and molecular processes. Description of collision processes, scatterings and resonances in composite systems. Rearrangement collisions and the methods of approximation. Prerequisites: Physics 212A, 212B.

232A-232B. Advanced Plasma Physics (3-3) W-S
Vlasov equations and elementary excitations of an infinite medium; ki-

netic theory with applications to diffusion, scattering, etc.; quasi-linear theory and turbulence. Invariants of single particle motions; stability theory; magnetohydrodynamics and generalizations to include resistivity and finite Larmor radius; microinstabilities; applications to fusion, MHD power generation, and propulsion. Prerequisites: Physics 200C, 203B, 210B.

233. Elementary Particle Theory (4) **F**
Current problems in elementary particle theory, especially the theory of strong interactions. Prerequisite: Physics 215.

234. High Energy Experimental Physics (4) **F**
Current elementary particles research. Techniques used in experiments with high energy accelerators. Prerequisite: Physics 215.

236. Many-Body Theory (4) **W**
Dilute classical systems; virial expansions; relation to statistical mechanics; quantum mechanical formulations; dilute systems, perturbation theory; calculation of ground state energy; nuclear matter; uncharged and charged Bose and Fermi liquids; collective modes of motion; screening; superconductivity and superfluidity; Green's function method; the self-consistent field; interacting systems of magnetic moments, ferromagnetism. Prerequisites: Physics 210C, 212D.

250. Solid State Physics Seminar (1) **F,W,S**
Discussions of current research in solid state physics.

251. High Energy Physics Seminar (1) **F,W,S**
Discussions of current research in nuclear physics, principally in the field of elementary particles.

252. Plasma Physics Seminar (1) **F,W,S**
Discussions of recent research in plasma physics.

253. Astrophysics and Space Physics Seminar (1) **F,W,S**
Discussions of recent research in astrophysics and space physics.

299. Research in Physics (1-6) **F,W,S**

PSYCHOLOGY

Office: 4202 Urey Hall

Norman H. Anderson, *Ph.D., Professor of Psychology*
J. Anthony Deutsch, *D.Phil., Professor of Psychology*
David M. Green, *Ph.D., Professor of Psychology*
George Mandler, *Ph.D., Professor of Psychology* (Chairman of the Department)
William J. McGill, *Ph.D., Professor of Psychology*
William J. McGuire, *Ph.D., Professor of Psychology*
Harry L. Munsinger, *Ph.D., Associate Professor of Psychology*
Donald A. Norman, *Ph.D., Associate Professor of Psychology*
George S. Reynolds, *Ph.D., Associate Professor of Psychology*

Edmund J. Fantino, *Ph.D., Assistant Professor of Psychology*
Peter H. Lindsay, *Ph.D., Assistant Professor of Psychology*
David E. Rumelhart, *Ph.D., Assistant Professor of Psychology*

* * *

Theodore M. Newcomb, *Ph.D., Visiting Professor of Psychology*
(Winter quarter only.)

The Major Program

Students majoring in psychology are expected to develop a broad knowledge of contemporary psychology, as well as special knowledge in the literature and experimental techniques of selected areas. The program of studies is designed to introduce basic skills in experimental and analytical procedures during the junior year. During the senior year, the students will be expected to apply their knowledge in advanced courses and seminars and a senior research project. Modern experimental psychology requires ancillary skills, particularly in the physical and biological sciences and mathematics.

The normal sequence of courses for the major in psychology includes a basic series of five courses in laboratory and quantitative methods (Psychology 101-105), three courses selected from the list of electives in psychology, a sequence of three related courses from some field of instruction contiguous to psychology, and a senior research project which will normally be completed during three consecutive quarters of Psychology 198.

Students may propose a wide variety of courses and schedules to fit their particular needs. Flexibility in the organization of the course schedule is encouraged. All course schedules must be approved by the student's major adviser, however, and flexibility may not weaken the major requirements. Qualified undergraduate students may elect to take graduate seminars in psychology, subject to approval by the instructors of the relevant courses.

The sequence of three courses from a field of instruction related to psychology need not necessarily all be from the same department, but students will be expected to justify their choices by illustrating a natural progression from one course to another. Normally, the last two courses in the sequence will be upper-division courses within one department. Departments which offer courses contiguous to psychology include Applied Electrophysics, Biology, Economics, Linguistics (Program B only), Mathematics, Philosophy, Physics.

Psychology 10, 11, and 12 are general introductory courses offered for non-psychologists. Students intending to major in psychology are not required to take these courses.

A thorough knowledge of quantitative methods is essential to the understanding of experimental psychology. Students should complete the Mathematics sequence 2A-2B-2C or its equivalent and two additional courses in Mathematics. Normally, at least one of these will be in probability theory. An acceptable sequence would be Mathematics 130A-130B.

Students are encouraged to complete the Mathematics requirement during their sophomore year.

Major Program in Psychology (Recommended Schedule)

	Fall	Winter	Spring
Junior Year	Psychology 101 Psychology 104	Psychology 102 Psychology 105 Mathematics	Psychology 103 Mathematics
Senior Year	Psychology 198 *Psychology †Elective	Psychology 198 *Psychology †Elective	Psychology 198 *Psychology †Elective

*Selected from Psychology electives.
†Three related courses (see text).

The Graduate Program

The Department of Psychology will provide broad training in experimental psychology. Increased specialization and the general burgeoning of the field of psychology make it impossible to provide training in depth in all aspects of experimental psychology for all students, but all major areas of experimental psychology will be represented in departmental research activities. One area of concentration of departmental effort will be communication and information research and human information processing. In addition, the department will have strong representation in the areas of animal learning, physiological psychology (including motivation and emotion), and developmental psychology.

Graduate study consists of the following components:

1. *Quantitative Methods* (Psychology 201A-201B-201C).
2. *Basic Seminars* (Psychology 202-219). These seminars are intended to cover current psychological knowledge and to provide the basis for more intensive and specialized study. All students (whether candidates for the M.A. or Ph.D. degree), during the first year of graduate study will normally be required to take no less than four and no more than six one-quarter seminars at the basic level. Typically, two of these basic seminars should be taken in the first quarter, and one each in the second and third quarters.
3. *Advanced Seminars* (Psychology 220-239). These seminars focus on specific areas of current knowledge and research. During the first year of graduate study, a student may take up to two advanced seminars during the second and third quarters. Graduate and upper-division courses in other departments may be substituted for advanced seminars with the approval of the Department. Course work in the second year will usually be confined to advanced seminars and

to interdisciplinary work. No further formal course requirements are established.

4. *Research Practicum* (Psychology 296). Beginning with the first year of graduate study, all students will be enrolled in a Research Practicum. Graduate students will be assigned to ongoing research projects in the Department and will receive the personal supervision of a member of the staff.
5. *Teaching Participation.* In order to acquire adequate teaching experience during graduate study, all graduate students are required to participate in the teaching activities of the Department during each year of residence.
6. *Comprehensive Evaluation.* At the end of the first year of graduate study, each student's work will be evaluated by the staff. This evaluation will consider all aspects of the student's performance: his work in courses and seminars, his research ability as demonstrated in the Research Practicum, and his teaching participation. Registration beyond the first year will be contingent upon the outcome of the evaluation.

   During the second year, the Department will survey the comprehensive preparation of the student. Additional written or oral evidence of competence in certain areas may be sought at this time, and where necessary, additional course work will be required.

Requirements for Admission

Apart from the University's requirements for admission to the Graduate Division, the Department of Psychology will require adequate preparation in psychology during the student's undergraduate career. Completion of a major in psychology, or at least a strong minor, would normally be a prerequisite, but exceptions may be made for applicants with strong preparation in such fields as biology and mathematics.

Foreign Language

No foreign language requirement is imposed at the M.A. level. Graduate students proceeding to the Ph.D. must demonstrate comprehension of one of the following languages: German, French, or Russian. Substitution of another language may be permitted with the approval of the Graduate Council, if a significant psychological literature can be shown to exist in that language.

Doctor's Degree Program

In addition to the program outlined above, candidates for the Ph.D. degree must fulfil the following requirements:

1. *Qualifying Examination.* At the end of the second year of graduate study, the student will be expected to prepare a paper outlining the major problems and findings in his area of specialization, describing his thesis topic, and including any preliminary results obtained in pilot studies and other preparatory research. He will be examined by his doctoral committee on the contents of this paper.
2. *The doctoral dissertation.*

Master's Degree Program

Normally, students will be accepted only for a plan of study that envisions proceeding to the doctoral level. Students in the doctoral program may, however, qualify for the M.A. degree.

Plan II for the Master's degree has been adopted by the Department of Psychology. (See *Graduate Division: The Master's Degree.*) The candidate for the Master of Arts degree in Psychology must obtain credit for 36 quarter-units, of which at least 14 must be in graduate courses in Psychology, 10 additional units in graduate courses, and 12 units in graduate or upper-division courses. Each candidate must complete Psychology 201A-201B-201C, and at least 6 additional units in graduate courses other than research courses or research units (Psychology 296 and 299). Each candidate must also pass the Master's examination offered by the Department once a year.

COURSES

LOWER DIVISION

10. Developmental Psychology F
An introduction to the psychological development of the human organism with special reference to cognitive development in the child. Two hours lecture, one hour recitation.

11. Perception and Learning W
An introduction to basic principles of perception, learning, and information processing. Two hours lecture, one hour recitation.

12. Choice and Decisions S
An overview of the human organism as an information processing system, stressing theory and data on choice and decision-making. Two hours lecture, one hour recitation.

Psychology 10, 11, 12 may be used in fulfilling the Revelle College social science requirement.

UPPER DIVISION

101. Experimental Psychology F
An introduction to the experimental investigation of human and animal behavior. Emphasis is given to problems in human and animal learning, perception, and information processing. Prerequisite: major in Psychology. Four hours laboratory, two hours lecture and recitation.

102. Experimental Psychology W
Continuation of Psychology 101. Prerequisite: Psychology 101.

103. Experimental Psychology S
Continuation of Psychology 102. Prerequisite: Psychology 102.

104. Quantitative Methods in Psychology F
An introduction to statistical and quantitative methods. Prerequisite: major in Psychology.

105. Quantitative Methods in Psychology W
Continuation of Psychology 104. Prerequisite: Psychology 104.

180. Special Topics F,W,S
Selected seminars by members of the staff. Prerequisite: major in Psychology.

198. Research in Psychology F,W,S
Research and research seminars under the direction of a member of the staff. Prerequisites: Psychology 103 and 105. May be repeated for credit.

199. Independent Study F,W,S
Independent study or research under direction of a member of the staff. Prerequisite: special permission of the Department.

GRADUATE

201A-201B-201C. Quantitative Methods in Psychology (3-3-3) F-W-S
Mr. Anderson, Mr. McGill
An intensive course in statistical methods and the mathematical treatment of data, with special reference to research in psychology.

202. Sensory Mechanisms (2) F
Mr. Green
An introduction to problems and methods. Lectures and seminar.

203. Physiological Psychology (2) W
Mr. Deutsch
The central nervous system and its relation to behavior. Lectures and seminar.

204. Social Psychology (2) S
Mr. McGuire
The behavior of man as a function of social variables. Lectures and seminar.

205. Memory and Attention (2) W
Mr. Norman
Contemporary theories of human attention and memory. Lectures and seminar.

206. Animal Learning (2) F
Mr. Reynolds
Classical and operant conditioning in lower animals. Lectures and seminar.

207. Developmental Psychology (2) F
Mr. Munsinger
The original behavioral repertory of the child and its subsequent development. Lectures and seminar.

220. Detection Theory in Psychology (2) W
Mr. Green
The application of detection theory to human information processing. Advanced seminar.

221. Judgmental Processes (2) **W**
Mr. Anderson
The psychology of judgments and information integration. Advanced seminar.

222. Brain Functions (2) **S**
Mr. Deutsch
Selected topics. Advanced seminar.

223. Advanced Topics in Psychophysics (2) **S**
Mr. McGill
Advanced seminar.

224. Verbal Learning and Memory (2) **S**
Mr. Mandler
Selected problems. Advanced seminar.

225. Experimental Analysis of Behavior (2) **S**
Mr. Reynolds
Advanced seminar in modern techniques and findings, with special emphasis on operant conditioning. Advanced seminar.

280. Seminar in Communication and Information Research (1) **F,W,S**
The Staff and Visiting Lecturers.

296. Research Practicum (1-6) **F,W,S**
The Staff
Research in psychology under supervision of individual staff members.

299. Independent Study and Thesis Research (1-6) **F,W,S**
The Staff

SCIENCE

See *Interdisciplinary Courses.*

SOCIOLOGY

A Department of Sociology is being formed. Courses will be announced as they become available.

SUBJECT A

See *Interdisciplinary Courses.*

VISUAL ARTS

Office: Building 235, Matthews Campus

Paul Brach, *M.F.A., Professor of Visual Arts* (Chairman of the Department)
Newton Harrison, *M.F.A., Assistant Professor of Visual Arts*

Donald Lewallen, *M.A., Assistant Professor of Visual Arts*
David Rifat, *Diploma of Art, Assistant Professor of Visual Arts*

The Visual Arts Department is being developed and courses in addition to those listed below will be offered in 1967–68. There will be enough of them to enable qualified students to begin a major in the fall term. In addition, there will be combinations of courses that may be taken by Revelle College students to fulfil the requirements for a noncontiguous minor.

COURSES

LOWER DIVISION

1A. Introduction to Art **F,W,S**
Fundamental aspects of the visual arts. Introduction to problems in art history, aesthetics, and other conceptual material relevant to the visual experience. Three hours lecture.

1B. Surfaces **F,W,S**
Fundamental aspects of the visual arts. Exploration of problems in organizing two-dimensional surfaces: function of color, composition, and spatial relationships. Six hours laboratory.

1C. Representation **F,W,S**
Fundamental aspects of the visual arts. Studies of systems of pictorial representation, including perspective, light and shade, photography, etc. Six hours laboratory.

(Visual Arts 1A-1B-1C may be used in fulfilling the Muir College Humanities and Fine Arts requirement.)

10. Nature of the Visual Arts **F,W,S**
Exploration of concepts, techniques, and materials. Investigation through drawing and painting and mixed media into basic art problems. Six hours laboratory.

11. Nature of the Visual Arts **W,S**
Three-dimensional problems such as structures and environments. Six hours laboratory. Prerequisite: Visual Arts 10 or equivalent.

12. Nature of the Visual Arts **S**
The course will stress the development of personal subject matter. Six hours laboratory. Prerequisite: Visual Arts 10 or equivalent.

Bright sun and books, part of everyday living and studying at UCSD

Rules and Procedures

REGISTRATION

After a student is officially admitted (see *Admission to the University*), he may register for classes. A student is not officially registered for classes each quarter until he has completed the *entire* registration procedure, which includes:

1. Consultation with academic adviser and the securing of any necessary permissions.
2. Filing of completed class enrolment and informational cards (Official Study-List Packet) with the Registrar's Office.
3. Payment of fees at the Cashier's Office (including any outstanding debts from the previous quarter).

Detailed instructions will be published prior to each quarter's registration.

Graduate Student Registration

All students entering graduate status for the first time are considered new students and must file an application for admission to graduate status and be accepted for admission by the Graduate Division (see *Graduate Division*). Every candidate for a higher degree is required to register each quarter until all degree requirements are fulfilled (including the thesis or dissertation and final examination). The candidate must continue to register until either the degree is awarded or he is granted a formal leave of absence or withdrawal.

If a graduate student fails to register or is absent without leave, the University will presume that he has withdrawn from the Graduate Division. He may apply for readmission at a later date, but cannot be assured of acceptance.

Physical Examination

All new students, graduate and undergraduate (including former undergraduates entering graduate status for the first time), and all students returning to the University after an absence of two or more quarters must have their physicians submit to the Student Health Service a completed medical examination form and must appear for a personal interview at the Health Service before they will be permitted to register. (See *Contents* for *Health Service.*)

Late Registration

Students will be assessed a late registration fee of $10 if they have not registered (paid fees) before the first day of classes each quarter (see *Academic Calendar*).

Registration Card

At the time of registration each student will receive a registration card, which is evidence that he is a regularly enrolled student at UCSD

and which entitles him to library privileges, student health care, and other University privileges. In addition, the registration card provides, for the undergraduate, identification for Associated Students functions.

If the card is lost, a duplicate may be obtained from the Registrar's Office for $3.

OFFICIAL STUDY LIST

In order to receive credit for courses undertaken the student must list them on his Official Study List, secure a class card for each course so listed, and file them with the Registrar's Office.

Unapproved withdrawal from, or neglect of, a course listed on the Official Study List will result in a failing grade. Any change in program after filing the list—whether to add, replace, or drop a course—must be by formal petition approved by the instructor and by the Provost (undergraduates) or adviser (graduate students). The approved petition must be filed at the Registrar's Office.

STUDY-LIST LIMITS

The normal undergraduate program consists of an average of four courses each quarter for four years. However, a student may enrol for three courses without the approval of the Provost of his college, as long as he maintains an average of four courses for the four years. If a student wishes to enrol in less than three courses in any quarter, he must secure the permission of the Provost of his college. For purposes of the Registrar's Office and the Selective Service Office, three courses are considered the minimum for a full-time student.

While four courses are suggested as the maximum number to be taken during any one quarter, a superior student may take more with the permission of the Provost of his college. However, students are cautioned not to overload their programs—a heavy course load is no excuse for poor scholarship.

A graduate student in a regular quarter is limited to 16 credits when he takes only undergraduate courses, to 12 credits when he takes only graduate courses, and to a total made up in the proper proportion of 12 to 16—as, for example, 6 graduate and 8 undergraduate—when he takes both undergraduate and graduate courses.

Research assistants and others employed approximately half time are limited to three-fourths of these totals. Students engaged full time in other occupations are limited to 6 credits of graduate and/or upper-division courses.

Study lists exceeding these limits may be accepted only with the approval of the Vice Chancellor–Graduate Studies and Research.

Each graduate student must register for, attend, and complete upper-division courses (courses in the 100 series), or graduate courses (200 series), amounting to at least 6 credits for each quarter so as to satisfy the minimum residence requirement in candidacy for most of the higher degrees or certificates issued by the University.

CHANGE OF PROGRAM

After the Official Study List has been filed, a student may add or drop courses, or change sections within a course, according to the following schedule:

First and second week of classes	ADD or DROP	No Fee
Third through sixth week of classes	DROP ONLY	$3 Fee

Permission to add or drop a course requires approval of the instructor and of the Provost (undergraduates) or adviser (graduates). Permission to change sections within a course requires approval of the instructor only.

A petition for a change in the Official Study List is available in the Registrar's Office or the Provost's Office and must be filed with the Registrar if the student is to be relieved of responsibility for dropped courses and credited for the added courses.

GRADES

Grades in courses (graduate or undergraduate) are defined as follows: *A*, excellent; *B*, good; *C*, fair; *D*, barely passing; *F*, failure; and *I*, undetermined (work of passing quality but incomplete). The designations *P*, passed, and *N*, not passed, are used in reporting grades on some graduate courses. The designations *S* and *U* are used in reporting satisfactory and unsatisfactory work in certain individual research or study programs for graduates. *NR* indicates that the instructor has not reported a grade.

All grades except *I* are final when filed by an instructor in his end-of-term course report. An exception is the correction of a clerical error. No term grade except *I* may be revised by re-examination.

Only courses for which grades *D* or *F* were received may be repeated for credit, and not more than once, unless authorized by the Provost of the student's college. When a course is repeated, the units will be credited toward a degree only once, but the student's grade-point average will be computed in terms of the total number of units attempted.

A student is entitled to replace the grade *I* with a passing grade and to receive credit provided he completes the work of the courses in a way approved by the instructor. The student is required to complete the necessary work by the end of the next quarter he is in attendance, or the grade will be changed to *F*. To remove an *I* grade, the student must complete a petition at the Registrar's Office, secure the instructor's approval, and pay a $5 fee at the Cashier's Office.

Special Grade Options

Satisfactory/Unsatisfactory

With the consent of the department, and subject to the approval of the Graduate Council, students pursuing individual programs of research and study or engaged in other appropriate graduate activities of an individual nature may receive unit credit for such work. In calculating grade-point standing, units gained in this way shall not be counted.

The work shall be graded *S*, satisfactory, or *U*, unsatisfactory. No credit will be allowed for work marked unsatisfactory.

Passed/Not Passed

A graduate student taking courses outside his own department has the option, with permission of his department chairman and of the course instructor, of enrolling in a special category where he may receive a *P*, passed, or *N*, not passed. A student must decide at the time he files his study list whether or not to elect this option, and may not later alter his status in the course. The student is responsible for notifying the Registrar of all courses taken on a "Passed/Not Passed" basis. With a grade of *P* the student will earn course credit toward the total of courses passed, but the grade will not be included in calculating grade-point average. A grade of *N* will be recorded as a failure.

Grade Points

Grade points are assigned on a four-point basis: *A*, 4 points per unit; *B*, 3 points per unit; *C*, 2 points per unit; *D*, 1 point per unit; *F* and *I*, no points. Each undergraduate course counts 4 units, and graduate courses range from 1 to 12 units each. (See course descriptions under *Departments of Instruction.*) Grade-point average is computed by dividing the total number of grade points earned by the total unit value of courses attempted. *P, N, S, U, and NR* grades are excluded in computing grade-point average.

Credit by Examination

With the instructor's approval, students in good standing may petition to obtain credit for some courses by examination. For further information, consult the Office of the Provost.

Final Examinations

Final examinations are obligatory in all undergraduate courses except laboratory courses and courses which, in the opinion of the Educational Policy Committee, require special treatment. In laboratory courses final examinations are held at the option of the department in charge. All examinations will be conducted in writing, as far as is practicable, and a maximum time will be assigned beforehand for each examination. The time for examination sessions may not be more than three hours.

Final Grades

As soon as possible after the end of each quarter, final grades will be mailed to students by the Registrar's Office. It should be emphasized that course reports filed by instructors at the end of each quarter are final.

SCHOLASTIC REQUIREMENTS

Undergraduates

The scholastic status of all UCSD undergraduates is governed by the following provisions:

1. *Probation.* A student will be placed on probation if, at the end of

any quarter, his grade-point average falls below 2.0 (C), computed on the total unit value of all courses undertaken in the University, including courses graded Incomplete. The basis for removal from probation is the achievement of a 2.0 (C) grade-point average based on all work taken in the University.

2. *Dismissal.* A student will be subject to dismissal from the University if his grade-point average falls below 1.5 for any quarter, or if, after one quarter on probation, he has not achieved a 2.0 average, computed on the total of all courses undertaken in the University including those graded Incomplete. He will also be subject to dismissal if he fails to make satisfactory progress toward a degree at UCSD.

If a student becomes subject to dismissal, his grades and records will be carefully reviewed by the Provost of his college, who will consider the student's total performance and take appropriate action. If the Provost feels the student will be able to overcome his academic deficiency, he will suspend dismissal and allow the student to continue on probation.

The Provost also has the power to continue probation or authorize the return of a dismissed student to probationary status. Students on probation or subject to dismissal will be under the supervision of the Provost of the college.

A student who has been dismissed or who is on probation and wishes to transfer from one campus of the University to another, must obtain the approval of the Dean or Provost into whose jurisdiction he seeks to transfer. After completing a transfer the student is subject to the supervision of the Dean or Provost on the new campus. See *Intercampus Transfer* below.

Graduates

For good standing and eligibility for an advanced degree, a graduate student must maintain a grade-point average of 3.0 (B), computed on the total unit value of all courses undertaken in graduate status at the University.

A graduate student is subject to dismissal if his overall grade-point average falls below 3.0 (B) at any time, or if his work in any two consecutive terms falls below a 3.0 average.

ANNOUNCEMENT OF CANDIDACY

Every undergraduate, at the beginning of each quarter during his senior year, is required to file an *Announcement of Candidacy for a Degree* (the A card in his study-list packet). This enables the Provost of the college to determine whether or not the program the student is undertaking will satisfy degree requirements. The student will be notified of any deficiency.

The quarter he expects to graduate, the student is required to file a *Degree Name Card* (available in the Registrar's Office).

APPLICATION FOR READMISSION

The deadline for all returning students to file an application for re-

admission is four weeks prior to the first scheduled day of registration (see *Academic Calendar*). Transcripts for work taken at other institutions must be submitted as part of the application.

INTERCAMPUS TRANSFER

An undergraduate who is now, or was previously, registered in a regular session at any campus of the University of California, and has not since registered at any other institution, may apply for transfer in the same status to another campus of the University. The student who wishes to transfer must file an application on his *present* campus. Application forms for intercampus transfer and for transcript of record are available in the Registrar's Office. They must be completed and filed with that office by March 1 for the Fall quarter, by November 1 for the Winter quarter, and by February 1 for the Spring quarter.

INTERCAMPUS EXCHANGE PROGRAM

A graduate student registered on any UC campus who wishes to take courses on another campus may become an Intercampus Exchange Graduate Student with the approval of his adviser and the Dean of the Graduate Division on the campus to be visited. He is not admitted to the graduate division at the host campus, but continues to be considered a graduate student in residence on his home campus.

Application forms for the Intercampus Exchange Program for graduate students may be obtained from the Registrar's Office.

CONCURRENT ENROLMENT

Concurrent enrolment in regular sessions at another institution or in University Extension while enrolled on the San Diego campus is permitted only when approved in advance by the Provost of the student's college.

LEAVE OF ABSENCE

Graduate students who are severing their connection with the University for a specific period of time, after which they intend to resume their studies, must secure a formal leave of absence. Petitions are available at the Registrar's Office. Leave of absence is a privilege requiring the endorsement of the department in which the student is studying and approval of the Vice Chancellor–Graduate Studies and Research.

Graduate students who are granted formal leave of absence are exempt from all fees during the period of their leave.

WITHDRAWAL FROM THE UNIVERSITY

A student withdrawing from the University during a quarter must file a *Notice of Withdrawal* with the Registrar's Office before leaving the campus. In cases of illness or emergency, notice of withdrawal should be made as soon as the student decides not to continue.

The importance of giving proper notice before discontinuing attendance cannot be overemphasized. If proper notice is not filed, the student will

receive failing grades in all courses and jeopardize his eligibility to re-enter the University of California or his admission by transfer into another institution.

LAPSE OF STATUS

Lapse of status means the enforced withdrawal of a student from the University and may be caused by:

1. Failure to respond to official notices.
2. Failure to meet financial obligations.
3. Failure to complete the physical examination.
4. Failure to file an Official Study List.

Each student who becomes subject to lapse-of-status action is given advance notice and ample time to deal with the situation. However, if the student fails to respond, action will be taken without further notice and he is entitled to no further services of the University except assistance toward reinstatement.

A student wishing to have his status restored must secure a petition from the Registrar. If the petition is approved, a fee of $10 must be paid in addition to any other charges that may be outstanding. Reinstatement is not final until the petition has been accepted by the Registrar.

TRANSCRIPT OF RECORDS

A $1 fee is charged for each transcript of a student's record. Applications for a transcript of record should be submitted to the Registrar several days in advance of the time needed. An application for a transcript must bear the student's signature; transcripts will be released only upon signed request of the student.

Transcripts will not be issued for a student whose status has lapsed or who has not made satisfactory arrangements regarding bills due or other indebtedness to the University.

PRESERVATION OF RECEIPTS

All receipts of payments made to the Cashier, whatever their nature, should be carefully preserved. Not only do they constitute evidence that financial obligations have been discharged, but they may support a claim that certain documents or petitions have been filed.

REFUND OF FEES

Students who withdraw from the University during the first five weeks of instruction will receive refunds of incidental fees, student activity fees, and nonresident tuition fees (if such have been paid) on the following basis:

First two weeks of instruction	80% of total paid
Third week of instruction	60% of total paid
Fourth week of instruction	40% of total paid
Fifth week of instruction	20% of total paid
After fifth week of instruction	No refund

The effective date for calculating a fee refund is the last day the student

attended any University class. Claims for refund of fees must be presented during the fiscal year (July 1 to June 30) in which the claim is applicable. To obtain a refund, the student must surrender his registration card and present his fee receipt to the Registrar.

CHANGE OF NAME OR ADDRESS

Students must notify the Registrar's Office promptly of any change of name or address. Forms are available in the Registrar's Office.

RULES GOVERNING RESIDENCE

The residence classification of each student is determined in accordance with Section 244 of the California Government Code, Sections 23054, 23055, and 23057 of the California Education Code and the Standing Orders of the Regents. It is therein provided that a resident student is any person who has been a legal resident of the State of California for more than one year immediately preceding the opening day of the quarter during which he proposes to enrol.

The attention of the alien prospective student is directed to the fact that he is a nonresident unless, in addition to the general residence requirements for tuition purposes, he has been admitted to the United States for permanent residence in accordance with all applicable laws of the United States. The prospective student under the age of 22 whose parents are not California residents, and the veteran who was not a resident of California at the time of his entrance into the Armed Forces, should note that presence in California for more than one year does not, of itself, entitle the student to classification as a resident.

Every student who is classified as a resident but who becomes a nonresident of California is obliged to notify the Deputy for the Attorney in Residence Matters at once.

Application for change of classification cannot be made retroactive under any circumstances.

A person incorrectly classified as a resident student is subject to reclassification as a nonresident. If the incorrect classification resulted from concealed facts or untruthful statements by him, the student shall be required to pay all tuition fees which would have been charged to him as a nonresident student. He shall be subject also to such discipline as the President of the University may approve.

Petitions for reclassification of residence are available in the Registrar's Office.

RESIDENCE STATUS

Every new or returning student is required to fill out a Statement of Legal Residence in order to determine his residence classification for fee purposes. If a student's family moves into or out of California, or if he maintains an independent household in any state other than that from which he was admitted, he should apply for reclassification to the Deputy for the Attorney in Residence Matters, Registrar's Office, or directly to the Attorney for the Regents in Residence Matters, 590 University Hall, University of California, Berkeley 94720.

General Information for Students

FEES AND EXPENSES

The exact cost of attending the University of California, San Diego, will vary according to personal tastes and financial resources of the individual. Generally, the total expense for three quarters, or a college year, will average about $1,960 for residents of California and $2,940 for nonresidents (including foreign students.)

It is possible to live simply and to participate moderately in the life of the student community on a limited budget. The best that the University can do to assist the student in planning his budget is to indicate certain and probable expenses.

Estimated Expenses for Undergraduates

I. RESIDENTS OF CALIFORNIA

	FALL QUARTER	WINTER QUARTER	SPRING QUARTER	TOTAL
Incidental Fee	$ 73.00	$ 73.00	$ 73.00	$ 219.00
Associated Students Fee	6.00	6.00	6.00	18.00
Board and Room in Residence Halls*	339.00	339.00	339.00	1,017.00
Books	50.00	50.00	50.00	150.00
Personal Expenses†	185.00	185.00	185.00	555.00
Total	$653.00	$653.00	$653.00	$1,959.00

*Figures given for each quarter are one-third of total; actual payments vary according to the quarter. For single room, add $100.00 for the year. (Students living off campus must expect considerable variation in room and board costs, as well as the cost of transportation to and from the campus.)

†Includes laundry, clothing, medical costs not covered by student health insurance, recreation, transportation, etc.

II. NONRESIDENTS

In addition to the above expenses, nonresidents are required to pay a nonresident tuition fee of $327.00 per quarter or $981.00 per year.

Incidental Fee

The incidental fee is currently $73 per quarter for graduates and undergraduates. This fee, which must be paid at the time of registration, covers certain expenses for use of library books, for recreational facilities and equipment, for registration and graduation, for all laboratory and course fees, and for such consultation, medical advice, and hospital care or dispensary treatment as can be furnished by the Student Health Service or by health and accident insurance purchased by the University. No part of this fee is refunded to students who do not make use of these

privileges. For undergraduate students, there is an additional Associated Students fee of $6.00 per quarter.

Reduced Incidental Fee

One-half of the established incidental fee may be paid by:

1. Graduate students whose research or study requires them to remain outside the State of California throughout the quarter. Authorization for this privilege is secured from the Vice Chancellor–Graduate Studies and Research.
2. Graduate students who are full-time non-academic employees of the University, as provided for in Personnel Rules, Rule 19, June 1, 1958. Authorization for this privilege is secured from the Personnel Manager.

Miscellaneous Expenses

Books and stationery for a student average about $50 per quarter. Exact information on these items may be obtained by writing directly to the school or department. Students who fail to pass the required examination in Subject A must pay a fee of $45 for the course in Subject A.

Parking Fee

Students who park on the campus are charged an annual parking fee of $31.50 for a car or $12.00 for a motorcycle or motor scooter.

Tuition

There is no tuition fee for students classified as resident students. Students classified as nonresidents are subject to payment of a nonresident tuition fee of $327 per quarter. (Exemption may be granted to dependents of military personnel or University faculty.) See *Rules and Procedures: Rules Governing Residence; Residence Status.* Graduate students may have the nonresident tuition fee waived under certain conditions (see the section following).

Waiver of Nonresident Tuition Fee

Graduate students who are admitted without deficiencies, who have proved that their scholarship is distinguished, and who are carrying full programs toward the fulfilment of requirements for higher academic and professional degrees, may apply for a waiver of the nonresident tuition fee at the time of application for admission to the Graduate Division. The waiver may be granted for graduate students appointed to teaching assistantships, teaching fellowships, or University fellowships under the jurisdiction of the Graduate Council and paid from intramural funds. Subject to funding restrictions, the waiver may also be granted for outstanding students in certain special programs or holding other appointments.

The waiver may not be granted for graduate students registered for thesis only, nor for students taking reduced programs for reasons of employment or health. These waivers are granted only on the basis of distinguished scholarship, as a recognition of academic excellence. They

are not granted on the basis of need and are not to be considered grants-in-aid. Students applying for the waiver should be prepared to pay the nonresident tuition fee when they register unless they have received written notice that a waiver has been granted. Further information may be obtained from the Office of Graduate Studies and Research.

Nonresident Fee for Reduced Programs

For the undergraduate student enrolled in less than three courses, the nonresident tuition fee is $112 per course or the proportionate part for a fractional course. For graduate students the nonresident tuition is $327 per quarter regardless of the number of courses undertaken. There is no reduction in incidental or Associated Students fees because of a reduced program.

UNDERGRADUATE SCHOLARSHIPS AND FINANCIAL AIDS

The University of California, San Diego, expects that the student and his family will bear as much of the necessary cost of the students' education as their circumstances will permit. In those cases where resources are insufficient to meet a normal budget, the Financial Aids Office will attempt to help students find supplemental financial aid. Applications and requests for information should be addressed to: Financial Aids Officer, University of California, San Diego, La Jolla, California 92037 (phone 453-2000, ext. 1946).

Students should have enough funds with them at the beginning of the fall quarter to cover registration fees, books, and initial housing costs, as scholarship and loan checks will not be available until after registration.

Scholarships

The Committee on Undergraduate Scholarships and Honors awards more than two hundred scholarships each year to undergraduate students enrolled on the San Diego campus. These scholarships are donated by private individuals, organizations, corporations, and by the Regents of the University.

All scholarship awards are made on a competitive basis, consideration being given to scholastic achievement, financial need (except for students applying for Regents' Scholarships), and promise. Eligibility for a scholarship is determined from the applicant's statements on his application form, appropriate letters of recommendation, official transcripts, and the Parents' Confidential Statement.

Applying for a Scholarship

Applications are available in the Financial Aids Office. Completed applications for the following academic year must be returned between December 1 and February 15. No application postmarked or presented in person after February 15 can be accepted.

Parents' Confidential Statement

To permit an evaluation of need, parents of all entering and contin-

uing students who apply for scholarships are required to provide financial information on the *Parents' Confidential Statement*. New students may obtain this form from their high school or college counselor. Continuing students may obtain a special form from the Financial Aids Office. This form must be filed by February 1 with the College Scholarship Service, P.O. Box 1025, Berkeley, California 94701 (or P.O. Box 176, Princeton, New Jersey 08540), and it must be indicated that a report is to be sent to the University of California, San Diego. A word of caution: The filing of the Parents' Confidential Statement does not constitute an application for a scholarship.

Announcement of Awards

Awards are announced by June 1. Most scholarships are awarded for one year; financial assistance for succeeding years will depend upon the student's academic performance in the University and continuing need. Unsuccessful applicants for scholarships beyond the first year should consult the Financial Aids Office. Every effort will be made to offer other assistance, such as long-term loans, part-time work, etc.

Regents' and Chancellor's Scholarships

The highest honor that may be conferred upon an undergraduate student is the awarding of a Regents' or Chancellor's Scholarship. They are granted by the President of the University and the Chancellor of the San Diego campus, on the basis of academic excellence and exceptional promise, without reference to need. Scholars receive an honorarium of $100 annually and, with the Regents' Scholarship, a stipend to cover the difference between their resources and the yearly standard cost of education. All scholarship applicants are considered for these awards. An applicant who wishes to be considered for a Regents' Scholarship with honorarium only should so indicate, and he need not file a Parents' Confidential Statement.

President's Undergraduate Fellowship Program

This new program (beginning 1967–68) is designed to assist unusually talented undergraduate students to carry out special studies and projects under faculty supervision. Three fellowships have been allocated to the San Diego campus. The prospective fellow and his faculty sponsor will submit a project proposal, including a tentative budget, preceding the academic year for which the award will be made. The Chancellor, acting with the advice of the Committee on Undergraduate Scholarships and Honors, will select the fellows by August 1 each year. Stipends will be based on need, to be determined by the cost of the project and the student's own resources.

Educational Opportunity Grants

The Higher Education Act of 1965 made provisions for Educational Opportunity Grants to assist students of exceptional financial need in obtaining a college education. Awards to students meeting University

admissions requirements are based upon financial need, and may vary from $200 to $800 per year, but in every case must be less than one-half the total aid required. The remainder may consist of a scholarship, a loan, or part-time employment. Each student receiving an Educational Opportunity Grant will be offered sufficient matching and supplemental financial assistance to meet his total financial need according to the Parents' Confidential Statement.

College Work-Study Program

This Federally financed program provides funds to finance student employment for the institution and for public and private non-profit organizations. Students from low-income families and other students who would not be able to attend college without this assistance are eligible for referral to job interviews. Once employed, the student may work up to forty hours a week during the summer and other vacation periods, and up to fifteen hours a week during weeks of classes and examinations, until this financial need, as determined by the Parents' Confidential Statement, has been met, and as long as his work is satisfactory and he continues to be a full-time student in good standing at the University.

The Work-Study Program provides experience in many fields, including city planning, mental health, community service in economically depressed areas, recreation, library work, experimental sciences (chemistry, physics, biology, oceanography and related fields), hospital and business administration, and office work. Pay varies from $1.30 to $2.42 per hour.

Sigurd Burckhardt Prize in Literature

This annual prize is supported by a fund established in memory of Sigurd Burckhardt, Professor of German Literature, by his colleagues, friends, and family. Professor Burckhardt was one of the original group of four professors who founded the Department of Literature on this campus. A substantial cash prize will be awarded each year to the graduating senior who, in the judgment of the Department, has done the most distinguished work in literature.

GRADUATE FELLOWSHIPS AND ASSISTANTSHIPS

Fellowships and Traineeships

A number of fellowships and traineeships which permit full-time study and research toward a degree are available for outstanding students. Some fellowships also involve participation in the teaching program of the University.

Fellowships and traineeships administered by the University include Regents' Fellowships, National Defense Education Act (Title IV) Graduate Fellowships, National Science Foundation Graduate Traineeships, and National Aeronautics and Space Administration Predoctoral Traineeships. The Department of Oceanography administers special fellowships for graduate study in oceanography and related fields.

Application for University-administered fellowships and traineeships should be made as early as possible. Forms and information are avail-

able in the department offices and in the Office of Graduate Studies and Research.

In addition to University-administered fellowships, many public and private agencies offer fellowship aid to graduate students. Publications available in the reference departments of large libraries describe these awards and the application procedures involved.

Teaching Assistantships

Several departments of the University employ graduate students as teaching assistants for classroom instruction, supervision of laboratory sections, the guiding of discussion sessions, and the grading of papers and notebooks. The Department of Linguistics employs a few individuals whose native language is not English to act as tutors in beginning language courses. Application for teaching or language assistantships should be made to the appropriate department.

Research Assistantships

Some departments employ graduate students as research assistants to participate in research activities under the supervision of University faculty members. In some instances, the work of a research assistant may be directly related to his thesis research; in others, it may be entirely different. While research assistantships are awarded through the academic departments, the duties performed may be either in the department or in one of the institutes or laboratories on campus. Application for these awards should be made to the department in which the appointment is desired.

LOANS

Loans are not intended to provide full support, but should be used to supplement other resources. Students with financial need are encouraged to request loan assistance as supplementary aid. Information about all available loans may be obtained from the Financial Aids Office.

Short-Term Loans

These funds, made possible by gifts to the University, are granted in small amounts to help students in short-term emergencies, and usually must be repaid within thirty days to one year.

Regents' Loan Funds

These funds are used principally to supplement stipends of scholarship and fellowship recipients but may also be granted to other qualified students. Regents' Loans, normally repayable in five years, bear an interest rate of 3 per cent on the unpaid balance, beginning upon graduation or withdrawal from the University.

National Defense Education Act Loans

A student is eligible for a National Defense Student Loan if he is a United States citizen or holds an immigrant visa and is carrying at least one-half the normal full-time academic workload. An undergraduate stu-

dent may apply for up to $1,000 a year to a total of $5,000 for his undergraduate career. A graduate or professional student may apply for up to $2,500 annually with a $10,000 maximum for his graduate career. Loans are granted for educationally related expenses and are intended to supplement a student's resources in order to meet standard costs of attending the University.

Repayment of NDEA loans begins nine months after graduation or withdrawal from the University and may be extended over a ten-year period at 3 per cent interest on the unpaid balance. Members of the armed forces, members of the Peace Corps, and VISTA may have their repayment deferred up to three years. Up to 50 per cent of the loan (and interest thereon) may be forgiven for borrowers who enter the teaching profession, at the rate of 10 per cent for each year of full-time teaching in a public or non-profit elementary or secondary school or in an institution of higher education. Borrowers who elect to teach in certain eligible schools located in low-income areas may qualify for cancellation of their entire obligation at the rate of 15 per cent per year.

Either a Parents' Confidential Statement or appropriate form to indicate financial need will be required in most cases for long-term and NDEA loans. Whenever possible, students should anticipate in the spring the financial need for the following academic year to allow for processing financial statements and applications for loans.

CAREER PLANNING AND PLACEMENT OFFICE

The Career Planning and Placement Office serves regularly enrolled UCSD students seeking part-time and summer employment, graduating students seeking full-time career opportunities, and alumni of the University who wish assistance in job betterment or relocation. Students' wives are also eligible for assistance in obtaining employment.

Many students who attend the University expect to earn a part of their expenses. However, the undergraduate curricula must be organized on the assumption that a student will give most of his time and attention to college studies. Any employment should be taken with full realization of academic responsibilities. The importance of planning one's time cannot be overemphasized.

Freshmen are not referred to jobs until they have been on campus for at least one month, except for those who are eligible for the College Work-Study Program. It is recommended that freshmen not attempt to work more than ten or twelve hours a week during an academic period; no freshman will be permitted to work more than fifteen.

Students seeking employment during the school term will find opportunities available in a variety of job categories ranging from clerical, child care, sales, and manual labor to the more specialized classifications requiring high-level skills and talents. These may range from temporary assignments to regular positions, both on and off campus. Since most of the jobs listed are for students who are immediately available, with the exception of live-in positions (room and board in exchange for

work in private homes), it is impossible to arrange for employment by correspondence.

The Career Planning and Placement Office maintains a library of vocational literature on current positions and future career possibilities, supplies information about training courses, apprenticeships, and graduate assistantships, and schedules interviews for students with employers from industry, business, and government agencies who recruit on campus.

Graduating students and alumni are invited to register in the Office if they are seeking career counseling or placement, and if they wish to have their employment credentials collected and kept up to date in the years to come for the use of prospective employers.

OFFICE OF INTERNATIONAL EDUCATION

The Office of International Education has both foreign and domestic functions. It is responsible for the proper documentation of all non-citizens on the campus, whether they be foreign students, postdoctoral fellows, or faculty. In addition to the official documentation required, the Office of International Education assists with hospitality programs, counseling, and other needs of the foreign community. All new students, researchers, and faculty who are citizens of a country other than the United States are asked to call at the Office of International Education as soon after their arrival on campus as possible and to bring their passports with them so that their visa status may be verified.

Education Abroad Program

A second and growing function of the Office of International Education is the Education Abroad Program. UCSD is associated with other campuses of the University of California in this program, which is created to provide opportunity for outstanding students of the University to participate in the life of a university overseas. Most participants are juniors, and must have applied in the first quarter of their sophomore year. The program is also available to graduate students, with the approval of their departments, the Graduate Division, and the Education Abroad Committee. At present, the program is established on campuses in Jerusalem, Beirut, Göttingen, the United Kingdom, Bordeaux, Madrid, Hong Kong, Delphi, Lund, Padua, and Tokyo. It is highly possible that additional international centers will be established in future years.

LIVING ACCOMMODATIONS

Information concerning all types of living accommodations is contained in a brochure included in each admissions application packet. The information, and the instructions on the campus housing application card attached to the brochure, should be read carefully before returning the card to the Housing Office. A brochure or further information can be obtained from the Housing Office upon request.

The University strongly encourages all freshmen to live on campus their first year at UCSD. Living accommodations are available in both Revelle and Muir Colleges. All residence halls are arranged on the suite

plan, with six to ten students sharing a common study-living area. Both single and double rooms are available, with priority for singles given to returning residents. The present room-and-board rate is $1,017 for the academic year, with an additional charge of $100 for single accommodations. Room without board is not available.

Limited accommodations for single graduate students are also available in the residence halls on a first-come, first-served basis. Graduate students will be assigned to graduate suites identical to those described above.

Apartments for married students consist of 19 studio units (which may be available for single graduate students), 56 one-bedroom apartments and 31 two-bedroom apartments. All of these units are unfurnished except for stove and refrigerator. Coin-operated washers and dryers are supplied in the community building on the apartment grounds. Monthly rental prices, including utilities, are $80 to $90 for a studio, $100 for a one-bedroom apartment, and $110 for a two-bedroom apartment.

The Housing Office will assist others in finding suitable accommodations in the surrounding communities of Clairemont, Del Mar, La Jolla, or Pacific Beach. There is a limited number of small apartments near the campus, many of which are of the studio type, with facilities for cooking, and large enough for two students to share. There are also a few room-and-board opportunities with private landlords. Rates per month may vary from $50 for a room to $100 and up for an apartment or room and board. Apartments or houses may be shared for a price range of $40 to $100 per student. Students should call in person at the Housing Office to request assistance for specific off-campus listings.

STUDENT HEALTH SERVICE

The purpose of the Student Health Service is to assist students in maintaining the best possible physical and mental health for maximum scholastic achievement.

Out-patient care is provided for minor illness and injury at the Student Health Center, and infirmary beds are available for short-term care.

Student Health Service personnel handle the presenting medical problems and at the same time take the opportunity to promote some aspects of health education on an individual basis.

A group medical and hospitalization insurance policy purchased by the University provides for consultation with local physicians upon referral by the Student Health Service physicians and for hospitalization at nearby Scripps Memorial Hospital. Foreign students are required to purchase insurance coverage for dependents who accompany them. These policies are available through the Student Health Center.

Immunizations are available and students are encouraged to keep their programs up to date.

Each new student, and each student re-entering UCSD after an absence of two or more consecutive quarters, is required to have a physical examination (including tuberculin test or chest x-ray) by his physician. The

completed physical examination form is to be mailed directly to the Student Health Center by the student's physician prior to the student's registration.

Proof of smallpox vaccination within the last three years is a requirement for admission.

SELECTIVE SERVICE, VETERANS' AFFAIRS, SOCIAL SECURITY EDUCATIONAL BENEFITS VOCATIONAL REHABILITATION ASSISTANCE

The Office of Special Services on the San Diego campus serves a variety of needs. Foremost among them is certification of enrolment to local Selective Service boards upon the request of any male student. Additional information regarding Selective Service and the branches of military service open for enlistment, active or reserve, is also available.

Information regarding the new Veterans' Readjustment Act of 1966, as well as Veterans' Dependents' Educational benefits and Social Security Educational Benefits may be obtained in the Office of Special Services. If you believe you may be eligible for educational benefits under any of these programs, please contact the appropriate local office in your area or the campus Office of Special Services for information as soon as possible. Students who are already receiving educational benefits under any of these programs should contact the Office of Special Services immediately after initial registration and every fall registration while at the San Diego campus.

Students receiving training through the Vocational Rehabilitation Service of the State Department of Education may call on the Office of Special Services for assistance at any time.

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Robert D. Tschirgi, M.D., Ph.D.

Vice Chancellor–Administration
Robert H. Biron, LL.B.

Vice Chancellor–Graduate Studies and Research
Frederick T. Wall, Ph.D.

Vice Chancellor–Medicine and Biological Sciences
Clifford Grobstein, Ph.D.

University Librarian
Melvin J. Voigt, M.A.

Dean of Student Affairs
George S. Murphy, Jr., M.S.

Registrar and Admissions Officer
John W. Brown, M.A.

Student Health Service Director
Robert W. Watson, M.D.

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John L. Stewart, Ph.D.

Provost, Revelle College
Paul D. Saltman, Ph.D.

Provost, The Third College
Armin Rappaport, Ph.D.

Dean, School of Medicine
Clifford Grobstein, Ph.D.

Dean, Scripps Institution of Oceanography
William A. Nierenberg, Ph.D.

Director, Emeritus
Roger R. Revelle, Ph.D.

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ANGUS TAYLOR
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Dean of University Extension

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ROBERT M. UNDERHILL
Vice-President and Treasurer of The Regents, Emeritus

JAMES H. CORLEY
Vice-President–Governmental Relations and Projects, Emeritus

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The term of the appointed Regents is sixteen years, and terms expire March 1 of the year indicated in parentheses.

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President

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Secretary to the Regents
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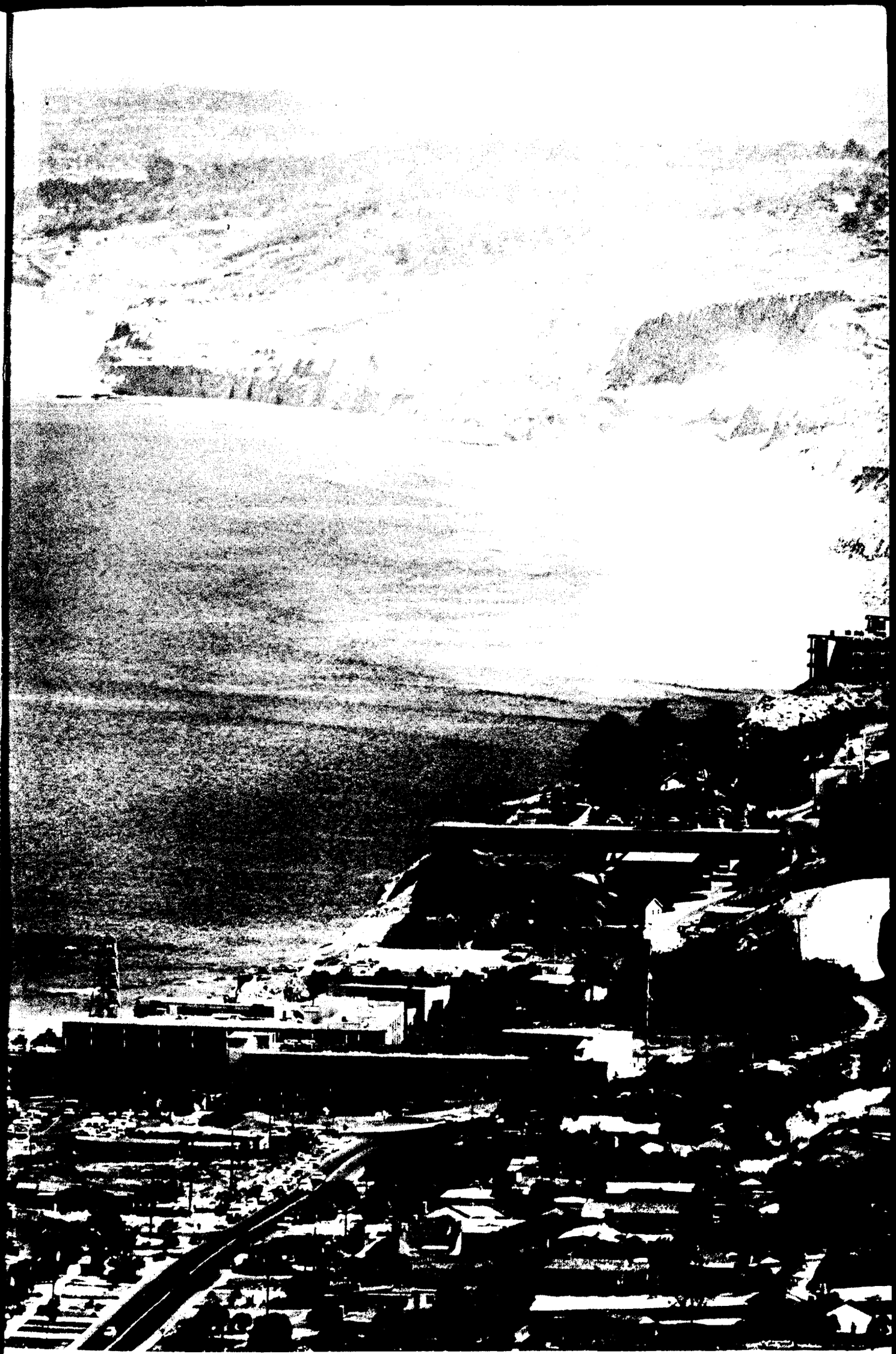

Scripps Institution of Oceanography

University of California, San Diego

General Catalogs,

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