Catalogue of

U. S. NAVAL POSTGRADUATE SCHOOL

Monterey, California

Academic Year 1953-1954

UNITED STATES NAVAL
POSTGRADUATE SCHOOL

CATALOGUE
for the
Academic Year 1953 -- 1954

MONTEREY, CALIFORNIA

1 JULY 1953

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Calendar of the United States Naval Postgraduate School for the Academic Year 1953—1954 at Monterey, California

1953

Engineering School Registration	Saturday, August 1
Engineering School First Term Begins	Monday, August 3
General Line School (Class 1953B) Registration	Thursday, August 6
General Line School Classes Begin	Monday, August 10
Labor Day (Holiday)	Monday, September 7
Engineering School First Term Ends	Thursday, October 8
Engineering School Second Term Begins	Tuesday, October 13
Armistice Day (Holiday)	Wednesday, November 11
Thanksgiving Day (Holiday)	Thursday, November 26
Engineering School Second Term Ends	Friday, December 18
Christmas Leave Period Begins	Friday, December 18

1954

General Line School Classes Resume	Monday, January 4
Engineering School Third Term Begins	Tuesday, January 5
Washington's Birthday (Holiday)	Monday, February 22
General Line School Class 1953B Graduation	Friday, February 19
Engineering School Third Term Ends	Tuesday, March 16
Engineering School Fourth Term Begins	Monday, March 22
General Line School (Class 1954A) Registration	Thursday, March 25
General Line School Classes Begin	Monday, March 29
Engineering School Fourth Term Ends	Friday, May 28
Memorial Day (Holiday)*	Sunday, May 30
Engineering School Commencement	Thursday, June 3
Independence Day (Holiday)**	Sunday, July 4
Engineering School Registration	Monday, August 2
Engineering School First Term Begins	Tuesday, August 3
General Line School Class 1954A Graduation	Friday, September 24

* Holiday observed on Monday, May 31

** Holiday observed on Monday, July 5

Calendar 1953

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LIST OF ILLUSTRATIONS

NOTE: The photographs indicated by an asterisk were made by Mr. James J. Melody through the courtesy of the Commanding Officer of the San Francisco Naval Shipyard.

LIST OF ILLUSTRATIONS

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SECTION I

U. S. NAVAL POSTGRADUATE SCHOOL

GENERAL INFORMATION

Superintendent
Frederick MOOSBRUGGER, Rear Admiral, U. S. Navy

Academic Dean
Roy Stanley GLASGOW, B.S., M.S., E.E.

Director, Engineering School
James Henry WARD
Captain, U. S. Navy

Director, General Line School
George Kittrell FRASER
Captain, U. S. Navy

SUPERINTENDENT'S STAFF

Charles Edwin CROMBE, Jr.
Captain, U. S. Navy
Aide and Chief of Staff

Richard Paul WENZLIK
Lieutenant, U. S. Navy
Aide to Superintendent

Warren Fuller ANDERSON
Commander, U. S. Navy
Staff Secretary

Paul Lawrence HATHAWAY
Commander, U. S. Navy
Comptroller

Freeman Mayville JONES
Lieutenant Commander, U. S. Navy
Administrative Assistant and
Public Relations Officer

ADMINISTRATIVE COMMAND

William Camp Fitzhugh ROBARDS
Captain, U. S. Navy
Commanding Officer

John Davis McCOMISH
Lieutenant Commander, U. S. Navy
Legal and Legal Assistance Officer

Arthur Frank HAMBY
Lieutenant Commander, U. S. Navy
First Lieutenant

Charles Hollis SARVER
Lieutenant, U. S. Navy
Special Services Officer

Clayton Forsling JOHNSON
Lieutenant, U. S. Navy
Closed Mess and BOQ Officer

David Nun HENRIQUES, Jr.
Lieutenant, U. S. Navy
Communications Officer

William Malcolm CALKINS
Lieutenant, U. S. Navy
Personnel Officer

Sara Elizabeth MITCHELL
Lieutenant, U. S. Navy
Custodian Registered Publications

Harry Edward HOWELL
Ship's Clerk, U. S. Navy
Assistant Personnel Officer

MEDICAL

Lloyd Bertram SHONE
Captain, MC, U. S. Navy
Senior Medical Officer

Bruce Morgan SHEPARD
Commander, MC, U. S. Navy
Medical Officer

Dana Foster RICHARDS
Lieutenant, MC, U. S. Navy
Assistant Medical Officer

Thomas Frederick McGUIRE
Lieutenant (junior grade), MC, U. S. Navy
Assistant Medical Officer

Charles Leonard JERNSTROM
Lieutenant (junior grade), MC, U. S. Navy
Assistant Medical Officer

Claude Crawford CASON
Lieutenant, MSC, U. S. Navy
Medical Services Officer

Lucille Mary OTERO
Lieutenant, NC, U. S. Navy
Senior Nurse

Lida Gertrude PARDEE
Lieutenant, NC, U. S. Navy
Nurse

Eunice Eleanor RICHARDSON
Lieutenant, NC, U. S. Navy
Nurse

DENTAL

James Linford WANGER
Captain, DC, U. S. Navy
Dental Officer

Wayne Wilbur JARVIS
Lieutenant, DC, U. S. Navy
Assistant Dental Officer

Jack Harland WILHELM
Lieutenant, DC, U. S. Navy
Assistant Dental Officer

CHAPLAIN

Walter Albert MAHLER
Commander, ChC, U. S. Navy
Chaplain

SUPPLY

Ben Saule GANTZ, Jr.
Lieutenant Commander, SC, U. S. Navy
Supply Officer

Paul Willis CRAWFORD
Lieutenant, SC, U. S. Navy
Officer in Charge Branch Navy Exchange

Charles Louis CULWELL
Lieutenant (junior grade), SC, U. S. Navy
Assistant Supply Officer

Christopher Tom COMPOGIANNIS
Lieutenant (junior grade), SC, U. S. Navy
Disbursing Officer and Assistant to Supply Officer

John Hamilton GRESS
Ensign, SC, U. S. Navy
Assistant to Supply Officer

PUBLIC WORKS

William Washington MOORE, Jr.
Commander, CEC, U. S. Navy
Public Works Officer and Resident Officer in Charge of Construction

Francis Xavier CONNELLY
Lieutenant Commander, CEC, U. S. Navy
Assistant to Resident Officer in Charge of Construction

Whitney Burford JONES
Lieutenant, CEC, U. S. Navy
Assistant Public Works Officer

David Donald McNELIS
Ensign, CEC, U. S. Navy
Assistant Public Works Officer

Byron Curtis McKINNEY
Chief Carpenter, U. S. Navy
Assistant Public Works Officer

NOTE: The Naval Staffs of the Engineering School and the General Line School are listed in the corresponding sections of the catalogue devoted to those schools.

UNITED STATES NAVAL POSTGRADUATE SCHOOL

GENERAL INFORMATION

HISTORICAL

The U. S. Naval Postgraduate School had a modest beginning at the Naval Academy in Annapolis in 1909, at which time the first class of ten officers enrolled in a Marine Engineering curriculum. Today, in its new location in Monterey, California, approximately 1200 officer students are enrolled in approximately forty curricula in engineering and related subjects, in the Engineering School and the General Line School. Facilities are being planned and implemented to accommodate a total of 1800 officer students—600 in the Engineering School and 1200 in the General Line School. Since 1909 the growth and development of the U. S. Naval Postgraduate School has been in keeping with its original objective of providing the Navy with officers of advanced technical education capable of administering and directing a modern Navy.

The need for technically trained officers became evident at the turn of the century. The idea of a naval graduate school had its inception in a course of instruction in Marine Engineering which the Bureau of Engineering instituted in 1904. The results of this course were so encouraging that in 1909 the Secretary of the Navy established a School of Marine Engineering at the Naval Academy in Annapolis. In 1912 the School was designated the Postgraduate Department of the U. S. Naval Academy.

The operation of the School was temporarily suspended during World War I. In 1919 classes were resumed in the converted Marine Barracks on the Naval Academy grounds. At this time curricula in Mechanical Engineering and Electrical Engineering were added. With the passing years other curricula —Ordnance Engineering, Radio Engineering and Aerological Engineering—were added as the Navy's need for officers with technical knowledge in these fields became evident.

In 1927 the General Line School was established within the Postgraduate Department to provide courses of instruction to acquaint junior line officers returning from sea duty with modern developments taking place in the Navy. The courses dealt with naval and military subjects for the most part. The General Line School remained as an integral part of the Postgraduate Department until the declaration of the emergency prior to the outbreak of World War II, at which time it was discontinued because of the need for officers in the growing fleet.

The enrollment in the Postgraduate Department increased rapidly in the war years both in the several engineering curricula and in the communications curriculum which was added to meet the need for trained communication officers in the naval establishment. The School outgrew its quarters necessitating the building of an annex to house the additional classrooms and laboratories required. Even with this addition, the space requirements of the expanded school were not met.

The post-war program called for yet further expansion and the re-establishment of the General Line School with a greatly increased enrollment. In 1946 the General Line School was established at Newport, Rhode Island, as an outlying element of the Postgraduate Department; in 1948 an additional General Line School was established at Monterey, California. The objective of the General Line School program for the re-established schools—that of providing an integrated course in naval science to broaden the professional knowledge of unrestricted line officers of the Regular Navy—continued in effect as it had since the inception of this program. The current curriculum is designed to provide such a course of approximately six months in length for ex-reserve and ex-temporary officers who have transferred to regular status.

The physical growth of the School and its increase in scope and importance were recognized in Congressional action which resulted in legislation during the years 1945 to 1951 emphasizing the academic level of the School, and providing for continued growth in a new location with modern buildings and equipment. This legislation authorized the School to confer Bachelors, Masters, and Doctors degrees in engineering and related subjects; created the position of Academic Dean to insure continuity in academic policy; established the School as a separate naval activity to be known as the United States Naval Postgraduate School; authorized the establishment of the School at Monterey, California; and provided funds to initiate the construction of buildings to house modern laboratories and class rooms at that location.

In December 1948 a survey was conducted by Region IV Committee on Engineering schools of the Engineering Council for Professional Development (ECPD). As a result of this survey which was a detailed and thorough investigation of the curricula, faculty and facilities of the School, the Naval Postgraduate School was informed on 29 October 1949 by the ECPD that the curricula in Aeronautical Engineering, Electrical Engineering (including option in Electronics) and Mechanical Engineering were accredited.

On 22 December 1951, by order of the Secretary of the Navy, the United States Naval Postgraduate School was officially disestablished at Annapolis, Maryland, and established at Monterey, California.

Concurrently with this relocation, the U. S. Naval School (General Line) at Monterey was disestablished as a separate military command and its functions and facilities were assumed by the U. S. Naval Postgraduate School. At the same time, there was established the U. S. Naval Administrative Command, U. S. Naval Postgraduate School, Monterey, to provide logistic support, including supply, public works, medical and dental functions, for the Naval Postgraduate School and its components.

During the period 21 November 1951 to 16 February 1952, the entire school at Annapolis—faculty, students and equipment—was moved to Monterey. This move, unique in character, involved the transcontinental transportation of approximately five hundred families, civilian and military, their household effects, and some three million pounds of school equipment. What had been the U. S. Naval Postgraduate School, Annapolis, was redesignated the Engineering School of the U. S. Naval Postgraduate School, Monterey.

The U. S. Naval Postgraduate School, Monterey, now comprises the Engineering School under a Director, The General Line School under a Director, and the Administrative Command under a Commanding Officer. In command of the Naval Postgraduate School and all of its components is a line officer of flag rank in the Regular Navy with the title of Superintendent.

POSTGRADUATE SCHOOL PROGRAM

The program for the advanced education and training of commissioned officers in general and technical subjects according to the Navy's need is under the cognizance and direction of the Superintendent of the U. S. Naval Postgraduate School. From officers applying for postgraduate instruction and from officers nominated by the technical bureaus and other activities of the Navy, candidates are selected by boards appointed by the Chief of Naval Personnel. The U. S. Army, U. S. Air Force, and U. S. Coast Guard also select officers from their respective services to participate in certain of the postgraduate curricula conducted at the U. S. Naval Postgraduate School.

Postgraduate education is conducted at the U. S. Naval Postgraduate School in Monterey, and at many civilian institutions which cooperate in providing special curricula to meet the requirements of the Navy.

For the most part, all officer students commence their postgraduate education at the Naval Postgraduate School in Monterey. General Line School students attend for a course of approximately six months. Engineering School students, according to the curriculum to which assigned, may attend one, two, or three years at the School, or one or two years at the School and one or two years subsequently at a civilian university. The curricula commencing in the Engineering School at Monterey are set forth in Section II. Exceptions to the procedure set forth above are made in the cases of certain non-engineering curricula, e.g., Law, Business Administration, Theology, for which the entire postgraduate education is conducted at appropriate civilian institutions. These curricula and the institutions at which the instruction is conducted are briefly set forth in Section II.

COMPONENTS OF THE U. S. NAVAL POSTGRADUATE SCHOOL

Engineering School, located at Monterey, California, comprises the engineering and scientific division which was formerly that portion of the School located at Annapolis, Maryland. The School is supervised and administered by a Director, who is a line officer of the Regular Navy, with the rank of captain.

General Line School, located at Monterey, California, provides instruction to round out the junior officer's preparation in professional naval subjects, in order to better fit him for continued general duties ashore and afloat. Though ultimately the curriculum will cover one year, for the present and until 1955, the General Line School program is shortened to six months in order to give the instruction to the large number of former reserve and temporary officers who, since World War II, have transferred to the Regular Navy. The School is under the supervision of a Director who is a line officer of the Regular Navy, with the rank of captain.

Administrative Command, located at Monterey, California, was established to provide logistic support to the Engineering School and the General Line School. It is a separate military command under a Commanding Officer, who is a line officer of the Regular Navy, with the rank of captain.

Naval Intelligence School, located at Anacostia, D. C., provides training in naval intelligence and foreign language instruction. The School is under a Commanding Officer, who is a line officer of the Regular Navy, with the rank of captain.

FACILITIES AND PHYSICAL PLANT

The Naval Postgraduate School is located east of the city of Monterey, California, on the grounds and in the buildings of the former Hotel Del Monte. The hotel buildings have been converted into laboratories, classrooms, offices, and living quarters to serve as an interim establishment until the completion of modern permanent buildings, construction

Main entrance to the Administrative Building. This building contains offices of the Superintendent, Academic Dean, Administrative Command, the Bachelor Officers' Quarters, and certain logistic facilities.

Air view of the Campus. The former hotel buildings, in center, serve as interim office, classroom and some laboratory space for General Line and Engineering Schools. The one-story buildings at far left are interim laboratories for the Engineering School. The Pacific Ocean is seen in the background.

Aerial view of campus and portion of nearby city of Monterey, with harbor, piers and breakwater in background.

Model of ultimate establishment. Proposed General Line School buildings in right foreground. Proposed chapel, auditorium, gymnasium and barracks in right and center background. New Engineering School buildings, now under construction, in left foreground.

of which started in June 1952, and which will be ready for occupancy in August, 1954.

The property acquired in the purchase of the site consists of some 604 acres. The buildings and the campus proper, lying between Fremont Street and Del Monte Avenue, occupy 133 acres of beautifully landscaped and wooded grounds.

The construction program as presently visualized will continue over a period of several years.

The first and second increments of the building program will be completed in the spring of 1954. These comprise the following Engineering School buildings:

A five-story building housing the departments of Electronics and Physics, Chemistry and Metallurgy, and Aerology.

An Electrical Engineering Laboratory of two stories.

A Mechanical Engineering and Aeronautical Engineering Laboratory of three stories.

A two-story building housing the Departments of Mathematics, Aeronautics and Aerology and providing offices, classrooms, drafting rooms, and interim library facilities for all departments.

A 1200-seat Lecture Hall.

A Power Plant.

Subsequent increments as yet planned but not appropriated for, and therefore not firmly scheduled for completion, are expected to provide the following additional laboratories:

A Steam Engineering Laboratory located on the beach to seaward of the main campus for the joint use of the Engineering School and the General Line School.

An Ordnance and Gunnery Laboratory similarly located for the joint use of both schools.

An Aeronautical Laboratory located adjacent to the Naval Auxiliary Air Station to house transsonic and supersonic wind tunnels and jet combustion pits.

The third and next building increment is expected to comprise a General Line School Building, an Infirmary, and Barracks and Mess Hall for enlisted personnel. Subsequent increments are expected to provide a Library, an additional Line School building, a Gymnasium, Chapel and an Auditorium.

STUDENT HOUSING

Married Officer Students. The Housing Officer of the U. S. Naval Postgraduate School maintains an up-to-date list of available houses and apartments in the Monterey Peninsula area. All inquiries concerning housing should be directed to him.

Available to naval personnel ordered to duty in the Monterey area are 519 housing units at La Mesa Village, a Wherry Housing development, completed in February 1953 on the elevated "mesa" one mile south of the Postgraduate School. These units consist of detached houses, duplexes and apartments with from one to three bedrooms. They are modern in all respects, with ample baths, carports and storage space. They are unfurnished except for stove, refrigerator, heater and blinds. They rent from $62.00 to $113.00 per month. Gas and electric power are paid for by the tenant. Water and garbage collection service are supplied by the management at no cost. Applications for these units can be obtained from the Housing Officer at the Postgraduate School.

The Wherry Housing at La Mesa Village is not adequate to meet the requirements of all students. Many highly satisfactory private houses are available in the Monterey Penninsula area for rental by officer students. Rentals average somewhat higher than in many other localities since this is a resort area.

All officers ordered to the U. S. Naval Postgraduate School will be provided with the School's "Information Bulletin," which treats this subject in greater detail.

Bachelor Officers' Quarters. A Bachelor Officers' Quarters and a Closed Mess, which facilities can accommodate approximately 160 officers, are operated in the main building of the Postgraduate School. Bachelor officers can expect to be ordered to occupy the BOQ up to its capacity.

EDUCATIONAL FACILITIES

The Monterey Peninsula area has adequate public school facilities from kindergarten through two years of college for the dependents of naval personnel. In addition, there are several private schools in the area offering education through high school. The Postgraduate School's "Information Bulletin" furnished to each officer ordered to the School thoroughly covers this subject.

FLIGHT PROFICIENCY

In order to provide for maintenance of flight proficiency for the large number of aviators in the Postgraduate School student body and the staff, the facilities of the Naval Auxiliary Air Station, Monterey, are made available. The Commanding Officer of that activity reports to the Superintendent, U. S. Naval Postgraduate School, for additional duty in connection with flight proficiency of all naval aviators attached to the School. The Air Station is located about two miles, by road, from the campus.

The Flight Liaison Officer, a naval aviator attached to the staff of the Postgraduate School, assists the Commanding Officer of the Naval Air Station in flight scheduling and maintains the close liaison necessary for smooth operations. Due to the limited number of planes and other facilities available at this small auxiliary air station, careful scheduling and planning are essential. Every effort is made to schedule the required minimum flight time with the least possible interference with the student's academic work.

LIBRARY FACILITIES

The Libraries of the U. S. Naval Postgraduate School, which contain various collections of published and unpublished materials for the use of students, faculty and staff of the Engineering School and of the General Line School, are three in number—the Reference and Research Library, the Technical Text Library and the Christopher Buckley Library.

The Reference and Research Library, temporarily located on the ground floor of the Administration Building, is an active collection of some 36,000 books, 15,000 bound volumes of periodicals and 65,000 research and development reports dealing mainly with the curricular subjects in the fields of science, engineering and naval studies. It receives over 600 periodicals and many serially published technical and scientific government publications as well as those issued by engineering stations of various universities and by industrial corporations. Its research and development report collection, including a classified section, is maintained for the purpose of keeping students and faculty currently informed of research being done—under government sponsored projects, by industrial organizations, by universities and by independent researchers. The Reference and Research Library also furnishes microfilm and photostat services and will obtain, on interlibrary loan, any publications which are requested and which are not present in its own collections.

The Technical Text Library, also located on the ground floor of the Administration Building, contains approximately 70,000 textbooks, reference books and pamphlets in multiple copies, which are issued to students on a term-loan basis and to instructors for an unlimited period. Students are assigned certain specified texts for their courses but may use this Library to obtain related material to use in conjunction with them.

The Christopher Buckley, Jr. Library, located on the first floor of the Administration Building, immediately above the Reference and Research Library, is a collection of about 4,000 books relating mainly to naval history or to subjects connected with the sea. It contains, among these, many rare or otherwise valuable books, including Sir Walter Raleigh's "Excellent Observations and Notes, Concerning the Royall Navy and Sea-Service", published in 1650; Samuel Pepys' "Memoires Relating to the State of the Royal Navy of England for Ten Years, Determin'd December 1688", the first edition (1773-1784) of Capt. James Cook's "Voyages", in eight volumes, a number of manuscripts, and many other interesting items. It is a comfortably furnished library in surroundings that are conducive to reading, relaxing, browsing or study. This collection was the result of the generosity and kindness of Mr. Christopher Buckley, resident of Pebble Beach, California, who donated these books in 1952.

The Reference and Research Library will occupy, on a temporary basis, a portion of one of the new Engineering School buildings which will be completed early in 1954; all Libraries will be accommodated eventually in the New Library Building.

RECREATION FACILITIES

The U. S. Naval Postgraduate School is situated in a nationally famous recreational area, consisting generally of the Monterey Peninsula, the nearby Santa Cruz Mountain area, and the rugged Santa Lucia range extending to the southeastward along the coast.

On the campus are several tennis courts, heavily wooded walking areas, a golf putting green, and a beautiful swimming pool with pavilion. There are also a child's wading pool, a badminton court, a playground and a screened sand-lot to make this pool area a valuable source of recreation. Bowling alleys are available at the Naval Auxiliary Air Station.

About one-half mile to the northward, across the Southern Pacific Railroad tracks, lies the ocean, with miles of beach. A nearby fish pier and small boat harbor afford opportunities for ocean fishing.

Golf is perhaps the most popular sport in the Monterey Peninsula area. The Del Monte Golf Course, formerly connected with the Hotel, is available to the public and lies directly across Fremont Avenue (State Route 1) from the Postgraduate School. Also available to the public is the Pacific Grove municipal course. Other outstanding courses in the vicinity include the Pebble Beach, Cypress Point, and Monterey Peninsula Country Club courses, all located in Del Monte Forest.

The primitive mountain country in this part of California provides many opportunities for hunting, fishing and hiking. Only a few hours distant are the mountain resorts such as Yosemite, Lake Tahoe and the Mount Shasta country.

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An Ordnance and Gunnery Laboratory similarly located for the joint use of both schools.

An Aeronautical Laboratory located adjacent to the Naval Auxiliary Air Station to house transsonic and supersonic wind tunnels and jet combustion pits.

The third and next building increment is expected to comprise a General Line School Building, an Infirmary, and Barracks and Mess Hall for enlisted personnel. Subsequent increments are expected to provide a Library, an additional Line School building, a Gymnasium, Chapel and an Auditorium.

STUDENT HOUSING

Married Officer Students. The Housing Officer of the U. S. Naval Postgraduate School maintains an up-to-date list of available houses and apartments in the Monterey Peninsula area. All inquiries concerning housing should be directed to him.

Available to naval personnel ordered to duty in the Monterey area are 519 housing units at La Mesa Village, a Wherry Housing development, completed in February 1953 on the elevated "mesa" one mile south of the Postgraduate School. These units consist of detached houses, duplexes and apartments with from one to three bedrooms. They are modern in all respects, with ample baths, carports and storage space. They are unfurnished except for stove, refrigerator, heater and blinds. They rent from $62.00 to $113.00 per month. Gas and electric power are paid for by the tenant. Water and garbage collection service are supplied by the management at no cost. Applications for these units can be obtained from the Housing Officer at the Postgraduate School.

The Wherry Housing at La Mesa Village is not adequate to meet the requirements of all students. Many highly satisfactory private houses are available in the Monterey Penninsula area for rental by officer students. Rentals average somewhat higher than in many other localities since this is a resort area.

All officers ordered to the U. S. Naval Postgraduate School will be provided with the School's "Information Bulletin," which treats this subject in greater detail.

Bachelor Officers' Quarters. A Bachelor Officers' Quarters and a Closed Mess, which facilities can accommodate approximately 160 officers, are operated in the main building of the Postgraduate School. Bachelor officers can expect to be ordered to occupy the BOQ up to its capacity.

EDUCATIONAL FACILITIES

The Monterey Peninsula area has adequate public school facilities from kindergarten through two years of college for the dependents of naval personnel. In addition, there are several private schools in the area offering education through high school. The Postgraduate School's "Information Bulletin" furnished to each officer ordered to the School thoroughly covers this subject.

FLIGHT PROFICIENCY

In order to provide for maintenance of flight proficiency for the large number of aviators in the Postgraduate School student body and the staff, the facilities of the Naval Auxiliary Air Station, Monterey, are made available. The Commanding Officer of that activity reports to the Superintendent, U. S. Naval Postgraduate School, for additional duty in connection with flight proficiency of all naval aviators attached to the School. The Air Station is located about two miles, by road, from the campus.

The Flight Liaison Officer, a naval aviator attached to the staff of the Postgraduate School, assists the Commanding Officer of the Naval Air Station in flight scheduling and maintains the close liaison necessary for smooth operations. Due to the limited number of planes and other facilities available at this small auxiliary air station, careful scheduling and planning are essential. Every effort is made to schedule the required minimum flight time with the least possible interference with the student's academic work.

LIBRARY FACILITIES

The Libraries of the U. S. Naval Postgraduate School, which contain various collections of published and unpublished materials for the use of students, faculty and staff of the Engineering School and of the General Line School, are three in number—the Reference and Research Library, the Technical Text Library and the Christopher Buckley Library.

The Reference and Research Library, temporarily located on the ground floor of the Administration Building, is an active collection of some 36,000 books, 15,000 bound volumes of periodicals and 65,000 research and development reports dealing mainly with the curricular subjects in the fields of science, engineering and naval studies. It receives over 600 periodicals and many serially published technical and scientific government publications as well as those issued by engineering stations of various universities and by industrial corporations. Its research and development report collection, including a classified section, is maintained for the purpose of keeping students and faculty currently informed of research being done—under government sponsored projects, by industrial organizations, by universities and by independent researchers. The Reference and Research Library also furnishes microfilm and photostat services and will obtain, on interlibrary loan, any publications which are requested and which are not present in its own collections.

The Technical Text Library, also located on the ground floor of the Administration Building, contains approximately 70,000 textbooks, reference books and pamphlets in multiple copies, which are issued to students on a term-loan basis and to instructors for an unlimited period. Students are assigned certain specified texts for their courses but may use this Library to obtain related material to use in conjunction with them.

The Christopher Buckley, Jr. Library, located on the first floor of the Administration Building, immediately above the Reference and Research Library, is a collection of about 4,000 books relating mainly to naval history or to subjects connected with the sea. It contains, among these, many rare or otherwise valuable books, including Sir Walter Raleigh's "Excellent Observations and Notes, Concerning the Royall Navy and Sea-Service", published in 1650; Samuel Pepys' "Memoires Relating to the State of the Royal Navy of England for Ten Years, Determin'd December 1688", the first edition (1773-1784) of Capt. James Cook's "Voyages", in eight volumes, a number of manuscripts, and many other interesting items. It is a comfortably furnished library in surroundings that are conducive to reading, relaxing, browsing or study. This collection was the result of the generosity and kindness of Mr. Christopher Buckley, resident of Pebble Beach, California, who donated these books in 1952.

The Reference and Research Library will occupy, on a temporary basis, a portion of one of the new Engineering School buildings which will be completed early in 1954; all Libraries will be accommodated eventually in the New Library Building.

RECREATION FACILITIES

The U. S. Naval Postgraduate School is situated in a nationally famous recreational area, consisting generally of the Monterey Peninsula, the nearby Santa Cruz Mountain area, and the rugged Santa Lucia range extending to the southeastward along the coast.

On the campus are several tennis courts, heavily wooded walking areas, a golf putting green, and a beautiful swimming pool with pavilion. There are also a child's wading pool, a badminton court, a playground and a screened sand-lot to make this pool area a valuable source of recreation. Bowling alleys are available at the Naval Auxiliary Air Station.

About one-half mile to the northward, across the Southern Pacific Railroad tracks, lies the ocean, with miles of beach. A nearby fish pier and small boat harbor afford opportunities for ocean fishing.

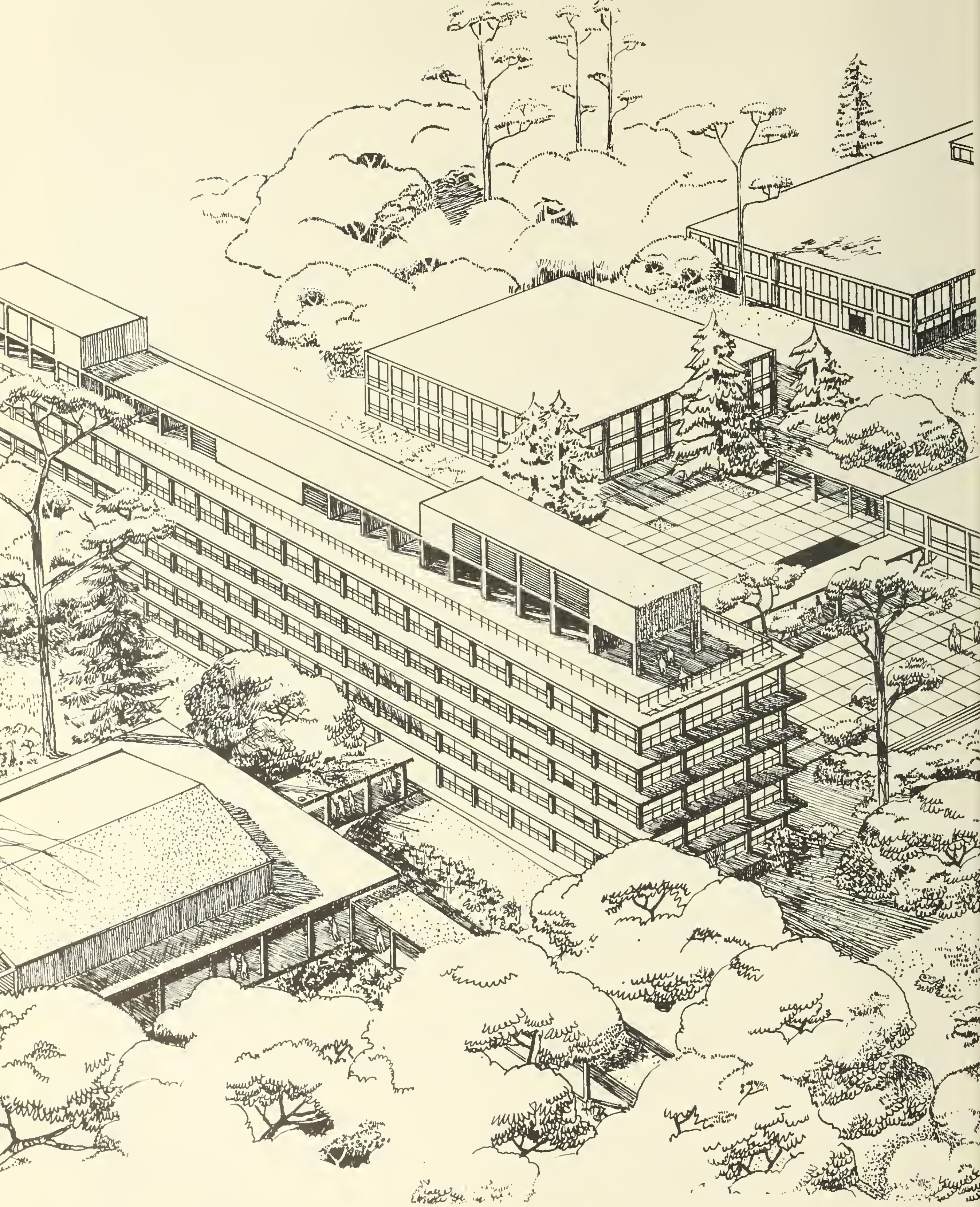
Golf is perhaps the most popular sport in the Monterey Peninsula area. The Del Monte Golf Course, formerly connected with the Hotel, is available to the public and lies directly across Fremont Avenue (State Route 1) from the Postgraduate School. Also available to the public is the Pacific Grove municipal course. Other outstanding courses in the vicinity include the Pebble Beach, Cypress Point, and Monterey Peninsula Country Club courses, all located in Del Monte Forest.

The primitive mountain country in this part of California provides many opportunities for hunting, fishing and hiking. Only a few hours distant are the mountain resorts such as Yosemite, Lake Tahoe and the Mount Shasta country.

The Interim Establishment Chapel, in former hotel lobby space, Administration Building.

Swimming Pool and Pavilion, on the campus, affording valuable recreation and exercise for students, faculty, staff and dependents.

Lobby of Administration Building.



Architect's sketch showing portions of five Engineering School buildings now under construction, scheduled for occupancy in 1954. At lower left is a lecture hall; other buildings house laboratories, offices, classrooms and the interim library.

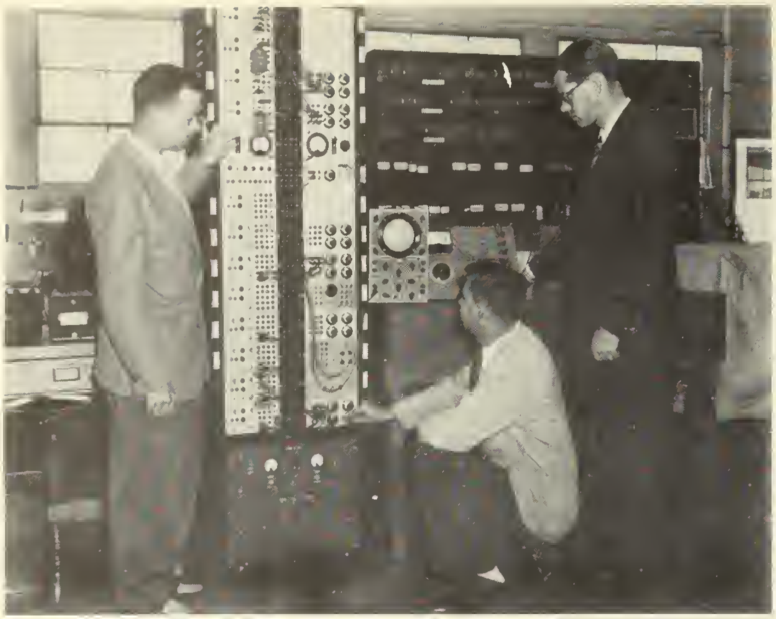
A typical view in the La Mesa low-cost housing project, located near the campus.

A typical housing unit in La Mesa Village.

Aerial view of Monterey peninsula showing the "La Mesa Village" housing in the left foreground, the school buildings near the shore in the center, city of Monterey at the left, and the Naval Auxiliary Air Field at the right. The Del Monte public golf course is shown in the foreground. The airplane shown is one of the planes used for flight proficiency by the students.

Training plane and control tower, Naval Auxiliary Air Station, about two miles from campus. Here the Postgraduate School students can take flight proficiency flying.

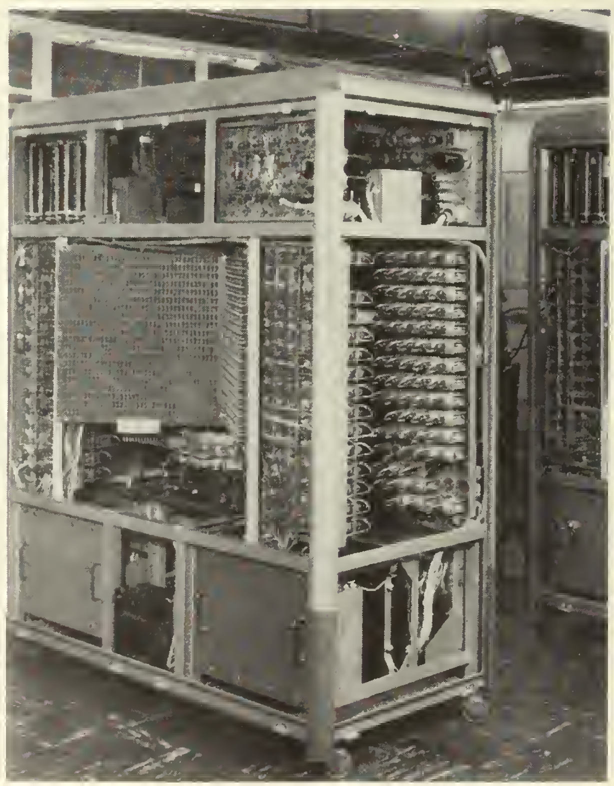
"Flight Line" of SNB planes assigned to Naval Auxiliary Air Station, Monterey, and used for flight proficiency training.



Electronic analog computer, being operated by two students and a professor.

The electronic digital computer. This machine, like the analog computer, is used for computation connected with research projects, and to support Mathematics Department courses in modern computing methods. With such equipment, a great variety of complex problems, such as high-order differential equations, can be solved in a few seconds, which would require several days by more conventional methods.

(By courtesy of Computer Research Corporation. Photo by Dean Vance)



SECTION II

THE ENGINEERING SCHOOL

Director

Harold David KRICK, Captain, U. S. Navy
B.S., USNA, 1923; M.S., Univ. of Mich., 1930.
(Detached in July 1953)

James Henry WARD, Captain, U. S. Navy
B.S., USNA, 1926.
(Reporting in August 1953)

Assistant to the Director

Richard Archibald MONTFORT, Lieutenant Commander, U. S. Navy
B.C.S., Drake Univ., 1939.

NAVAL STAFF

AEROLOGICAL ENGINEERING CURRICULA

† George Deveraux GOOD
Commander, U. S. Navy
Officer in Charge
B.S., USNA, 1935.

William Stanley LANTERMAN
Commander, U. S. Navy
Assistant Officer in Charge
Aerological Engineering Instructor
B.S. Lafayette College, 1935; M.S., 1937.

Robert Earl MOTTERN
Lieutenant Commander, U. S. Navy
Aerological Engineering Instructor
B.S., USNA, 1942; M.S., USNPGS, 1948.

James Francis O'CONNOR
Lieutenant Commander, U. S. Navy
Aerological Engineering Instructor
B.S., R.I.State, 1937; B.Educ., R.I.College of Education, 1939; M.S., M.I.T., 1943.

Charles Gerhard KNUDSEN
Lieutenant Commander, U. S. Navy
Aerological Engineering Instructor
M.A., Columbia Univ., 1939.

Willard Samuel HOUSTON, Jr.
Lieutenant, U. S. Navy
Aerological Engineering Instructor
M.S., USNPGS, 1953.

Elston WYATT
Lieutenant, U. S. Navy
Aerological Engineering Instructor
B.S., USNA, 1943;
M.S., USNPGS, 1950.

Edward Snide HUDSON
Chief Aerographer, U. S. Navy
Aerological Engineering Instructor

Richard LANE
Chief Aerographer, U. S. Navy
Aerological Engineering Instructor

AERONAUTICAL ENGINEERING CURRICULA

‡ Edwin Samuel LEE, Jr.
Captain, U. S. Navy
Officer in Charge
B.S., USNA, 1934; M.S.(AE) and AeE, Cal. Tech., 1943.

Loys Malcolm SATTERFIELD
Lieutenant Commander, U. S. Navy
Assistant to Officer in Charge
B.S., Trinity Univ., 1940; AeE, Cal. Tech., 1947.

COMMUNICATIONS CURRICULA

Leland Griffith SHAFFER
Captain, U. S. Navy
Officer in Charge
B.S., USNA, 1931.

Robert Gwathmey MERRITT
Commander, U. S. Navy
Assistant to Officer in Charge
B.S., USNA, 1939.

James Joseph McMULLAN
Lieutenant Commander, U. S. Navy
Communications Instructor
B.S.S., St Mary's College, 1941.

Richard Webster HYDE
Lieutenant Commander, U. S. Navy
Communications Instructor
B.S., Yale Univ., 1940.

Myles Cornelius KING
Lieutenant Commander, U. S. Navy
Communications Instructor
A.B., Boston College, 1938.

Melvin Eugene FOX
Lieutenant, U. S. Navy
Communications Instructor

Donald Douglas RITCHIE
Lieutenant, U. S. Navy
Communications Instructor

Clarence Joseph ZIELKE
Lieutenant, U. S. Navy
Communications Instructor

Francis Emil HOROBETZ
Lieutenant, U. S. Navy
Communications Instructor

Richard Erwin CROSS
Lieutenant, U. S. Navy
Communications Instructor

ENGINEERING ELECTRONICS CURRICULA

** Charles Maurice RYAN
Captain, U. S. Navy
Officer in Charge
B.S., USNA, 1925; M.S., Univ. of Calif., 1933.

Jackson Madison RIGHTMYER
Lieutenant Commander, U. S. Navy
Assistant to Officer in Charge

Richard Labagh KILE
Lieutenant, U. S. Navy
Engineering Electronics Instructor

NAVAL ENGINEERING CURRICULA

Wells THOMPSON
Captain, U. S. Navy
Officer in Charge
B.S., USNA, 1928; M.S., Univ. of Calif., 1938.

Dale Eugene COCHRAN
Commander, U. S. Navy
Assistant to Officer in Charge
Naval Engineering Instructor
B.S., USNA, 1935.

William Mac NICHOLSON
Commander, U. S. Navy
Naval Engineering Instructor
B.S., USNA, 1941; M.S., M.I.T., 1948.

Claude Clyde BRUBAKER
Lieutenant Commander, U. S. Navy
Laboratory and Machine Shop Officer

ORDNANCE ENGINEERING CURRICULA

William Robinson SMITH, 3rd.
Commander, U. S. Navy
Officer in Charge
B.S., USNA, 1934.

James Emmet BRENNER, Jr.
Commander, U. S. Navy
Assistant to Officer in Charge
Ordnance Engineering Instructor
B.S., USNA, 1938.

Felix Leonard ENGLANDER
Commander, U. S. Navy
Ordnance Engineering Instructor
B.S., USNA, 1940; B.S., USNPGS, 1949; M.S., Lehigh Univ., 1950.

CIVILIAN FACULTY

Roy Stanley GLASGOW
Academic Dean (1949)*
B.S., Washington Univ., 1918; M.S., Harvard Univ., 1922; E.E., 1925.

DEPARTMENT OF AEROLOGY

William Dwight DUTHIE
Professor of Aerology; Chairman (1946)*
A.B., Univ. of Washington, 1935; M.S., 1937; Ph.D. Princeton Univ., 1940.

George Joseph HALTINER
Associate Professor of Aerology (1946)
B.S., College of St. Thomas, 1940; Ph.M., Univ. of Wisconsin, 1942; Ph.D., 1948.

Frank Lionel MARTIN
Associate Professor of Aerology (1947)
A.B., Univ. of British Columbia, 1936; A.M., 1938; Ph.D., Univ. of Chicago, 1941.

Robert Joseph RENARD
Instructor in Aerology (1952)
M.S., Univ. of Chicago, 1952.

Jacob Bertram WICKHAM
Asst. Professor of Aerology and Oceanography (1951)
B.S., Univ. of California, 1947; M.S., Scripps Institution of Oceanography, 1949.

DEPARTMENT OF AERONAUTICS

Wendell Marois COATES
Professor of Aeronautics; Chairman (1931)
A.B., Williams College, 1919; M.S., Univ of Michigan, 1923; D.Sc., 1929.

The year of joining the Postgraduate School faculty is indicated in parentheses.

Richard William BELL
Associate Professor of Aeronautics (1951)
A.B., Oberlin College, 1939; AeE., California Institute of Technology, 1941.

Theodore Henry GAWAIN
Associate Professor of Aeronautics (1951)
B.S., Univ. of Pennsylvania, 1940; D.Sc., Massachusetts Institute of Technology, 1944.

Vernon Kenneth GUNKEL
Professor of Aeronautics (1952)
B.S., North Dakota Agriculture College, 1940; M.S. Texas Agriculture and Mechanical College, 1942; B.M.E. Alabama Polytechnic Institute, 1949.

Richard Moore HEAD
Professor of Aeronautics (1949)
B.S., California Institute of Technology, 1942; M.S., 1943; A.E., 1943; Ph.D., 1949.

George Judson HIGGINS
Professor of Aeronautics (1942)
B.S., Univ. of Michigan, 1923; Ae.E., 1934.

Charles Horace KAHR, Jr.
Associate Professor of Aeronautics (1947)
B.S., Univ. of Michigan, 1944; M.S., 1945.

Henry Lebrecht KOHLER
Professor of Aeronautics (1943)
B.S., Univ. of Illinois, 1929; M.S., Yale Univ., 1930; M.E., 1931.

Michael Hans VAVRA
Professor of Aeronautics (1947)
Dipl. Ing., Swiss Federal Institute of Technology, 1934.

DEPARTMENT OF ELECTRICAL ENGINEERING

Charles Van Orden TERWILLIGER
Professor of Electrical Engineering; Chairman (1925)
B.E., Union College, 1916; M.S., 1919; M.S., Harvard Univ., 1922; D.Eng., Johns Hopkins Univ., 1938.

Charles Benjamin OLER
Associate Professor of Electrical Engineering (1946)
B.S., Univ. of Pennsylvania, 1927; M.S., 1930; D.Eng., Johns Hopkins Univ., 1950.

Orval Harold POLK
Professor of Electrical Engineering (1946)
B.S., Univ. of Colorado, 1927; M.S., Univ. of Arizona, 1933; E.E., Univ. of Colorado, 1940.

Charles Henry ROTHAUGE
Associate Professor of Electrical Engineering (1949)
B.E., Johns Hopkins Univ., 1940; D.Eng., 1949.

William Conley SMITH
Associate Professor of Electrical Engineering (1946)
B.S., Ohio Univ., 1935; M.S., 1939.

William Alfred STEIN
Assistant Professor of Electrical Engineering (1951)
B.S., Washington Univ., 1943; M.S., 1947; D.Sc., 1951.

George Julius THALER
Assistant Professor of Electrical Engineering (1951)
B.E., Johns Hopkins Univ., 1940; D.Eng., 1947.

Allen Edgar VIVELL
Professor of Electrical Engineering (1945)
B.E., Johns Hopkins Univ., 1927; D.Eng., 1937.

Richard Carvel Hensen WHEELER
Professor of Electrical Engineering (1929)
B.E., Johns Hopkins Univ., 1923; D.Eng., Rensselaer Polytechnic Institute, 1926.

DEPARTMENT OF ELECTRONICS AND PHYSICS

Austin Rogers FREY
Professor of Physics; Chairman (1946)
B.S., Harvard Univ., 1920; M. S., 1924; Ph.D., 1929.

Neal Sample ANDERSON
Assistant Professor of Physics (1951)
A.B., Univ. of California at Los Angeles, 1946; A.M., 1949; Ph.D., 1951.

Robert Edmund BAUER
Assistant Professor of Electronics (1948)
B.S., Villanova College, 1947; M.S., Univ. of Pennsylvania, 1949.

William Malcolm BAUER
Professor of Electronics (1946)
B.S., Northwestern Univ., 1927; E.E., 1928; M.S., Harvard Univ., 1929; D.Sc., 1940.

Jesse Gerald CHANEY
Professor of Electronics (1946)
A.B., Southwestern Univ., 1924; A.M., Univ. of Texas, 1930.

Roderick Keener CLAYTON
Associate Professor of Physics (1952)
B.S., California Institute of Technology, 1947; Ph.D., 1951.

Paul Eugene COOPER
Associate Professor of Electronics (1946)
B.S., Univ. of Texas, 1937; M.S., 1939.

William Peyton CUNNINGHAM
Professor of Physics (1946)
B.S., Yale Univ., 1928; Ph.D., 1932.

John James DOWNING
Instructor in Electronics (1952)
B.S., Massachusetts Institute of Technology, (1948).

George Robert GIET
Professor of Electronics (1925)
A.B., Columbia Univ., 1921; E.E., 1923.

Earl Gascoigne GODDARD
Assistant Professor of Electronics (1948)
B.S., New Mexico State College, 1939; A. M., Stanford Univ., 1947; E.E., 1947.

Robert KAHAL
Associate Professor of Electronics (1952)
B.E.E., Cooper Union, 1943; M.E.E., Polytechnic Institute of Brooklyn, 1947; D.E.E., 1950.

Sydney Hobart KALMBACH
Assistant Professor of Physics (1947)
B.S., Marquette Univ., 1934; M.S., 1937.

Lawrence Edward KINSLER
Professor of Physics (1946)
B.S., California Institute of Technology, 1931; Ph.D., 1934.

Clarence Frederick KLAMM, Jr.
Assistant Professor of Electronics (1951)
B.S., Washington Univ., 1943; M.S., 1948.

William Warner LANG
Instructor in Physics (1951)
B.S., Iowa State College, 1946; M.S., Massachusetts Institute of Technology, 1949.

Carl Ernest MENNEKEN
Professor of Electronics (1942)
B.S., Univ. of Florida, 1932; M.S., Univ. of Michigan, 1936.

Robert Lee MILLER
Associate Professor of Electronics (1946)
B.Ed., Illinois State Normal Univ., 1936; M.S., Univ. of Illinois, 1942.

Norman Lee OLESON
Professor of Physics (1948)
B.S., Univ. of Michigan, 1935; M.S., 1937; Ph.D., 1940.

William Henry ROADSTRUM
Assistant Professor of Electronics (1948)
B.S., Lehigh Univ., 1938; M.S., Carnegie Institute of Technology, 1948.

Abraham SHEINGOLD
Associate Professor of Electronics (1946)
B.S., College of the City of New York, 1936; M.S., 1937.

Donald Alan STENTZ
Assistant Professor of Electronics (1949)
B.S., Duke Univ., 1949.

Michael Satoshi WATANABE
Professor of Physics (1952)
B.S., Tokyo Univ., 1933; D.Sc., Paris Univ., 1935; D.Sc., Tokyo Univ., 1940.

DEPARTMENT OF MATHEMATICS AND MECHANICS

Warren Randolph CHURCH
Professor of Mathematics and Mechanics; Chairman (1938)
A.B., Amherst, 1926; A.M., Univ. of Pennsylvania, 1930; Ph.D., Yale Univ., 1935.

Willard Evans BLEICK
Professor of Mathematics and Mechanics (1946)
M.E., Stevens Institute of Technology, 1929; Ph.D., Johns Hopkins Univ., 1933.

Richard Crowley CAMPBELL
Associate Professor of Mathematics and Mechanics (1948)
B.S., Muhlenberg College, 1940; A.M., Univ. of Pennsylvania, 1942.

Frank David FAULKNER
Associate Professor of Mathematics and Mechanics (1950)
B.S., Kansas State Teachers College, 1940; M.S., Kansas State College, 1942.

Joseph GIARRATANA
Professor of Mathematics and Mechanics (1946)
B.S., Univ. of Montana, 1928; Ph.D., New York Univ., 1936.

Walter JENNINGS
Associate Professor of Mathematics and Mechanics (1947)
A.B., Ohio State Univ., 1932; B.S., 1934; A.M., 1934.

Brooks Javins LOCKHART
Associate Professor of Mathematics and Mechanics (1948)
A.B., Marshall College, 1937; M.S., West Virginia Univ., 1940; Ph.D., Univ. of Illinois, 1943.

Aladuke Boyd MEWBORN
Professor of Mathematics and Mechanics (1946)
B.S., Univ. of Arizona, 1927; M.S., 1933; Ph.D., California Institute of Technology, 1940.

Thomas Edmond OBERBECK
Associate Professor of Mathematics and Mechanics (1951)
A.B., Washington Univ., 1938; A.M., Univ. of Nebraska, 1940; Ph.D., California Institute of Technology, 1948.

Clay Lamont PERRY, Jr.
Associate Professor of Mathematics (1953)
A.B., Univ. of California at Los Angeles, 1942; A.M., Univ. of Southern California, 1946; Ph.D., Univ. of Michigan, 1949.

John Philip PIERCE
Associate Professor of Mathematics and Mechanics (1948)
B.S., Worcester Polytechnic Institute, 1931; M.E.E., Polytechnic Institute of Brooklyn, 1937.

Francis McConnell PULLIAM
Associate Professor of Mathematics and Mechanics (1949)
A.B., Univ. of Illinois, 1937; A.M., 1938; Ph.D., 1947.

Charles Henry RAWLINS, Jr.
Professor of Mathematics and Mechanics (1922)
Ph.B., Dickinson College, 1910; A.M., 1913; Ph.D., Johns Hopkins Univ., 1916.

Ralph Eugene ROOT
Professor Emeritus of Mathematics (1914)
B.S., Morningside College, 1905; A.M., Univ. of Iowa, 1909; Ph.D., Univ. of Chicago, 1911.

Charles Chapman TORRANCE
Professor of Mathematics and Mechanics (1946)
M.E., Cornell Univ., 1922; A.M., 1927; Ph.D., 1931.

DEPARTMENT OF MECHANICAL ENGINEERING

Paul James KIEFER
Senior Professor of Mechanical Engineering; Chairman (1920)
A.B., Wittenberg College, 1908; B.S., Case Institute of Technology, 1911; M.E., 1939; D.Sc., Wittenberg College, 1953.

Eugene Elias DRUCKER
Assistant Professor of Mechanical Engineering (1950)
B.S., Massachusetts Institute of Technology, 1949; M.S., 1950.

Ernest Kenneth GATCOMBE
Professor of Mechanical Engineering (1946)
B.S., Univ. of Maine, 1931; M.S., Purdue Univ., 1939; Ph.D., Cornell Univ., 1944.

Dennis KAVANAUGH
Professor of Mechanical Engineering (1926)
B.S., Lehigh Univ., 1914.

Cecil Dudley Gregg KING
Assistant Professor of Mechanical Engineering (1952)
B.E., Yale Univ., 1943; M.S., Univ. of California, 1952.

Robert Eugene NEWTON
Professor of Mechanical Engineering (1951)
B.S., Washington Univ., 1938; M.S., 1939; Ph.D., Univ. of Michigan, 1951.

Roy Walters PROWELL
Associate Professor of Mechanical Engineering (1946)
B.S., Lehigh Univ., 1936; M.S., Univ. of Pittsburgh, 1943.

Allen Kleiber SCHLEICHER
Assistant Professor of Mechanical Engineering (1950)
B.S., Washington Univ., 1943; M.S., 1950.

Ivar Howard STOCKEL
Instructor in Mechanical Engineering (1950)
B.S., Massachusetts Institute of Technology, 1950; M.S., 1950.

Harold Marshall WRIGHT
Professor of Mechanical Engineering (1945)
B.S., North Carolina State College, 1930; M.M.E., Rensselaer Polytechnic Institute, 1931.

DEPARTMENT OF METALLURGY AND CHEMISTRY

Frederick Leo COONAN
Professor of Metallurgy and Chemistry; Chairman (1931)
A.B., Holy Cross College, 1922; M.S., 1924; D.Sc., Massachusetts Institute of Technology, 1931.

Newton Weber BUERGER
Professor of Metallurgy (1942)
B.S., Massachusetts Institute of Technology, 1933; M.S., 1934; Ph.D., 1937.

John Robert CLARK
Professor of Metallurgy (1947)
B.S., Union College, 1935; D.Sc., Massachusetts Institute of Technology, 1942.

Alfred GOLDBERG
Assistant Professor of Metallurgy (1953)
B.E., McGill Univ., 1946
M.S., Carnegie Institute of Technology, 1949.

William Wisner HAWES
Associate Professor of Metallurgy and Chemistry (1952)
B.S., Purdue Univ., 1924; M.S., Brown Univ., 1927; Ph.D., 1930.

Carl Adolph HERING
Associate Professor of Chemical Engineering (1946)
B.S., Oregon State College, 1941; M.S., Cornell Univ., 1944.

Gilbert Ford KINNEY
Professor of Chemical Engineering (1942)
A.B., Arkansas College, 1928; M.S., Univ. of Tennessee, 1930; Ph.D., New York Univ., 1935.

Lloyd Randall KOENIG
Instructor in Chemical Engineering (1950)
B.S., Washington Univ., 1950.

George Daniel MARSHALL, Jr.
Associate Professor of Metallurgy (1946)
B.S., Yale Univ., 1930; M.S., 1932.

George Harold McFARLIN
Associate Professor of Chemistry (1948)
A.B., Indiana Univ. 1925; A.M., 1926.

Melvin Ferguson REYNOLDS
Professor of Chemistry (1946)
B.S., Franklin and Marshall College, 1932; M.S., New York Univ., 1935; Ph.D., 1937.

James Edward SINCLAIR
Assistant Professor of Chemistry (1949)
B.S., Johns Hopkins Univ., 1945

James Woodrow WILSON
Associate Professor of Chemical Engineering (1949)
A.B., Stephen F. Austin State Teachers College, 1935; B.S., Univ. of Texas, 1939; M.S., Texas Agricultural and Mechanical College, 1941.

LIBRARY

George Ridgely LUCKETT
Associate Professor; Director of Libraries (1950)
B.S., Johns Hopkins Univ., 1949; M.S., Catholic Univ., 1951.

Morris HOFFMAN
Assistant Professor; Associate Librarian (1952)
B.S., Univ. Minnesota, 1947; A.M., 1949.

Jack Benjamin GOLDMANN
Reference Librarian (1952)
A.B., Univ. of California, 1939; A.M., 1940; B.L.S., 1950; Ph.D., 1953.

Georgia Plummer LYKE
Technical Reports Cataloger (1952)
A.A., Hartnell Junior College, 1940.

Margaret H. McBRIDE
Catalog Librarian (1951)
A.B., Univ. of California, 1945; B.L.S., 1947.

Ignatius McGUIRE
Assistant Librarian (1948)

Cyril Harrison SYKES
Acquisitions Librarian (1951)
A.B., Norwich Univ., 1947; M.S., Syracuse Univ., 1949.

Marjorie Idana Vollmer THORPE
Technical Reports Librarian (1952)
A.B., Univ. of California at Los Angeles, 1942; B.S., Univ. of Southern California, 1943.

** To be relieved in July by Capt. Paul Van Leunen, Jr., USN.

† To be relieved in August by Capt. John F. Tatom, USN.

‡ To be relieved in July by Comdr. Ralph W. Arndt, USN.

ACADEMIC ASSOCIATES

For each group of curricula, a faculty member is designated who acts as adviser to the officer in charge of respective curricula, in academic matters pertaining to curricula, such as formulation, proposed changes, etc.

Curriculum	Group Designator	Academic Associate
Advanced Science		
Chemistry	RC	Professor Kinney
Mathematics	RM	Professor Church
Physics	RP, RX	Professor Frey
Aerological Engineering	MA, MS	Professor Duthie
Aeronautical Engineering	A, AG	Professor Coates
Aeronautical Engineering (Electrical)	AE	Professor Vivell
Aeronautical Engineering (Armament)	AR	Professor Bleick
Communications	C, CS	Professor Giet
Engineering Electronics	E, EA, EW	Professor Giet
Mine Warfare	RW	Professor Kinsler
Naval Engineering		
Chemical Engineering	NC	Professor Kinney
Electrical Engineering	NL	Professor Polk
Gas Turbines	NJ	Professor Polk, Professor Vavra
Mechanical Engineering	NH, NQ	Professor Wright
Mechanical Engineering (Nuclear Power)	NN	(To be assigned)
Metallurgical Engineering	NM	Professor Coonan
Petroleum Engineering	NP	Professor Coonan
Nuclear Engineering (Effects)	RZ	Professor Frey
Operations Analysis	RO	Professor Cunningham
Ordnance Engineering		
Aviation	OE	Professor Bleick
Explosives	OP	Professor Kinney
Fire Control	OF	Professor Bleick
General	O	Professor Bleick
Guided Missiles	OG	(To be assigned)
Jet Propulsion	OJ	Professor Bleick
Special Physics	OX	Professor Frey

Liaison Officials at Other Institutions, where students from the Postgraduate School are enrolled.

Boston University	*P.N.S., Harvard University
California Institute of Technology	P.N.S., Univ. of So. Calif.
Carnegie Institute of Technology	Assoc. Prof. J. W. Ludewig, Dept. of Metallurgical Eng.
Catholic University	Office of the Judge Advocate General
Columbia University	P.N.S.
Fordham University	P.N.S., Columbia Univ.
Georgetown University	Office of the Judge Advocate General
George Washington University (Comptrollership)	Prof. A. R. Johnson
George Washington University (Law)	Office of the Judge Advocate General
Georgia Institute of Technology	P.N.S.
Harvard University	P.N.S.
Iowa State College	P.N.S.
Lehigh University	Dean Harvey A. Neville, Graduate School
Massachusetts Institute of Technology	CO, Naval Administrative Unit

Oak Ridge School of Reactor Technology	Director (Dr. F. C. Vonderlage)
Ohio State University	P.N.S.
Princeton University	P.N.S.
Purdue University	P.N.S.
Rensselaer Polytechnic Institute	P.N.S.
Rochester Institute of Technology	P.N.S., Univ. of Rochester
Royal Naval College, Greenwich, England	U. S. Naval Attache, London
Scripps Institute of Oceanography	P.N.S., University of Calif.
Stanford University	P.N.S.
Stevens Institute of Technology	Prof. B. K. Erdoss, Graduate School
Swiss Federal Institute, Zurich, Switzerland	Dr. O. Etter
Union Theological Seminary	P.N.S., Columbia University
University of California	P.N.S.
University of Illinois	P.N.S.
University of Michigan	P.N.S.
University of Minnesota	P.N.S.
University of Pittsburgh	Prof. H. G. Botset, Dept. of Petroleum Engineering
University of Southern California	P.N.S.
Webb Institute of Naval Architecture	Capt. N. W. Gokey, USN (Ret), Luckenback Graduate School
Yale University	P.N.S.

*P.N.S. signifies Professor of Naval Science.

FUNCTION OF THE SCHOOL

The Engineering School of the U. S. Naval Postgraduate School is established for the purpose of maintaining courses of instruction for the advanced education and training of commissioned officers in such general or technical subjects as the Secretary of the Navy may prescribe.

This institution is not in competition with the various civilian colleges of the country. On the contrary, the postgraduate program utilizes the best available sources of learning in each field. The curricula are thus seen to include varying proportions at outside institutions, some being conducted entirely at a civilian college.

At the Engineering School, instruction is given in basic sciences and in the application of these sciences to naval uses. The basic sciences (mathematics, physics, chemistry) are the same whether studied at this school or at a civilian college; the application of the sciences to naval machinery and equipment, however, can be learned best at a naval school, where the important teaching experience is developed over the years. Thus, in the fields of mechanical engineering, electrical engineering, electronics, ordnance and aeronautical engineering, all of great importance in the Navy, most curricula are given entirely at Monterey. Even in these, however, a civilian college is utilized in some cases for the final year of advanced instruction in particular fields such as Gas Turbines, Explosives, Metallurgical Engineering, and Petroleum Engineering.

Conducted entirely at civilian colleges are the following curricula, in which no instruction or facilities are available at the Engineering School:

(a) Civil Engineering
(b) Naval Architecture
(c) Advanced study in pure science
(d) Business Administration
(e) Textile Engineering
(f) Law
(g) Religion, and a few other highly specialized programs.

Close and cordial relations are maintained with many of the leading universities, including some foreign institutions.

The selection of officers applying for postgraduate instruction is made by boards appointed by the Chief of Naval Personnel. The courses available, the conditions of eligibility and other pertinent data are published annually in Bureau of Naval Personnel directives.

ADMINISTRATION

Responsibility for administration of the Engineering School rests in the Director. Under the Director are the Naval Staff and the Civilian Faculty.

The Naval Staff consists of the officers in charge of curricula, with their respective officer assistants, some of whom are also instructors in naval professional subjects.

The Civilian Faculty is organized into academic departments, each with a chairman who is responsible for the instruction given in his department.

Academic departments are listed as follows:
- Department of Aerology
- Department of Aeronautics
- Department of Electrical Engineering
- Department of Electronics and Physics
- Department of Mathematics and Mechanics
- Department of Mechanical Engineering
- Department of Metallurgy and Chemistry

The Civilian Faculty members of the Engineering School are under the over-all supervision and administration of the Academic Dean, insofar as their academic work and performance are concerned. The Dean represents the Superintendent and the Director, with many of the functions usually resting in the Dean of a civilian college. The faculty members are civil service personnel, with "excepted" status.

The officer students of the Engineering School are under the military supervision of the respective officers in charge of curricula, who represent the Director, Engineering School. The officer in charge of the student's curricula group conducts the usual naval administration, such as fitness reports and muster.

In addition to the task of military supervision of the officer students, the officer in charge of a curricula group is responsible for planning and composing the curricula assigned to him, selecting courses which will fill the needs of the Navy. The officer in charge keeps the curricula flexible, affording instruction in new applications of engineering and science, as well as in the basic sciences. In this work, he maintains close liaison with the sponsoring material bureaus and offices of the Navy.

In carrying out his duties, the officer in charge of a curricula group is assisted by the Academic Associate, a faculty member assigned to a designated group of curricula.

In the Engineering School, there are six curricular officers:

Officer in Charge, Aerological Engineering Curricula

Officer in Charge, Aeronautical Engineering Curricula

Officer in Charge, Communications Curricula

Officer in Charge, Engineering Electronics Curricula

Officer in Charge, Naval Engineering Curricula

Officer in Charge, Ordnance Engineering Curricula

Each curriculum is assigned to one of these officers, as indicated in the Tabulation of Curricula at Monterey and at other institutions.

Each curriculum at a civilian institution is supervised by one of the officers in charge of curricula, who plans the curriculum in accordance with the Navy's needs and the institution's requirements. If a degree is to be sought at the civilian institution, the requirements of the institution must be further considered.

REGULATIONS GOVERNING THE AWARD OF DEGREES

In accordance with Public Law 303 of the 79th Congress, with the Regulations prescribed by the Secretary of the Navy, and with accreditation by the Engineers' Council for Professional Development, the Superintendent is authorized to confer the degree of Bachelor of Science in the Mechanical Engineering, the Electrical Engineering, the Engineering Electronics and the Aeronautical Engineering curricula. The recipients of such degrees must be found qualified by the Academic Council in accordance with certain academic standards.

The Superintendent is further authorized to confer Masters and Doctors degrees in engineering or related fields, upon the recommendation by the faculty, based upon satisfactory completion of a program of advanced study approved by the Academic Council.

The following paragraphs set forth the requirements for the degrees:—

(1) Requirements for the Bachelor of Science Degree:

(a) The Bachelor's degree in engineering or other scientific fields may be awarded for successful completion of a curriculum which serves the needs of the Navy and has the approval of the Academic Council as meriting a degree. Such a curriculum shall conform to current practice in accredited engineering institutions and shall contain a well-defined major, with appropriate cognate minors.

(b) Admission with suitable advanced standing and a minimum of two academic years of residence at the Naval Postgraduate School are normally required. With the approval of the Academic Council, this residence requirement may be reduced to not less than one academic year in the case of particular students who have had sufficient prior preparation at other institutions.

(c) To be eligible for the degree, the student must attain a minimum average quality point rating of 1.0 in all the courses of his curriculum. In very exceptional cases, small deficiences from this figure may be waived at the discretion of the Academic Council.

(d) With due regard for the above requirements, the Academic Council will decide whether or not to recommend the candidate to the Superintendent of the Naval Postgraduate School for the award of the Bachelor's degree.

(2) Requirements for the Master of Science Degree:

(a) The Master's degree in engineering and related fields is awarded for the successful completion of a curriculum which complements the basic scientific education of a student and which has been approved by the Academic Council as meriting a degree, provided the student exhibits superior scholarship, attains scientific proficiency, and meets additional requirements as stated in the following paragraphs.

(b) Since curricula serving the needs of the Navy ordinarily contain undergraduate as well as graduate courses, a minimum of two academic years of residence at the Naval Postgraduate School is normally required. With the approval of the Academic Council, the time of residence may be reduced in the case of particular students who have successfully pursued graduate study at other educational institutions. In no case will the degree be granted for less than one academic year of residence at the Naval Postgraduate School.

(c) A curriculum leading to a Master's degree shall comprise not less than 48 term hours (32 semester hours) of work that is clearly of graduate level, and shall contain a well-supported major, together with cognate minors. At least six of the term hours shall be in advanced mathematics. The proposed program shall be submitted to the cognizant department chairman for review and approval. If the program is satisfactory to the department chairman, it shall be forwarded by him to the Academic Council for final action.

(d) To become a candidate for the Master's degree the student shall have completed at least three quarters of the graduate credit courses of his curriculum with a quality point rating in them of not less than 1.75 as defined in the section on scholarship.

(e) To be eligible for the Master's degree, the student must attain a minimum average quality point rating of 2.0 in all graduate credit courses; 1.5 in all of his other courses. In special cases, under very extenuating circumstances, small deficiencies from the figures noted in paragraphs (d) and (e) may be waived at the discretion of the Academic Council.

(f) A reasonable proportion of the graduate work leading to the Master's degree shall be composed of research and a thesis reporting the results obtained. The thesis topic may be selected by the student, subject to the approval of the cognizant department chairman. The completed thesis must indicate ability to perform independent work and to report on it in a scholarly fashion. The thesis, in final form, will be submitted to the cognizant department chairman for review and evaluation. Upon final approval of the thesis by the department chairman, the student shall be certified as eligible for final examination.

(g) If the thesis is accepted, the candidate for the degree shall take a final oral examination, the duration of which will be approximately one hour. An additional comprehensive written examination may be required at the discretion of the cognizant department chairman. Not more than one half of the oral examination shall be devoted to questions directly related to the candidate's thesis topic; the remainder to the candidate's major and related areas of study.

(h) With due regard for the above requirements, the Academic Council will decide whether or not to recommend the candidate to the Superintendent of the Naval Postgraduate School for the award of the Master's degree.

(3) Requirements for the Doctor's Degree:

(a) The Doctor's degree in engineering and related fields is awarded as a result of very meritorious and scholarly achievement in a particular field of study which has been approved by the Academic Council as within the purview of the Naval Postgraduate School. A candidate must exhibit faithful and scholarly application to all prescribed courses of study, achieve a high level of scientific advancement and establish his ability for independent investigation, research, and analysis. He shall further meet the requirements described in the following paragraphs.

(b) Any program as leading to the Doctor's degree shall require the equivalent of at least three academic years of study beyond the undergraduate level, and shall meet the needs of the Navy for advanced study in the particular area of investigation. At least one academic year of the doctorate work shall be spent at the Naval Postgraduate School.

(c) A student seeking to become a candidate for the doctorate shall hold a Bachelor's degree from a college or university, based on a curriculum that included the prerequisites for full graduate status in the department of his major study, or he shall have pursued successfuly an equivalent course of study. The student shall submit his previous record to the Academic Council, via the Academic Dean, for final determination of the adequacy of his preparation.

(d) Upon favorable action by the Academic Council, the student will be notified that he may request the chairman of the department of his major subject to form a Doctorate Committee. This chairman will specify one or more minor subjects and, with the chairmen of the corresponding departments, will nominate a Doctorate Committee consisting of five or more members, at least three of whom are under different departments. The chairman of the department of the major subject will submit to the Academic Council for its approval the choice of minor fields and the names of the faculty members nominated for the Doctorate Committee.

(e) After a sufficient period of study in his major and minor fields, the student shall submit to qualifying examinations, including tests of his reading knowledge of foreign languages. The selection of these languages depends on the field of study. The minimum is a reading knowledge of German and a second language to be suggested by his Doctorate Committee and approved by the Academic Council. The language examinations will be conducted by a committee especially appointed by the Academic Council. The other qualifying examinations will cover material previously studied in his major and minor fields; they will be written and oral and will be conducted by the Doctorate Committee. The members of the Academic Council or their delegates may be present at the oral examinations. The Doctorate Committee will report the results of the qualifying examinations to the Academic Council for consideration and, upon approval, the student becomes a candidate for the Doctorate. The qualifying examinations are not given, ordinarily, before the completion of the first year of residence at the Naval Postgraduate School; they must be passed successfully at least two years before the degree is granted.

(f) Upon successful qualification as a candidate, the student will be given a further program of study by the Doctorate Committee. This program must be approved by the Academic Council.

(g) The distinct requirement of the doctorate is the successful completion of an original, significant, and scholarly investigation in the candidate's major area of study. The results of the investigation, in the form of a publishable dissertation, must be submitted to the Academic Council at least two months before the time at which it is hoped the degree will be granted. The Academic Council will select two or more referees, who will make individual written reports on the dissertation. Lastly, the Academic Council will vote upon the acceptance of the dissertation.

(h) After the approval of the dissertation, and not later than two weeks prior to the award of the degree, the candidate will be subject to written and oral examination in his major and minor subjects. Written examinations will be conducted by the department having cognizance of the particular subject. The occasion and scope of each examination will be arranged by the Doctorate Committee, after consultation with the departments concerned and the members of the Academic Council. The Doctorate Committee will notify the Academic Council of the time of the oral examination and will invite their attendance, or that of their delegates. The Committee will also invite the attendance of such other interested persons as it may deem desirable. In this oral examination, approximately one half of the allotted time will be devoted to the major subject and one half to the minor subjects. The Doctorate Committee will submit the results of all examinations to the Academic Council for their approval.

(i) With due regard for all of the above requirements, the Academic Council will decide whether to recommend the candidate to the Superintendent of the Naval Postgraduate School for the award of the doctorate.

SCHOLARSHIP AND GRADING SYSTEM

For each course conducted in the Engineering School, a grade is assigned to the student at the completion of the term, in accordance with the following table:

Grade		Quality Point Number
A	Excellent	3.0
B	Good	2.0
C	Fair	1.0
D	Barely Passing	.0
X	Failure	—1.0

In addition to the grade, a quality point number, in accordance with the table in the preceding paragraph, is assigned for each course completed. The product of this number times the credit-hours allowed for the course gives the quality points for that course.

For each ten-week term, the quality points for all courses completed are added to form a total. This total divided by the number of credit-hours for the entire term, gives a quotient called the "Quality

Point Rating" (QPR). The QPR is recorded for each term and for the entire curriculum to date, the latter figure forming the basis for degree qualification.

Thus, if a person earns all "A's" his QPR will be 3.0, the maximum; if he earns all "B's," the QPR is 2.0, etc.

One term credit-hour is given for each hour per week of lecture or recitation and half of this amount for each hour per week of laboratory or practical work, in a completed course. A term credit-hour is equivalent to two-thirds of the conventional college semester credit-hour. Example:—ME412(A) Hydromechanics, 4-2; this course results in four plus $(2 \div 2)$, or five term credit-hours.

The grades and quality points are recorded and filed, to be shown to the student concerned on request. After leaving the Postgraduate School, an officer may request a transcript of his work at the School by submitting appropriate letter to the Superintendent.

LABORATORY FACILITIES AND EQUIPMENT OF THE ENGINEERING SCHOOL

Extensive laboratory experimentation is carried on at the Engineering School in connection with the instructional and research programs of the various departments. In the present interim establishment, the laboratory facilities are housed in eight Butler-type buildings and in several other buildings on the school grounds. These facilities will be expanded substantially when they are moved early in 1954 to their permanent locations in the new buildings of the Engineering School.

The Physics laboratories are equipped to carry on experimental and research work in acoustics, atomic physics, electricity, nuclear physics and geometrical and physical optics. A bio-physics laboratory is planned for the near future.

The work in the acoustics laboratory is particularly directed toward underwater sound applications. Hence, a large proportion of the laboratory space is devoted to sonar equipment, test tanks and instrumentation for investigations in underwater sound.

The equipment of the optics laboratory is soon to be supplemented by a Mach-Zehnder interferometer and a large-grating spectrograph having a resolving power of 170,000. Both instruments are now under construction. Also, a completely automatic infrared spectrograph is soon to be acquired.

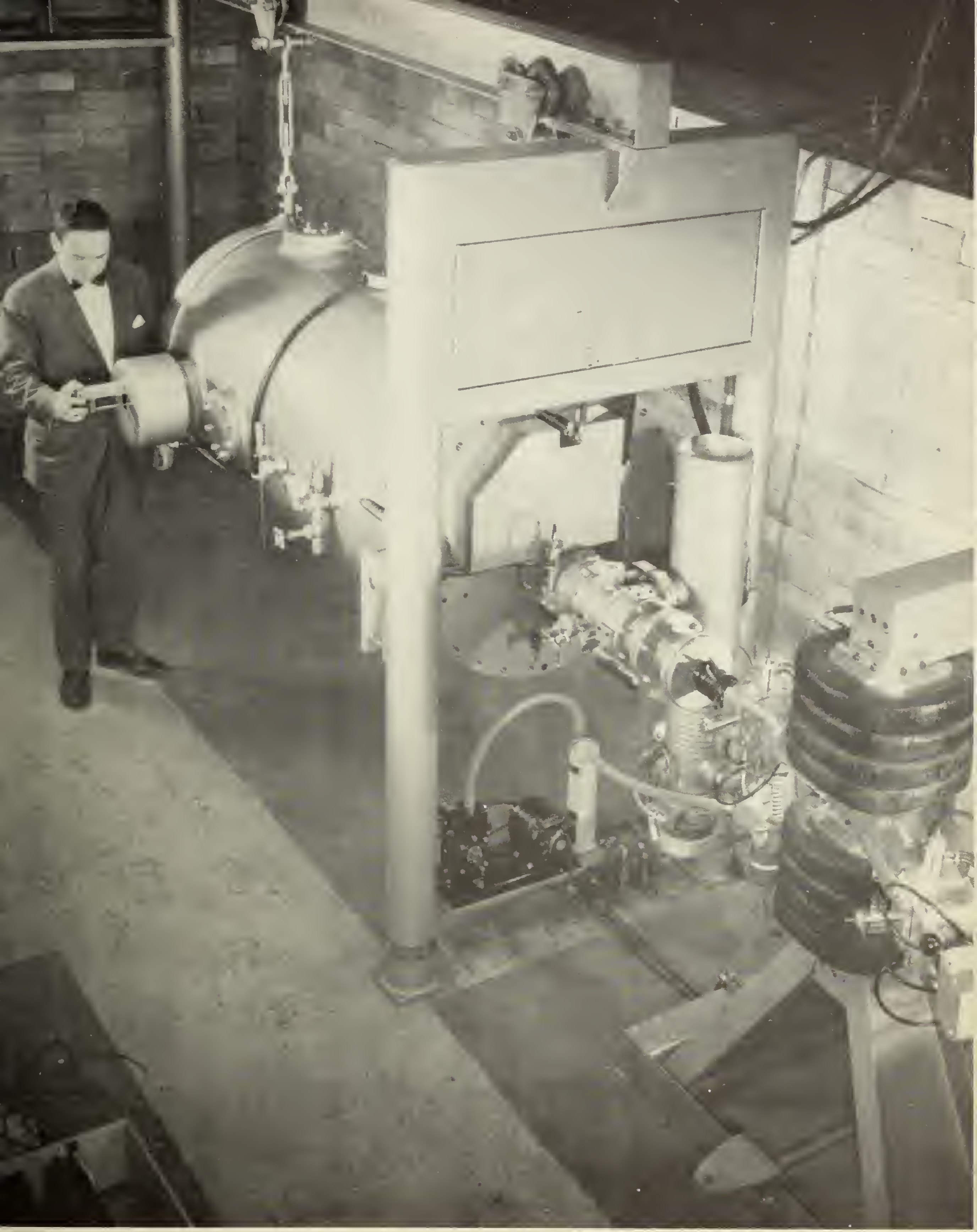
In the new Engineering School building, the Physics Department will have additional equipment and space for staff and student experimentation and research. A two-million-volt Van de Graaff nuclear accelerator will be available in the nuclear physics laboratory; the acoustics laboratory facilities will include a medium-sized Anechoic (echo-free) chamber, a small Reverberation chamber, and a multi-unit acoustics laboratory for student experimentation in airborne acoustics; and additional facilities will be available for work in atomic physics, bio-physics, gaseous discharges and infra-red spectrometry.

The Aeronautical laboratories contain facilities for experimentation and research in aerodynamics, structural and stress analysis, aerothermodynamics and propulsion problems.

Facilities for the study of subsonic technical aerodynamics are centered about a 32″ × 45″ subsonic wind tunnel, having a speed range extending from approximately 10 to 185 knots. The Structural Test Laboratory contains a testing machine of 200,000 pounds capacity, used in structural and stress analysis of aircraft components. The facilities of the Compressibility Laboratory include a transonic wind tunnel having a 4″ × 16″ test section and operating in the Mach number range from 0.4 to 1.4, and a supersonic wind tunnel having a 4″ × 4″ test section and operating in the Mach number range from 1.4 to 4. Instruments associated with these wind tunnels include a 9″ Mach-Zehnder interferometer and a 9″ and two 5″ Schlieren systems for flow observations. The Propulsion Laboratory contains a single test block and facilities for measurement of thrust, fuel flow, temperature, pressures and other parameters of engine operation. Present engine equipment consists of a 9½″ Westinghouse Turbo-Jet and three pulse jet engines. A small flame tube, especially equipped for the study of flame propagation, is also available.

The Chemical laboratories are well equipped for instructional purposes at both the graduate and undergraduate level. Noteworthy among the available facilities are a Beckman spectrophotometer, an advanced-design Adiabatic fractionating column, a plastics laboratory unit where experimental plastics may be prepared, photo-elastic equipment for studies of tensile and compressive strain effects on transparent plastics, a drop-weight apparatus for explosives testing and equipment for radioactivity studies, as well as precision equipment for studies in analytical and physical chemistry and a well-equipped fuel and lubricant laboratory.

In the new Engineering School building, additional facilities will be available for making, fabricating and testing plastics. The fabricating facilities will include an injection molding press, several 12-ton compression molding presses and two 30-ton compression molding presses.

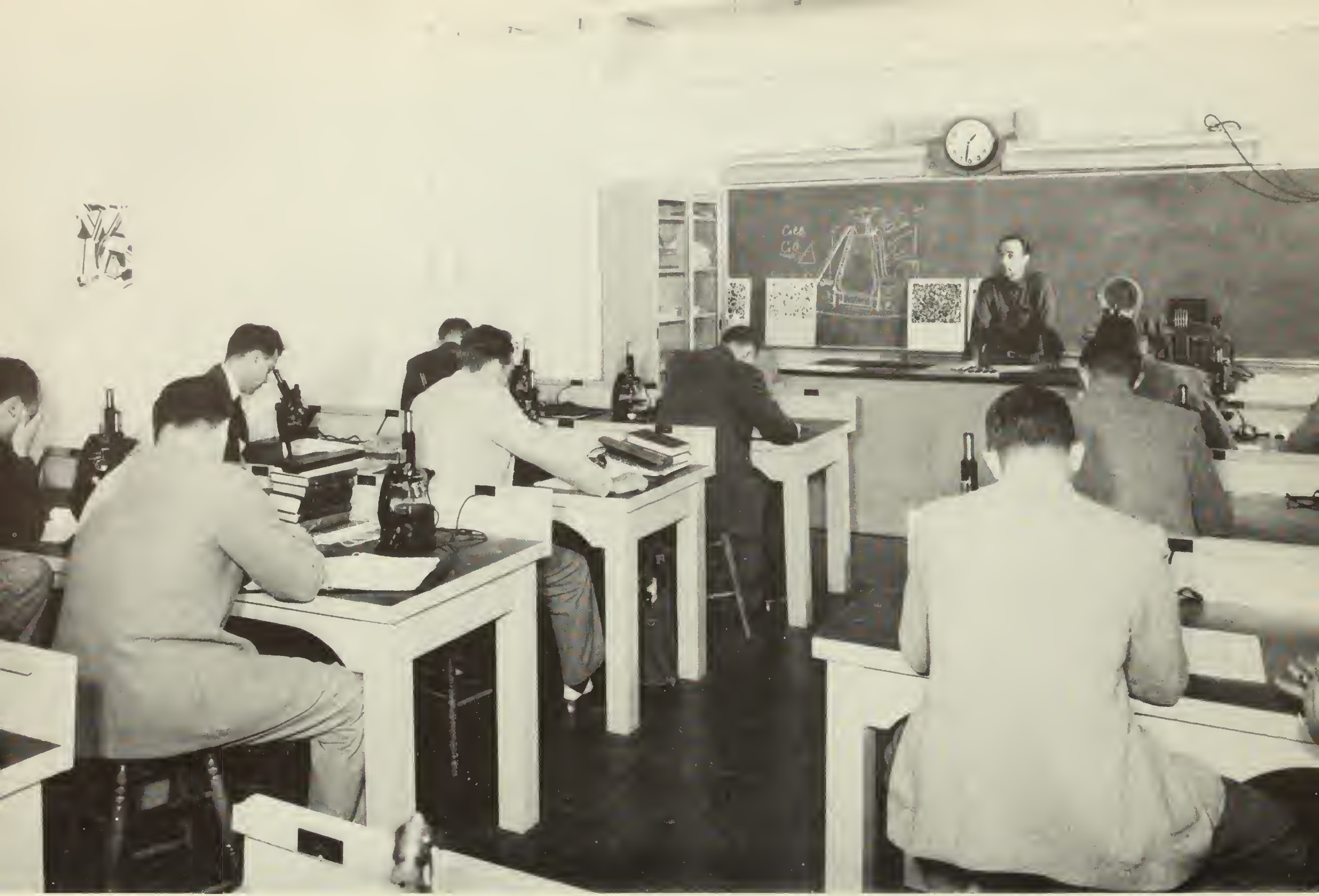


The two-million-volt Van de Graaff nuclear accelerator, part of the physics laboratory equipment.
(By courtesy of High Voltage Engineering Corporation)

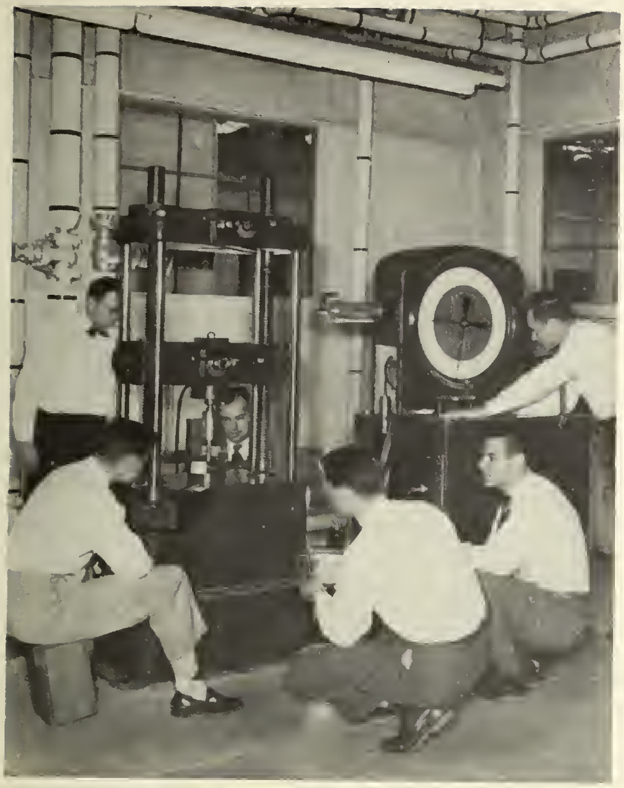
Metallurgy equipment, including hardness testers, rolling mill, furnaces and tension testing machine.

Part of the plastic laboratory, Department of Metallurgy and Chemistry.

Part of a chemistry laboratory. Currently in former hotel bedrooms, the chemistry equipment will be moved in 1954, to the permanent Engineering School buildings.



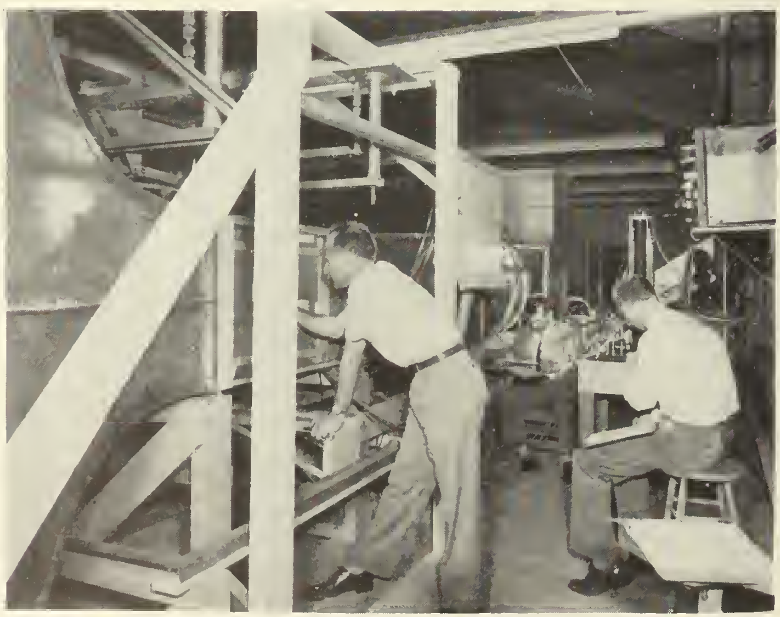
A class in metallorgraphy. Modern equipment and techniques assist in teaching the metallurgy courses, of great importance to engineers.



A testing machine, in the Mechanical Engineering Department Laboratory.

A laboratory session, Materials Testing Laboratory course, Mechanical Engineering Department.

The jet engine pit, Aeronautical Engineering Laboratory.



A wind tunnel, used by Aeronautical Engineering students.

Servomechanisms Laboratory, with a class in Electrical Engineering. The Postgraduate School has for years emphasized this important subject.

A portion of the Reference Library, containing technical books and periodicals, supporting the academic departments.

The **Electronics** laboratories are well equipped for carrying on a comprehensive program of experimental work in the various branches of the field. Facilities are available for investigating the operational characteristics of radio and electronic circuits at frequencies ranging from d-c to the microwave region. For precision measurements and accurate calibration of instruments, standard frequency sources and standardizing equipment are available.

To illustrate modern communications practices, representative systems are available covering a wide range of operating frequencies, power outputs and methods of modulation. These include systems for transmitting manual and automatic telegraphy, voice and video signals. Additional systems include electronic countermeasures equipment, radio aids to navigation and a broad selection of Navy radar systems.

Improved facilities are being provided for the study of telemetering systems, computing systems, modern radar systems, antenna radiation characteristics and microwave phenomena, as well as for conducting more advanced work in circuit measurements. Additional space will also be available for conducting individual research and project work.

The laboratory facilities of the **Department of Metallurgy** include heat treatment and materials fabricating and testing laboratories, a metallography laboratory and a crystallographic laboratory. The heat treatment equipment includes induction heating units and heat treating furnaces. The testing equipment includes three universal testing machines, Rockwell hardness testers and a microhardness machine. The materials fabricating equipment include a rolling mill and a swaging machine. Equipment used in crystal structure studies includes various types of powder cameras, heating cameras for obtaining diffraction patterns at controlled elevated temperatures, Weissenberg x-ray goniometers and a precision recording photodensitometer. Also available are several x-ray diffraction units, a Geiger counter spectrometer and radiographic equipment. In the metallography laboratory are bench-type microscopes and research type metallographs with completely equipped photomicrography facilities.

In the **Electrical Engineering** laboratories, facilities are provided for instruction and research in servomechanisms, electronics, electrical machinery and circuits. The laboratories are equipped with many duplicate sets of equipment for performing all standard experiments. Additional items of special equipment include a five-unit harmonic set, a high-voltage set, a Schering Bridge, an analog computer (shared with the Mathematics and Aeronautics departments), BTA motors, wave analysers, sound meters, special servo analysers, oscillographs, industrial analysers, Brush recorders, dynamometers, synchroscopes, amplidynes and rototrols.

When the current construction program is completed early in 1954, the Electrical Engineering laboratories will be housed in a specially designed two-story steel, concrete and glass building (132′ × 132′) adjacent to the main engineering building. The ground floor will house the machinery and high voltage laboratories, and the second floor will be devoted to electronics, control, servomechanisms and measurements. Both floors will be provided with switchboards able to distribute a wide range of DC, AC 60-cycle or 400-cycle power to any location. The ground floor will have a completely equipped darkroom and the upper floor an excellent standards laboratory.

The **Mechanical Engineering** laboratories provide facilities for instruction and research in elastic-body mechanics and dynamics, in hydromechanics and in heat-power and related fields. Noteworthy equipment in the heat-power laboratories include a forced-circulation boiler, 3500 psi and 1000°F; a gas or oil-fired boiler, 250psi and 8000 lb./hr., fully automatic controls; a 150-HP Boeing turbo-prop gas turbine installation, dynamometer loaded; a two-dimensional supersonic air nozzle with schlieren equipment for analysis of shock-wise flows; a vapor-compression still and a solo-shell dual-effect evaporator. Facilities of the Elastic-body Mechanics and Dynamics laboratories include a Universal Fatigue Tester, for testing in tension, compression, bending or torsion, a Chapman Polariscope for stress determination by photo-elastic method; vibration inducer units and associated equipment for inducing vibrations in mechanical systems with controlled amplitudes and frequencies from 20 to 20,000 cycles per second; Gisholt and Olsen dynamic balancing machines; and a linear accelerometer and calibrator unit.

The procuring of additional special equipment for the Hydro-mechanics Laboratory is being deferred until completion of new laboratory space. This laboratory will then include such items as a small circulating water tunnel and channel and a towing tank.

The laboratory facilities in **Aerology** include all instruments in present-day use for measuring the current physical and dynamic state of the atmosphere, as well as teletype and facsimile communications equipment for the rapid reception and dissemination of weather data in coded and analyzed form for the entire northern hemisphere.

The instruments for gathering weather data include rawinsonde equipment, which provides a continuous recording of temperature, pressure, humidity and wind directions and velocities at designated levels from the surface; rasonde equipment whereby pressure, temperature and humidity information is transmitted to ground via radio signals from heights that may extend above 100,000 feet; a wiresonde that measures air temperature and humidity conditions in the lower strata of the atmosphere, an inversion meter designed for remote recordings of atmospheric temperature at designated heights in the boundary layer; and a bathythermograph for recording sea temperature gradients.

The equipment of the Mathematics and Mechanics Department includes comprehensive computation facilities for use in the instruction and research program of the Engineering School. Computing equipment now available includes an electronic differential analyzer used to find the solution to a large class of differential equations; a specially modified accounting machine, used in finite difference computations; and a variety of planimeter-type instruments, including a large precision moment integrator, a Stieltjes integrator and a harmonic analyzer. In addition, a modern general-purpose automatically sequenced digital computer will be installed during this academic year. This instrument contains provision for the storage of 1,000 numbers or instructions on a drum rotating at 40 r.p.s. and 100,000 numbers or instructions on a magnetic tape. It will be useful in the solution of a great variety of problems.

RESEARCH PROJECTS

From time to time, research projects, sponsored by a material bureau or other government activity, are undertaken by members of the faculty, utilizing laboratory equipment and specialized skills. The policy of the School is to encourage such work when done without interference with routine teaching. Some outside interests are usually of benefit to the individual and also, indirectly, to the School; moreover, occasionally significant contributions to the supply of knowledge result.

Sponsored research projects are, of course, entirely separate from the normal thesis research, mandatory for the graduate degrees, conducted by the officer students or by junior faculty members.

THE CURRICULA AT MONTEREY

All instruction is conducted at the School, Monterey, California, except where otherwise indicated.

For each course, the short title, the academic level, the descriptive name, the classroom and laboratory hours per week are set forth.

Example: Ma-101(C) Introduction to Engineering Mathematics 4-0

The academic year at Monterey consists of four ten-week terms, with the usual holidays, intersessional periods between terms, etc. About two weeks are allowed in December, for leave, and about the same period for students is provided in the summer.

In the summer in addition to the leave period, a practical work period or field trip, lasting normally about six weeks, is scheduled. The officers in charge of curricula arrange for and schedule trips to industrial establishments, shipyards, or other places as appropriate and practicable.

The faculty members normally are free during the entire summer intersessional period of about two months.

Tabulation of Curricula Conducted Entirely or in Part at the Engineering School, Monterey, California

Curriculum	Group Designator	Length	Cognizant Curricular Officer
Advanced Science			
Chemistry	RC	3 yrs.	Engineering Electronics
Mathematics	RM	3 yrs.	Engineering Electronics
Physics (General)	RP	3 yrs.	Engineering Electronics
Physics (Nuclear)	RX	3 yrs.	Engineering Electronics
Aerological Engineering	MA	18 mos.	Aerological Engineering
Advanced Aerological Engineering	MS	18 mos.	Aerological Engineering
Aerology	M	1 yr.	Aerological Engineering
Aeronautical Engineering	A,AG	2 yrs.	Aeronautical Engineering
Armament	AR	3 yrs.	Aeronautical Engineering
Compressible Flow	AC3	3 yrs.	Aeronautical Engineering
Electrical	AE	3 yrs.	Aeronautical Engineering
Flight Performance	AF3	3 yrs.	Aeronautical Engineering
Gas Turbines	AT3	3 yrs.	Aeronautical Engineering
General	A3	3 yrs.	Aeronautical Engineering
Jet Propulsion	AJ3	3 yrs.	Aeronautical Engineering
Nuclear Propulsion	AN3	3 yrs.	Aeronautical Engineering
Propulsion Systems	AP3	3 yrs.	Aeronautical Engineering
Seaplane Hydrodynamics	AH3	3 yrs.	Aeronautical Engineering
Structures	AS3	3 yrs.	Aeronautical Engineering

Communications	C	1 yr.	Communications
Communications (Short Course)	CS	12 wks.	Communications
Engineering Electronics	E,EA2	2 yrs.	Engineering Electronics
Engineering Electronics	E,E2,E3	3 yrs.	Engineering Electronics
Engineering Electronics (Sonar)	E,E2,EW3	3 yrs.	Engineering Electronics
Mine Warfare	RW	2½ yrs.	Ordnance Engineering
Naval Engineering			
Chemical Engineering	NC	3 yrs.	Naval Engineering
Electrical Engineering	NL,NLA	2 yrs., 3 yrs.	Naval Engineering
Gas Turbines	NJ	3 yrs.	Naval Engineering
Mechanical Engineering	NH,NHA	2 yrs., 3 yrs.	Naval Engineering
Mechanical Engineering (Equalization)	NQ	2 yrs.	Naval Engineering
Mechanical Engineering (Nuclear Power)	NN	3 yrs.	Naval Engineering
Metallurgical Engineering (in alternate years)	NM	1 yr.	Naval Engineering
Petroleum Engineering	NP	3 yrs.	Naval Engineering
Nuclear Engineering (Effects)	RZ	2 yrs.	Ordnance Engineering
Operations Analysis	RO	2 yrs.	Ordnance Engineering
Ordnance Engineering			
Aviation	OE	3 yrs.	Ordnance Engineering
Explosives	OP	3 yrs.	Ordnance Engineering
Fire Control	OF	3 yrs.	Ordnance Engineering
General	O,O2	2 yrs.	Ordnance Engineering
Guided Missiles	OG	3 yrs.	Ordnance Engineering
Industrial Engineering	O,O2,O3	3 yrs.	Ordnance Engineering
Jet Propulsion	OJ	3 yrs.	Ordnance Engineering
Special Physics	OX	3 yrs.	Ordnance Engineering

ADVANCED SCIENCE

Chemistry (RC), Applied Mathematics (RM), General Physics (RP) and Nuclear Physics (RX) Groups

OBJECTIVE

To prepare selected officers to deal with the problems of fundamental research in the separate natural sciences of chemistry, applied mathematics, general physics and nuclear physics. The basic education given is "fundamental" rather than "engineering" in character.

CURRICULA

The Advanced Science Curricula are sponsored by the Office of Naval Research and are under the cognizance of the Officer in Charge, Engineering Electronics Curricula. The chairmen of the departments of Chemistry and Metallurgy, Mathematics and Mechanics, and Electronics and Physics are the Academic Associates.

Officers nominated for the Advanced Science Curricula are selected from among the first-year students enrolled in the Engineering School of the U. S. Naval Postgraduate School who apply for these curricula. Applicants are carefully screened and only those having a very good academic background and who appear to have an excellent chance of succeeding in their chosen field are nominated.

Officers in the Advanced Science Curricula complete the first year of their curriculum in the Engineering School at the U. S. Naval Postgraduate School. The second and third years are spent at a civilian university selected by each of the officers with the advice of the appropriate academic associate at the U. S. Naval Postgraduate School and representatives of the Office of Naval Research. These officers spend the summer prior to entering the civilian universities on duty at the Office of Naval Research, Washington, D. C., familiarizing themselves with the work of the Office of Naval Research in the basic natural sciences, and preparing themselves for graduate school language requirements.

The curriculum at the civilian university for each officer is arranged by the student officer with the advice of his faculty advisor at the university, subject to approval by the Officer in Charge, Advanced Science Curricula. The courses are selected to suit the needs of the Navy, to develop the capabilities of the individual student and to meet the ultimate objective of his specialty.

The Advanced Science Curricula normally lead to the Master of Science degree for those officers meeting the requirements of the civilian universities for that degree and may, in exceptional cases for especially qualified officers, lead to a Doctor's degree.

AEROLOGICAL ENGINEERING

OBJECTIVE

To prepare officers to become qualified aerologists, with a working knowledge of oceanography as applied to naval operations.

FIRST YEAR (MA)

FIRST TERM

Ma-161(C)	Algebra, Trigonometry, and Analytic Geometry	5-0
Mr-200(C)	Introduction to Synoptic Meteorology	3-0
Mr-201(C)	Weather Maps and Codes	2-12
Ph-190(C)	Surveys of Physics I	3-0
		13-12

SECOND TERM

Ma-162(C)	Introduction to Calculus	5-0
Mr-202(C)	Surface Weather Map Analysis	2-12
Oc-101(C)	Introduction to Oceanography	2-1
Ph-191(C)	Survey of Physics II	3-0
		12-13

THIRD TERM

Ma-163(C)	Calculus and Vector Analysis	5-0
Mr-203(C)	Weather Analysis and Forecasting	2-12
Mr-301(C)	Synoptic Meteorology I	4-0
Mr-402(C)	Meteorological Charts and Diagrams	3-0
*SL-101	New Weapons Development I (Lecture)	0-1
		14-13

FOURTH TERM

Ma-381(C)	Elementary Probability and Statistics	4-2
Mr-204(C)	Upper Air Analysis and Forecasting	2-9
Mr-302(C)	Synoptic Meteorology II	4-0
Mr-510(C)	Climatology	2-0
Oc-201(C)	Physical Oceanography	2-0
*SL-102	New Weapons Developement II (Lecture)	0-1
		14-12

Field Trip during Intersessional Period

SECOND YEAR (MA2)

FIRST TERM

Mr-215(B)	Advanced Weather Analysis and Forecasting	0-12
Mr-303(C)	Synoptic Meteorology III	4-0
Mr-403(C)	Introduction to Physical Meteorology	4-0
Mr-410(C)	Meteorological Instruments	2-3
Mr-610(C)	Sea and Swell Forecasting	2-2
		12-17

SECOND TERM

Mr-110(C)	Radiological Defense	2-0
Mr-216(B)	Advanced Weather Analysis and Forecasting	2-12
Mr-217(B)	Upper Air Analysis and Forecasting	0-8
Oc-203(C)	Amphibious Oceanography	2-1
Oc-301(C)	Military Oceanography	2-1
		8-22

*Lecture course—no academic credit.

Successful completion of the above curriculum may lead to the award of the Bachelor of Science degree.

AEROLOGY

OBJECTIVE

To prepare selected junior officers to become qualified for limited aerological duties.

FIRST YEAR (M)

FIRST TERM

Ma-162(C)	Introduction to Calculus	5-0
Mr-402(B)	Meteorological Charts and Diagrams	3-0
Mr-200(C)	Introduction to Synoptic Meteorology	3-0
Mr-211(C)	Weather Codes, Maps and Elementary Surface Analysis	2-12
		13-12

SECOND TERM

Ma-163(C)	Calculus and Vector Analysis	5-0
Mr-212(C)	Surface Weather Map Analysis	2-12
Mr-311(B)	Synoptic Meteorology Ia	5-0
Mr-510(C)	Climatology	2-0
		14-12

THIRD TERM

Ma-361(C)	Statistics	4-2
Mr-213(B)	Weather Analysis and Forecasting	2-12
Mr-312(B)	Synoptic Meteorology IIa	5-0
Mr-403(B)	Physical Meteorology	4-0
		15-14

FOURTH TERM

Mr-110(C)	Radiological Defense	2-0
Mr-410(C)	Meteorological Instruments	2-3
Mr-216(B)	Advanced Weather Analysis and Forecasting	2-12
Mr-217(B)	Upper-air Analysis and Forecasting	0-8
Mr-610(C)	Sea and Swell Forecasting	2-2
		8-25

ADVANCED AEROLOGICAL ENGINEERING

OBJECTIVE

To supplement by advanced studies the previous technical education of selected aerological officers, prepare them for individual investigations in the field of research and development, and educate them in the latest aerological and oceanographic techniques which are applicable to naval problems and operations.

FIRST YEAR (MS)

FIRST TERM

Ma-131(C)	Algebraic Equations and Series	3-0
Ma-132(C)	Topics in Engineering Mathematics	5-0
Oc-111(B)	General Oceanography	3-1
Ph-196(C)	Review of General Physics	5-0
		16-1

SECOND TERM

Ma-103(B)	Functions of Several Variables and Vector Analysis	5-0
Mr-411(B)	Thermodynamics of Meteorology	5-2
Mr-412(A)	Physical Meteorology	3-0
Oc-311(C)	Oceanagraphic Factors in Underwater Sound	2-1
		15-3

THIRD TERM

Ma-134(B)	Vector Mechanics and Introduction to Statistics	5-0
Mr-226(B)	Advanced Weather Analysis and Forecasting	2-9
Mr-228(B)	Southern Hemisphere and Tropical Meteorology	2-0
Mr-321(A)	Dynamic Meteorology I	3-0
Mr-620(B)	Sea and Swell Forecasting	2-2
*SL-101	New Weapons Development I (Lecture)	0-1
		14-12

FOURTH TERM

Ma-331(A)	Statistics	4-2
Mr-227(B)	Upper Air Analysis and Forecasting	2-9
Mr-322(A)	Dynamic Meteorology II	3-0
Mr-323(A)	Dynamic Meteorology III (Turbulence and Diffusion	3-2
Mr-229(B)	Selected Topics in Meteorology	2-0
*SL-102	New Weapons Development II (Lecture)	0-1
		14-12

Field Trip during Intersessional Period.

SECOND YEAR (MS2)

FIRST TERM

Ma-135(B)	Partial Differential Equations and Numerical Methods	4-1
Mr-422(A)	The Upper Atmosphere	5-0
Mr-520(B)	Applied Climatology	2-2
	Thesis I	2-6
		13-9

SECOND TERM

Mr-110(C)	Radiological Defense	2-0
Oc-213(C)	Littoral Oceanography	2-2
Mr-230(A)	Operational Forecasting	0-10
Mr-810(A)	Seminar	2-0
	Thesis II	4-0
		10-12

*Lecture course--no academic credit.

Successful completion of the above curriculum normally leads to the award of the Master of Science degree.

AERONAUTICAL ENGINEERING

OBJECTIVE

To provide officers with advanced aeronautical engineering knowledge to meet the technical requirements of the Navy in this field. Specifically, these curricula are designed to cover the fundamental and advanced theories of mathematics, mechanics, metallurgy, structural analysis, aerodynamics, dynamics, and aircraft propulsion, electricity and electronics as they concern the particular curriculum.

AERONAUTICAL ENGINEERING, GENERAL

These curricula consist of two years of study at the Naval Postgraduate School, the last year of which includes a performance and flight test program. Qualified volunteers will be selected at the end of the fifth term to take the three-year curricula, the last year of which is spent at a civilian engineering school. Curricula for the third year at the various civilian institutions are arranged to provide emphasis on such fields as aircraft structural analysis, aircraft propulsion systems, compressibility, hydrodynamics and seaplane design, pilotless aircraft, aircraft performance, and nuclear engineering as well as general aeronautical engineering. Satisfactory completion of any three-year curriculum normally leads to the award of a graduate degree in aeronautical engineering.

FIRST YEAR (A) GROUPS

FIRST TERM

Ma-100(C)	Vector Algebra and Geometry	2-1
Ma-111(C)	Introduction to Engineering Mathematics	3-1
Mc-101(C)	Engineering Mechanics I	3-0
Ae-200(C)	Rigid Body Statics of Aircraft	3-2
Ch-121(B)	General and Petroleum Chemistry	4-2
Mt-201(C)	Introductory Physical Metallurgy	3-2
		18-8

SECOND TERM

Ma-112(B)	Differential Equations and Boundary Value Problems	4-0
Mc-102(C)	Engineering Mechanics II	2-2
Ae-211(C)	Stress Analysis I	4-0
Ae-100(C)	Basic Aerodynamics	3-4
Mt-202(C)	Ferrous Metals	3-2
Me-601(C)	Materials Testing Laboratory	0-2
*Ae-001	Aeronautical Lecture	0-1
		16-11

THIRD TERM

Ma-113(B)	Vector Analysis and Introduction to Partial Differential Equations	3-0
Ae-212(C)	Stress Analysis II	4-2
Ae-121(C)	Technical Aerodynamics	3-2
Mt-203(B)	Physical Metallurgy	2-2
Ma-201(C)	Graphical and Mechanical Computations	0-2
EE-111(C)	Fundamentals of Electrical Engineering	3-2
*SL-101	New Weapons Development I (Lecture)	0-1
		15-11

FOURTH TERM

Ma-114(A)	Partial Differential Equations and Functions of a Complex Variable	3-0
Ae-213(B)	Stress Analysis III	4-2
Ae-131(C)	Aerodynamics Performance	4-2
ME-131(C)	Engineering Thermodynamics	4-2
EE-351(C)	DC Machinery	2-2
*SL-102	New Weapons Development II (Lecture)	0-1
		17-9

*Lecture course—no academic credit.

Note: Approximately six weeks of June and July 1954, Intersessional Period, will be spent in the field at aviation activities.

SECOND YEAR (AG2) GROUP

FIRST TERM

Ae-311(C)	Airplane Design I	2-4
Ae-132(B)	Flight Analysis	3-2
Ae-410(B)	Thermodynamics (Aeronautical)	3-2
Ae-501(A)	Hydro-Aero Mechanics I	4-0
EE-241(C)	AC Circuits	3-2
*IE-101(C)	Principles of Industrial Organization (Lecture)	0-1
		15-11

SECOND TERM

Ae-141(A)	Aircraft Dynamics I	3-4
Ae-151(B)	Flight Testing and Evaluation I	2-0
Ae-161(B)	Flight Testing and Evaluation Laboratory I	0-4
Ae-411(B)	Aircraft Engines	4-2
Ae-502(A)	Hydro-Aero Mechanics II	4-0
*Ae-001	Aeronautical Lecture	0-1
		13-11

THIRD TERM

Ae-142(A)	Aircraft Dynamics II	3-4
Ae-152(B)	Flight Testing and Evaluation II	2-0
Ae-162(B)	Flight Testing and Evaluation Laboratory II	0-4
Ae-421(B)	Aircraft Propulsion	3-2
EE-611(B)	Servomechanisms	3-4
*SL-101	New Weapons Development I (Lecture)	0-1
*IE-103(C)	Applied Industrial Organization (Lecture)	0-1
		11-16

FOURTH TERM

Ae-153(B)	Flight Testing and Evaluation III	2-0
Ae-163(B)	Flight Testing and Evaluation Laboratory III	0-8
Ae-508(A)	Compressibility	3-2
EE-711(C)	Electronics	3-2
		8-12

*Lecture course—no academic credit.

If practicable, a summer period will be spent in a civilian institution summer course in industrial engineering before reporting to a new duty station.

SECOND YEAR (A2) GROUPS

FIRST TERM

Ae-311(C)	Airplane Design I	2-4
Ae-132(B)	Flight Analysis	3-2
Ae-410(B)	Thermodynamics (Aeronautical)	3-2
Ae-501(A)	Hydro-Aero Mechanics I	4-0
EE-241(C)	AC Circuits	3-2
*IE-101(C)	Principles of Industrial Organization (Lecture)	0-1
		15-11

SECOND TERM

Ae-141(A)	Aircraft Dynamics I	3-4
Ae-411(B)	Aircraft Engines	4-2
Ae-502(A)	Hydro-Aero Mechanics II	4-0
Ae-214(A)	Stress Analysis IV	3-0
Ae-312(B)	Airplane Design II	1-4
*Ae-001	Aeronautical Lecture	0-1
		15-11

THIRD TERM

Ae-142(A)	Aircraft Dynamics II	3-4
Ae-421(B)	Aircraft Propulsion	3-2
Ae-503(A)	Compressibility I	4-0
**Ch-521(A)	Chemistry of Plastics	3-2
Ma-116(A)	Matrices and Numerical Methods	4-0
*SL-101	New Weapons Development I (Lecture)	0-1
*IE-103(C)	Applied Industrial Organization (Lecture)	0-1
		17-10

FOURTH TERM

Ae-431(A)	Internal Flow in Aircraft Engines	4-0
Ae-215(A)	Advanced Stress Analysis	4-0
Ae-504(A)	Compressibility II	3-2
Mc-311(A)	Vibrations	3-2
**ME-622(B)	Experimental Stress Analysis	2-2
*IE-104(C)	Technical Lectures	0-1
*SL-102	New Weapons Development II (Lecture)	0-1
		16-8

*Lecture Course—no academic credit.

**Propulsion group takes Ch-561(A) Physical Chemistry (3-2) and Flight Performance group takes Ma-118(A) in place of ME-622(B) 4th term.

Nuclear Engineering group takes Atomic Physics, Ph-640(B) (3-3) in place of ME-622(B) 4th term, and Quantitative Analysis, Ch-231(C) (2-4) in place of Ch-521(A) 3rd term.

THIRD YEAR CURRICULA

Aeronautical Engineering, General

THIRD YEAR (A3) AT THE UNIVERSITY OF MICHIGAN

FALL TERM

Ae-116 Advanced Fluid Dynamics
Ae-172 Instrumentation and Research
*Ae-118 Experimental Aerodynamics
*Ae-174 Atomic Physics
*Ae-105 Dynamic Stability
*EM-123 Theory of Strength
*MA-152 Mathematics—Fourier Series
*Ae-133 Advanced Airplane Structures
*Ae-250 Theory of Non-linear Oscillations
Ae-162 Thesis
*Elective Courses

SPRING TERM

*Ae-102 Advanced Design
Ae-160-2 Symposium—Propulsion
Ae-162 Thesis
*Ae-165 Aircraft Propulsion I
*Ae-171 Aircraft Servo Control Systems
*Ae-202 Dynamics of Compressible Fluids
*Ae-203 Dynamics of Perfect Fluids
*Ae-204 Aircraft Propulsion II
*EM-129 Plasticity

*Elective Courses

SECOND AND THIRD YEAR (A2 and A3) AT THE COLLEGE OF AERONAUTICS, CRANFIELD, ENGLAND

At the end of the first year of work in the A curriculum at the Postgraduate School certain students may be selected for study at the College of Aeronautics. Students selected may choose a curriculum from the following options:

Aerodynamics
Aircraft Design
Aircraft Propulsion
Aircraft Economics and Production
Aircraft Electronics

Aeronautical Engineering, Aerodynamics

THIRD YEAR (AC3) CALIFORNIA INSTITUTE OF TECHNOLOGY

Ae-260 Research
Ae-261 Hydrodynamics of Compressible Fluids
Ae-266 Real and Perfect Fluids
Ae-265 Adv. Problems in Aerodynamics
Ae-271 Exper. Methods in Aeronautics
Ae-269 Seminar in Fluid Mechanics
Ae-290 Aeronautical Seminar

THIRD YEAR (AC3) AT UNIVERSITY OF MINNESOTA

FALL TERM

*Ae-116 Advanced Airplane Stresses
**Ae-201 Aerodynamics of Compressible Flow
Ae-220 High Speed Performance and Design
Ae-280 Thesis

WINTER TERM

Ae-117 Advanced Airplane Stresses
Ae-202 Compressible Fluids
Ae-203 High Speed Performance and Design
Ae-280 Thesis

SPRING TERM

Ae-119 Structural Test of Aircraft
Ae-204 Supersonic Aerodynamics Laboratory
ME-253 Advanced Gas Turbines
Ae-280 Thesis

*Candidates who have taken Ae-213(B), Stress Analysis, at the U. S. Naval Postgraduate School, and received a grade of B or better, may apply for transfer credit.

**Candidates who have taken Ae-503(A), Compressibility, at the U. S. Naval Postgraduate School, and received a grade of B or better, may apply for transfer credit.

In case transfer credit is granted for either or both of these subjects, they will not be taken and course Ae-204, Supersonic Aerodynamics Laboratory, will be taken in the Fall Term in order to leave the Spring Term more free for thesis work.

Aeronautical Engineering, Flight Performance

THIRD YEAR (AF3) AT PRINCETON UNIVERSITY

FALL TERM

EE-316(a) Electronics
AE-565 Airplane Dynamics
AE-567 Helicopter Analysis
AE-583 Advanced Airplane Performance Thesis

SPRING TERM

AE-566 Airplane Dynamics
AE-568 Helicopter Analysis
EE-528 Servomechanisms Thesis
Plus one elective

Aeronautical Engineering, Seaplane Hydrodynamics

THIRD YEAR (CH3) AT STEVENS INSTITUTE OF TECHNOLOGY AND NEW YORK UNIVERSITY

FALL TERM

FD-203 Mechanics of Fluid Resistance
FD-204 Hydrodynamic Theory
FD-215 Seaplane Design I
*FD-217 Marine and Aircraft Propulsion I
*FD-213 Special Problems, Fluid Dynamics I
*MA-517 Ordinary and Partial Differential Equations
*MA-519 Advanced Calculus I
*AE-206 Applied Elasticity
AE-209 Advanced Stress Analysis
Thesis

SPRING TERM

FD-210 Experimental Mathematics in Hydrodynamics
FD-211 Mechanics of Bodies in Fluids
FD-216 Seaplane Design II
*FD-218 Marine and Aircraft Propulsion II
*FD-214 Special Problems, Fluid Dynamics II
*MA-520 Advanced Calculus II
*AE-117 Aircraft Structural Laboratory
AE-210 Aircraft Stress Analysis
Thesis
*Elective courses

Aeronautical Engineering, Industrial

THIRD YEAR (AI3) AT PURDUE UNIVERSITY

FALL TERM

GE-128 Motion and Time Study
GE-183 Production Planning
GE-184 Tool Design
GE-117 Industrial Relations
GE-91 Elements of Accounting
Psych-173 Personal Psychology

SPRING TERM

Psych-173 Personal Psychology
GE-185 Production Control
GE-186 Plant Layout
GE-229 Thesis
Psych-175 Psychology of Industrial Training

Aeronautical Engineering, Jet Propulsion

THIRD YEAR (AJ3) AT CALIFORNIA INSTITUTE OF TECHNOLOGY

Ae-261 Hydrodynamics of Compressible Fluids
Ae-271 Experimental Methods in Aeronautics
JP-121 Rockets
JP-130 Thermal Jets
JP-200 Chemistry Problems in Jet Propulsion
JP-280 Research in Jet Propulsion
Ae-290 Aeronautics Seminar

THIRD YEAR (AJ3) AT UNIVERSITY OF MINNESOTA

FALL TERM

*AE-116 Advanced Airplane Stresses
**AE-201 Aerodynamics of Compressible Fluids
ME-252 Advanced Reciprocating Engines
Thesis

WINTER TERM

AE-117 Advanced Airplane Stresses
AE-202 Compressible Fluids
ME-253 Advanced Gas Turbines
Thesis

SPRING TERM

AE-119 Structural Test of Aircraft
AE-204 Supersonic Aerodynamics Laboratory
ME-255 Thermal Jets and Rockets
Thesis

*Candidates who have taken Ae-213(B), Stress Analysis, at the U. S. Naval Postgraduate School, and received a grade of B or better, may apply for transfer credit.

**Candidates who have taken Ae-503(A), Compressibility, at the U. S. Naval Postgraduate School, and received a grade of B or better, May apply for transfer credit.

In case transfer credit is granted for either or both of these subjects they will not be taken and course Ae-204, Supersonic Aerodynamics Laboratory, will be taken in the Fall Term in order to leave the Spring Term more free for thesis work.

THIRD YEAR (AJ3)AT PRINCETON UNIVERSITY

FALL TERM

AE-563 Jet Propulsion
AE-581 Gas Dynamics
AE-587 Rockets
AE-589 Fluid Friction and Heat Transfer
Thesis

SPRING TERM

AE-564 Jet Propulsion
AE-582 Gas Dynamics
AE-589 Fluid Friction and Heat Transfer
AE-586 Combustion Problems in Jet Propulsion, or, Mechanical Aspects of Jet Engines
Thesis

Aeronautical Engineering, Nuclear Engineering

THIRD YEAR (AN3) AT IOWA STATE COLLEGE

FALL TERM

Engg.-501 Elements of Nuclear Engineering
Engg.-620 Seminar
Lib.-614 Bibliographical Research
Phys.-435 Nuclear Physics for Engineers
*ME-325 Heat Transfer
Chem.-529 Radiochemistry
Engg.-600 Research

WINTER TERM

Engg.-502 Reactor Materials and Structures
Phys.-346 Nuclear Physics for Engineers
Chem.-529 Radiochemistry
**Engg.-600 Research

SPRING TERM

Engg.-503 Reactor Fuels and Wastes
Engg.-504 Reactor Design
Engg.-600 Research

*Technical elective to be substituted if candidate has credit in ME-325.

**Physics-422 (Quantum Mechanics) may be substituted for 3 credits of Engg.-600.

THIRD YEAR (AN3) AT OAK RIDGE SCHOOL OF REACTOR TECHNOLOGY

Reactor Chemistry	36 hours
Nuclear Physics	36 or 72 hours
Reactor Theory	186 hours
Experimental Reactor Physics	90 hours
Metallurgy and Ceramics	72 hours
Engineering	36 or 72-hours
Reactor Engineering	72 hours
Reactor Design Problems or Component Development Research	500 hours

Aeronautical Engineering, Propulsion Systems

THIRD YEAR (AP3) AT MASSACHUSETTS INSTITUTE OF TECHNOLOGY

FALL TERM

2.213 Gas Turbines
2.797T Internal Combustion Engines, Advanced
10.70 Combustible Principles
16.105 Applied Aerodynamics
Thesis

SPRING TERM

2.212 Advanced Mechanics
2.798T Internal Combustion Engines, Advanced
16.56 Jet Propulsion Engines
Thesis

Aeronautical Engineering, Structures

THIRD YEAR (AS3) AT CALIFORNIA INSTITUTE OF TECHNOLOGY

Ae-260 Research
Ae-270 Elasticity Applied to Aeronautics
Ae-271 Experimental Methods in Aeronautics
Ae-274 Aeroelasticity
Ae-275 Seminar in Solid Mechanics
Ae-290 Aeronautics Seminar
AM-150 Vibration and Flutter

THIRD YEAR (AS3) AT UNIVERSITY OF MINNESOTA

FALL TERM

*Ae-116 Advanced Airplane Stresses
**Ae-201 Aerodynamics of Compressible Fluids
Ae-240 Dynamics of Airplane Structures
Ae-280 Thesis

WINTER TERM

Ae-117 Advanced Airplane Stresses
Ae-202 Compressible Fluids
Ae-241 Dynamics of Aircraft
Ae-280 Thesis

SPRING TERM

Ae-118 Stresses in Aircraft Structures
Ae-204 Supersonic Aerodynamics Laboratory
Ae-119 Structural Test of Aircraft
Ae-280 Thesis

*Candidates who have taken Ae-213(B), Stress Analysis, at the U. S. Naval Postgraduate School, and received a grade of B or better, may apply for transfer credit.

**Candidates who have taken Ae-503(A), Compressibility, at the U. S. Naval Postgraduate School, and received a grade of B or better, may apply for transfer credit.

In case transfer credit is granted for either or both of these subjects, they will not be taken, and course Ae-204, Supersonic Aerodynamics Laboratory, will be taken in the Fall Term in order to leave the Spring Term more free for thesis work.

AERONAUTICAL ENGINEERING, ARMAMENT

This curriculum consists of two years of study at the Postgraduate School. Selected students will continue for a third year of study at the Massachusetts Institute of Technology. Satisfactory completion of the three-year curriculum normally leads to the award of a graduate degree. This curriculum is designed to cover electrical, aeronautical, and mechanical engineering subjects and related mathematics, metallurgy, electronics, and ordnance courses. The third year at Massachusetts Institute of Technology majors in guided missile electronics controls and fire control systems.

FIRST YEAR (AR) GROUP

FIRST TERM

EE-151(C)	DC Circuits and Fields	3-4
Ma-100(C)	Vector Algebra and Geometry	2-1
Ma-111(C)	Introduction to Engineering Mathematics	3-1
Mc-101(C)	Engineering Mechanics I	3-0
Ae-200(C)	Rigid Body Statics of Aircraft	3-2
Ch-101(C)	General Inorganic Chemistry	3-2
		17-10

SECOND TERM

EE-251(C)	AC Circuits	3-4
Ma-112(B)	Differential Equations and Boundary Value Problems	4-0
Mc-102(C)	Engineering Mechanics II	2-2
Ae-211(C)	Stress Analysis I	4-0
Ae-100(C)	Basic Aerodynamics	3-4
*Ae-001	Aeronautical Lecture	0-1
		16-11

THIRD TERM

EE-451(C)	Transformers and Synchros	2-2
Ma-113(B)	Vector Analysis and Introduction to Partial Differential Equations	3-0
Mt-201(C)	Introductory Physical Metallurgy	3-2
Ae-212(C)	Stress Analysis II	4-2
Ae-121(C)	Technical Aerodynamics	3-2
Ma-201(C)	Graphic and Mechanical Computation	0-2
*SL-101	New Weapons Development I (Lecture)	0-1
		15-11

FOURTH TERM

EE-455(C)	Asynchronous Motors	2-2
Ma-114(A)	Partial Differential Equations and Functions of a Complex Variable	3-0
Mt-202(C)	Ferrous Physical Metallurgy	3-2
Ae-213(B)	Stress Analysis III	4-2
Ae-136(B)	Aircraft Performance	3-2
*SL-102	New Weapons Development II (Lecture)	0-1
		15-9

*Lecture course—no academic credit.
Six weeks intersessional period in the field.

SECOND YEAR (AR2) GROUP

FIRST TERM

Ma-105(A)	Fourier Series and Boundary Value Problems	4-0
Ae-501(A)	Hydro-Aero Mechanics I	4-0
Ae-311(C)	Aircraft Design	2-4
EE-551(B)	Transmission Lines and Filters	3-2
EE-751(C)	Electronics	3-4
*IE-101(C)	Principles of Industrial Organization (Lecture)	0-1
		16-11

SECOND TERM

Ma-106(A)	Complex Variable and Laplace Transform	4-0
Mc-201(A)	Methods in Dynamics	2-2
Mc-402(A)	Dynamics of Missiles and Gyros	3-0
Ae-502(A)	Hydro-Aero Mechanics II	4-0
EE-755(A)	Electronic Control and Measurement	3-4
*Ae-001	Aeronautical Lecture	0-1
		16-7

THIRD TERM

EE-671(A)	Transients	3-4
Mc-401(A)	Exterior Ballistics	3-0
Or-141(C)	Guided Missiles Guidance	2-0
Ae-508(A)	Compressibility	3-2
Ae-146(C)	Aircraft Dynamics	3-2
*SL-101	New Weapons Development I (Lecture)	0-1
*IE-103(C)	Applied Industrial Organization (Lecture)	0-1
		14-10

*Lecture course—no academic credit.

FOURTH TERM

EE-672(A)	Servomechanisms	3-3
Es-456(C)	Introduction to Radar (Airborne)	2-2
Ma-401(A)	Mechanical Computers	2-2
Mt-203(B)	Physical Metallurgy	2-2
Or-142(C)	Guided Missiles Guidance	2-0
*IE-104(C)	Technical Lectures	0-1
*SL-102	New Weapons Development II (Lecture)	0-1
		11-11

Summer period will be spent in a civilian institution summer course in industrial engineering.

THIRD YEAR (AR3) AT MASSACHUSETTS INSTITUTE OF TECHNOLOGY

FALL TERM

16.47 Projectiles, Missiles and Rockets
13.39T Vector Kinematics and Gyroscopic Instrument Theory
16.15 Advanced Stability and Control of Aircraft
16.41 Fire Control Principles
16.43 Fire Control Instrument Laboratory

SPRING TERM

16.42 Fire Control Systems
16.44T Advanced Fire Control Instruments Laboratory
16.40T Automatic Control Equipment for Aircraft
Thesis

AERONAUTICAL ENGINEERING, ELECTRICAL

This curriculum consists of two years of study at the Naval Postgraduate School. Selected students will continue for a third year of study at the Naval Postgraduate School. Satisfactory completion of the three-year curriculum normally leads to the award of a graduate degree in electrical engineering. This curriculum is designed to provide major emphasis on electricity and is supported by aeronautics, mathematics, metallurgy, electronics, and mechanics. The objective of this curriculum is to provide electrical engineers who will have a good understanding of aeronautical engineering.

FIRST YEAR (AE) GROUP

FIRST TERM

Ma-100(C)	Vector Algebra and Geometry	2-1
Ma-111(C)	Introduction to Engineering Mathematics	3-1
EE-171(C)	Electric Circuits and Fields	3-4
Mc-101(C)	Engineering Mechanics I	3-0
Ae-200(C)	Rigid Body Statics of Aircraft	3-2
Ch-101(C)	General Inorganic Chemistry	3-2
		17-10

SECOND TERM

Ma-112(B)	Differential Equations and Boundary Value Problems	4-0
EE-271(C)	AC Circuits	3-2
Mc-102(C)	Engineering Mechanics II	2-2
Ae-211(C)	Stress Analysis I	4-0
Ae-100(C)	Basic Aerodynamics	3-4
*Ae-001	Aeronautical Lecture	0-1
		16-9

THIRD TERM

Ma-113(B) Vector Analysis and Introduction to to Partial Differential Equations ---------- 3-0
EE-272(B) AC Circuits ---------- 2-2
Mt-201(C) Introductory Physical Metallurgy ---------- 3-2
Ae-212(C) Stress Analysis II ---------- 4-2
Ae-121(C) Technical Aerodynamics I ---------- 3-2
Ma-201(C) Graphical and Mechanical Computation ---------- 0-2
*SL-101 New Weapons Development I (Lecture) ---------- 0-1

15-11

*Lecture course—no academic credit.

FOURTH TERM

Ma-114(A) Partial Differential Equations and Functions of a Complex Variable ---------- 3-0
EE-371(C) DC Machinery ---------- 3-2
Mt-202(C) Ferrous Physical Metallurgy ---------- 3-2
Ae-213(B) Stress Analysis III ---------- 4-2
Ae-136(B) Aircraft Performance ---------- 3-2
*SL-102 New Weapons Development II (Lecture) ---------- 0-1

16-9

Six weeks intersessional period in the field at an aviation test activity.

SECOND YEAR (AE2) GROUP

FIRST TERM

Ma-105(A) Fourier Series and Boundary Value Problems ---------- 4-0
EE-471(C) Transformers and Asynchronous Machines ---------- 3-4
Ae-311(C) Aircraft Design ---------- 2-4
Ae-501(A) Hydro-Aero Mechanics I ---------- 4-0
*IE-101(C) Principles of Industrial Organization (Lecture) ---------- 0-1

13-9

SECOND TERM

Ma-106(A) Complex Variable and Laplace Transform ---------- 4-0
EE-472(C) Synchronous Machines and Synchros ---------- 3-4
EE-971(A) Seminar ---------- 1-0
Mc-201(A) Methods in Dynamics ---------- 2-2
Ae-502(A) Hydro-Aero Mechanics II ---------- 4-0
*Ae-001 Aeronautical Lecture ---------- 0-1

14-7

THIRD TERM

Ae-508(A) Compressibility ---------- 3-2
Ae-146(A) Aircraft Dynamics ---------- 3-2
EE-571(B) Transmission Lines and Filters ---------- 3-4
EE-771(B) Electronics ---------- 3-2
EE-971(A) Seminar ---------- 1-0
*SL-101 New Weapons Development I (Lecture) ---------- 0-1
*IE-103 Applied Industrial Organization (Lecture) ---------- 0-1

13-12

FOURTH TERM

Ch-521(A) Platics ---------- 3-2
EE-671(A) Transients ---------- 3-4
EE-772(B) Electronics ---------- 3-2
EE-971(A) Seminar ---------- 1-0
Mt-203(B) Physical Metallurgy ---------- 2-2
*IE-104(C) Technical Lectures ---------- 0-1
*SL-102 New Weapons Development II (Lecture) ---------- 0-1

12-12

*Lecture course—no academic credit.

THIRD YEAR (AE3) GROUP

FIRST TERM

EE-672(A) Servomechanisms ---------- 3-3
EE-871(A) Electrical Machine Design ---------- 4-0
Es-326(A) Radio Systems ---------- 3-3
Es-227(B) Ultra-High Frequency Tubes ---------- 3-2
Thesis ---------- 0-3

13-11

SECOND TERM

EE-872(A) Electrical Machine Design ---------- 4-0
EE-971(A) Seminar ---------- 1-0
Es-421(B) Radar Fundamentals ---------- 2-3
Thesis ---------- 0-10

7-13

THIRD TERM

EE-873(A) Electrical Machine Design ---------- 4-0
EE-971(A) Seminar ---------- 1-0
Es-422(B) Radar System Engineering ---------- 3-3
Thesis ---------- 0-10

8-13

FOURTH TERM

EE-874(A) Electrical Machine Design ---------- 4-0
EE-971(A) Seminar ---------- 1-0
Es-423(B) Radar System Engineering ---------- 3-6
Es-536(B) Counter Measures ---------- 2-3
Thesis ---------- 0-6

10-15

COMMUNICATIONS

OBJECTIVE

To prepare officers for communications, operations and staff duties, and to fit them better for command duties.

This curriculum majors in practical communications, operations, tactics and electronics. Students are required to enroll in Naval War College correspondence course in Strategy and Tactics, and to complete the first four assignments prior to graduation.

C-GROUP

FIRST TERM

Co-101(C)	Typing and Radiotelegraph Code	0-4
Co-111(C)	Radiotelegraph and Visual Procedure	2-2
Co-121(C)	Security of Classified Matter and Registered Publication Handling	2-1
Co-131(C)	Tactics	2-2
Co-135(C)	Correspondence Course in Strategy and Tactics	
Es-186(C)	Fundamentals of Radio Communications	4-4
Es-281(C)	Electronics Fundamentals	2-2
		12-15

SECOND TERM

Co-102(C)	Radiotelegraph Code and Procedure	0-3
Co-112(C)	Tape Relay and Toll Traffic Procedure	2-1
Co-122(C)	Communication Planning	2-1
Co-132(C)	Tactics	2-2
Co-135(C)	Correspondence Course in Strategy and Tactics	
Es-282(C)	Vacuum Tube Circuits	4-4
Es-786(C)	RF Energy Transmission	3-2
		13-13

THIRD TERM

Co-103(C)	Visual and Radiotelephone Procedure	1-3
Co-113(C)	International and Commercial Communications	1-1
Co-123(C)	Communication Planning	2-2
Co-133(C)	Tactics	2-2
Co-135(C)	Correspondence Course in Strategy and Tactics	
Es-283(C)	Vacuum Tube Circuits	4-3
Es-286(C)	Pulsing and High Frequency Circuits	3-2
*SL-101	New Weapons Development I (Lecture)	0-1
		13-14

FOURTH TERM

Co-104(C)	Military Communication Organizations	1-1
Co-114(C)	Correspondence and Mail	1-1
Co-115(C)	Cryptosystems	0-3
Co-124(C)	Communication Planning	1-2
Co-134(C)	Tactics	2-2
Co-135(C)	Correspondence Course in Strategy and Tactics	
Es-386(C)	Transmitters and Receivers	3-3
Es-586(C)	Special Systems	3-3
*SL-102	New Weapons Development II (Lecture)	0-1
		11-16

*Lecture course—no academic credit.

COMMUNICATION OFFICERS SHORT COURSE CURRICULUM

OBJECTIVE

To educate officers in the operational aspects of communications and to qualify them for positions of responsibility in the communication organization afloat. Graduates are qualified to serve as communication officers of auxiliary types and destroyers or as assistant communication officers of large ships and staffs.

This curriculum extends over a period of twelve academic weeks. Sections will convene during fiscal 1954 on the following dates.

6 July 1953	26 October 1953	8 March 1954	7 June 1954
3 August 1953	11 January 1954	5 April 1954	28 June 1954
31 August 1953	8 February 1954	3 May 1954	

CS-Group

Co-150(C)	Communication Procedures	68 hours
Co-151(C)	Security	32 hours
Co-152(C)	Cryptography	38 hours
Co-153(C)	Communication Plans	56 hours
Co-154(C)	Miscellaneous Communication Subjects	24 hours
Co-155(C)	Typing, Radiotelephone Code, and Radiotelephone Operating	32 hours
Co-160(C)	Tactics	74 hours
	Total Classroom Hours	324 hours

OBJECTIVE

To give the student a thorough practical and theoretical training in engineering electronics in preparation for future duties involving the development and use of electronics equipment and systems in the Naval Establishment.

THREE-YEAR CURRICULUM

(Presented at graduate level)

FIRST YEAR (E)

FIRST TERM

Es-111(C)	DC and AC Electric Circuits	4-5
Es-616(C)	Electric and Magnetic Fields	2-2
Ma-100(C)	Vector Algebra and Geometry	2-1
Ma-101(C)	Introduction to Engineering Mathematics	3-0
Ph-211(C)	Optics	3-0
*IE-101(C)	Principles of Industrial Organization (Lecture)	0-1
		14-9

SECOND TERM

Es-112(C)	AC Electricity	2-0
Es-212(C)	Electron Tubes and Circuits	4-6
Ma-102(C)	Differential Equations and Series	5-0
Ph-212(B)	Physical Optics and Introductory Dynamics	3-3
		14-9

THIRD TERM

Es-113(C)	Circuit Analysis and Measurements	3-3
Es-213(C)	Electron Tubes and Circuits	4-3
Ma-103(B)	Functions of Several Variables and Vector Analysis	5-0
Ph-113(B)	Dynamics	3-0
*IE-103(C)	Applied Industrial Organization (Lecture)	0-1
*SL-101	New Weapons Development I (Lecture)	0-1
		15-8

*Lecture course—no academic credit.

FOURTH TERM

Es-114(C)	Circuit Analysis and Measurements	3-3
Es-214(C)	Electron Tubes and Circuits	4-3
Ma-104(A)	Partial Differential Equations and Related Topics	5-0
Ph-311(B)	Electrostatics and Magnetostatics	3-0
*IE-104(C)	Technical Lectures	0-1
*SL-102	New Weapons Development II (Lecture)	0-1
		15-8

Intersessional Field Trip; summer leave period.

SECOND YEAR (E2)

FIRST TERM

Es-225(A)	Electron Tubes	3-6
Es-621(A)	Electromagnetics	3-0
EE-314(C)	D and AC Machinery	3-4
Ph-421(A)	Fundamental Acoustics	3-0
		12-10

SECOND TERM

Es-121(A)	Advanced Circuit Theory	3-2
Es-126(C)	Radio-Frequency Measurements	2-6
Es-622(A)	Electromagnetics	4-0
Ph-422(A)	Applied Acoustics	3-0
		12-8

THIRD TERM

Es-122(A)	Advanced Circuit Theory	3-2
Es-321(B)	Radio Systems	3-3
Es-623(A)	Electromagnetics	4-0
Ph-423(A)	Underwater Acoustics	2-3
		12-8

Intersessional Field Trip; summer leave period.

FOURTH TERM

Es-123(A)	Advanced Circuit Theory	3-0
Es-226(A)	Ultra-High-Frequency Techniques	4-3
Es-322(B)	Radio Systems	3-3
Es-624(A)	Electromagnetics	3-0
		13-6

The B.S. degree in Engineering Electronics is normally awarded at the end of the second year of this curriculum to students meeting the requirements for that degree.

THIRD YEAR (E3)

FIRST TERM

Es-134(A)	Advanced Circuit Theory	3-0
Es-333(B)	Radio Systems	2-3
Es-431(B)	Radar System Engineering	3-3
Es-736(B)	Antennas, Transmission Lines	3-3
		11-9

SECOND TERM

Es-432(B)	Radar System Engineering	3-6
Es-531(B)	Special Systems	3-3
EE-672(A)	Servomechanisms	3-3
	Thesis	2-0
		11-12

THIRD TERM

This term is spent in an industrial electronics laboratory, such as Bell Telephone Laboratories, R.C.A., or General Electric Company. During this period the student works as a junior engineer or physicist on a selected project which forms part of, or is related to his thesis.

FOURTH TERM

Es-036(C)	Electronics Administration	2-0
Es-532(B)	Special Systems	3-3
Es-836(A)	Project Seminar	1-0
Ph-631(B)	Atomic Physics	4-0
	Thesis	4-0
		14-3

The M.S. degree in Engineering Electronics is normally awarded at the end of the third year of this curriculum to students meeting the requirements for that degree.

TWO-YEAR CURRICULUM

(Presented at undergraduate level)

FIRST YEAR (E)

Follow first year (E) of three-year curriculum.

SECOND YEAR (EA2)

FIRST TERM

Es-227(C)	Ultra-High-Frequency Techniques	3-2
Es-326(B)	Radio Systems	3-3
EE-314(C)	DC and AC Machinery	3-4
Ph-427(B)	Fundamental and Applied Acoustics	4-0
		13-9

SECOND TERM

Es-126(C)	Radio Frequency Measurements	2-6
Es-327(B)	Radio Systems	4-3
Es-421(B)	Pulse Techniques	2-3
Ph-428(B)	Underwater Acoustics	2-3
		10-15

THIRD TERM

Es-328(B)	Radio Systems	2-3
Es-422(B)	Radar System Engineering	3-3
Es-521(B)	Special Systems	3-3
Es-721(B)	Antennas and Wave Propagation	3-3
		11-12

FOURTH TERM

Es-036(C)	Electronics Administration	2-0
Es-423(B)	Radar System Engineering	3-6
Es-522(B)	Special Systems	3-3
Es-722(B)	Antennas and Wave Propagation	3-3
		11-12

The B.S. degree in Engineering Electronics is normally awarded at the end of the second year of this curriculum to students meeting the requirements for that degree.

ENGINEERING ELECTRONICS (SONAR)

OBJECTIVE

To give the student a thorough practical and theoretical training in engineering electronics and acoustics in preparation for future duties involving the development and use of underwater electronics equipment and systems in the Naval Establishment.

FIRST YEAR (E)

Follow first year (E) of three-year curriculum.

MINE WARFARE CURRICULUM

SECOND YEAR (E2)

Follow second year (E2) of three-year curriculum except substitute Ph-424(A) Sonar Systems and Developments for Es-322(B) Radio Systems. A Bachelor of Science degree in Engineering Electronics is normally awarded at the end of the second year to students meeting the requirements for that degree.

THIRD YEAR (EW3) AT UNIVERSITY OF CALIFORNIA AT LOS ANGELES

FALL SEMESTER

Phys 114C Acoustics Laboratory
Phys 124 Nuclear Physics
Phys 214 Advanced Acoustics
Phys 220A Theoretical Mechanics

SPRING SEMESTER

Phys 112 Heat
Phys 264 Advanced Acoustics Seminar
Phys 266 Propagation of Waves in Fluids
Phys 284 Experimental Techniques in Acoustics
Phys 290 Acoustics Research
X-141 ABC Principles of Transducer Design and Evaluation

The degree of Master of Science (Applied Physics) is normally awarded by UCLA to students meeting the requirements for that degree.

MINE WARFARE CURRICULUM

OBJECTIVE

To train officers in the various phases of mine warfare in order that they may have a basic knowledge of mines and mine countermeasures; assist in the development of mines and mine countermeasures; advise commanders afloat in matters concerning mining and mine countermeasures.

FIRST YEAR (RW)

FIRST TERM

Ch-101(C)	General Inorganic Chemistry	3-2
Es-141(C)	DC Electricity	4-4
Ma-100(C)	Vector Algebra and Geometry	2-1
Ma-111(C)	Introduction to Engineering Mathematics	3-1
Mc-101(C)	Engineering Mechanics I	2-2
		14-10

SECOND TERM

Es-142(C)	AC Electricity	4-3
Ma-112(B)	Differential Equations and Boundary Value Problems	4-0
Mc-102(C)	Engineering Mechanics II	2-2
ME-500(C)	Strength of Materials	3-0
ME-601(C)	Materials Testing Lab	0-2
		13-7

THIRD TERM

Es-261(C)	Electronic Tubes and Circuits	3-2
Ma-113(B)	Vector Analysis and Partial Differential Equations	3-0
Mt-301(C)	Introduction to Physical Metallurgy	3-2
Oc-101(C)	Introduction to Oceanography	2-1
Or-191(C)	Mines and Mine Mechanisms	2-0
Ph-610(B)	Atomic Physics	3-0
*IE-103(C)	Applied Industrial Organization	0-1
		16-6

FOURTH TERM

Es-262(C)	Electronic Tubes and Circuits	3-2
Ma-114(A)	Partial Differential Equations and Complex Variables	3-0
Mt-202(C)	Ferrous Physical Metallurgy	3-2
Or-104(C)	Ordnance IV	2-1
Or-192(C)	Mining Operations	2-0
Ph-311(B)	Electrostatics and Magnetostatics	3-0
*IE-104(C)	Technical Lectures	0-1
		16-6

*Lecture course—no academic credit.

Summer course in Industrial Administration at Stanford University.

SECOND YEAR (RW2)

FIRST TERM

Ch-561(A)	Physical Chemistry	3-2
Mt-203(B)	Physical Metallurgy (Special Topics)	2-2
Oc-401(C)	Naval Applications of Oceanography	3-0
Or-291(C)	Mine Countermeasures	3-0
Ph-312(B)	Applied Electromagnetics	3-0
Ph-421(A)	Fundamental Acoustics	3-0
*IE-101(C)	Principles of Industrial Organization	0-1
		17-5

SECOND TERM

Ae-100(C)	Basic Aerodynamics	3-4
Ch-521(A)	Plastics	3-2
Ma-381(B)	Probability	4-0
Or-292(C)	Mine Countermeasures	3-2
Ph-425(A)	Underwater Acoustics	3-2
		16-10

THIRD TERM

Ch-591(A)	Blast and Shock Effects	3-0
Ma-382(A)	Probability and Statistics	2-0
Oa-152(C)	Measures of Effectiveness of Mines	3-0
Or-295(A)	Thesis I	2-9
*SL-101(C)	New Weapons Development I	0-1
		10-10

FOURTH TERM

Ma-401(A)	Mathematical Computation by Physical Means	2-2
Oa-153(B)	Game Theory and Its Application to Mine Fields	3-0
Or-294(A)	Mine Warfare Seminar	2-0
Or-296(A)	Thesis II	2-6
Ph-424(A)	Shock Waves and Sonar Developments	3-3
*SL-102(C)	New Weapons Development II	0-1
		12-12

*Lecture course—no academic credit.
Six months practical work at various mine warfare installations.

NAVAL ENGINEERING CURRICULA

The Naval Engineering curricula include the following:

Chemical Engineering
Electrical Engineering
Gas Turbines
Mechanical Engineering
Mechanical Engineering (Equalization)
Mechanical Engineering (Nuclear Power)
Metallurgical Engineering
Petroleum Engineering

CHEMICAL ENGINEERING

OBJECTIVE

To educate a small group of officers in the fundamentals of applied chemistry and chemical emgineering processes so that they will be qualified for duties involving: research, development and use of naval materials other than metals; liaison with civilian chemical industry; preparation of material specifications; supervision of naval activities involving chemical processes.

FIRST YEAR (NC)

FIRST TERM

Ch-101(C)	General Chemistry	3-2
EE-171(C)	Electric Circuits and Fields	3-4
Ma-100(C)	Vector Algebra and Geometry	2-1
Ma-111(C)	Introduction to Eng. Mathematics	3-1
Mc-101(C)	Engineering Mechanics I	2-2
		13-10

SECOND TERM

Ch-221(C)	Qualitative Analysis	3-2
EE-251(C)	AC Circuits	3-4
Ge-101(C)	Physical Geology	3-0
Ge-241(C)	Geology of Petroleum	2-2
Ma-112(B)	Differential Equations and Boundary Value Problems	4-0
		15-8

THIRD TERM

Ch-231(C)	Quantitative Analysis	2-3
Ch-311(C)	Organic Chemistry	3-2
Ch-411(C)	Physical Chemistry	3-2
Cr-311(B)	Crystallography and Mineralogy	3-2
Ma-113(B)	Vector Analysis and Introduction to Partial Differential Equations	3-0
Mt-201(C)	Introductory Physical Metallurgy	3-2
		17-11

FOURTH TERM

Ch-312(C)	Organic Chemistry	3-2
Ch-412(C)	Physical Chemistry	3-2
Ch-521(A)	Plastics	3-2
Ch-611(C)	Thermodynamics	3-2
Ge-302(C)	Determinative Mineralogy	1-4
		13-12

Intersessional Field Trip; summer leave period.

SECOND YEAR (NC2)

FIRST TERM

Ch-541(A)	Reaction Motors	2-2
Ch-612(C)	Thermodynamics	3-2
ME-500(C)	Strength of Materials	3-0
ME-601(C)	Materials Testing Laboratory	0-2
Mt-202(C)	Ferrous Physical Metallurgy	3-2
*IE-101(C)	Principles of Industrial Organization (Lecture)	0-1
		11-9

SECOND TERM

Ch-111(A)	Fuel and Oil Chemistry	2-2
Ch-413(A)	Physical Chemistry Advanced	2-2
EE-751(C)	Electronics	3-4
ME-421(C)	Hydromechanics	3-2
ME-700(C)	Kinematics of Machinery	2-3
		12-13

THIRD TERM

Ch-321(A)	Organic Qualitative Analysis	2-2
Ch-323(A)	Chemistry of High Polymers	3-0
Ch-701(C)	Chemical Engineering Calculations	3-2
Ch-721(C)	Unit Operations	3-0
ME-422(B)	Hydromechanics	2-2
Ph-610(B)	Atomic Physics	3-0
*IE-103(C)	Applied Industrial Organization (Lecture)	0-1
*SL-101	New Weapons Development I (Lecture)	0-1
		16-8

FOURTH TERM

Ch-322(A)	Organic Chemistry Advanced	3-2
Ch-722(C)	Unit Operations	3-0
Ch-800(A)	Chemistry Seminar	2-0
Ma-301(B)	Statistics	3-2
ME-310(B)	Heat Transfer	3-2
Mt-301(A)	High Temperature Materials	3-0
*IE-104(C)	Technical Lectures	0-1
*SL-102	New Weapons Development II (Lecture)	0-1
		17-8

Summer leave period.

*Lecture course—no academic credit.

THIRD YEAR (NC3)
At Lehigh University

SUMMER

Supervised study of Unit Operations and allied subjects.

FALL SEMESTER

Chem.440 Adv. Physical Chemistry
Chem.Eng.480 Industrial Chemistry and Chemical Engineering Research
Chem.Eng.484 Chemical Engineering
Chem.Eng.300 Chemical Engineering Thermodynamics
*Chem.Eng.302 Chemical Engineering Kinetics

*Or additional mathematics, mechanical engineering, or physics.

This curriculum normally leads to the degree of Master of Science, conferred by the civilian university.

SPRING SEMESTER

Chem.441 Adv. Physical Chemistry
Chem.Eng.481 Industrial Chemistry and Chemical Eng-. Research
Chem.Eng.485 Chemical Engineering
Chem.Eng.486 Chemical Engineering Process Control
Chem.Eng.301 Process Design

Note: This curriculum will be discontinued after graduation of the presently enrolled students in June 1954.

ELECTRICAL ENGINEERING

OBJECTIVE

To prepare officers in advanced electrical engineering for technical and administrative duties ashore and afloat, involving research, development, design and inspection of naval machinery and engineering plants.

BASIC CURRICULUM (TWO YEARS)

Designed to supply, to maximum extent possible in two years, broad coverage in a variety of subjects essential to understanding of modern naval engineering, with emphasis on electrical engineering.

FIRST YEAR (NL)

FIRST TERM

Ma-100(C)	Vector Algebra and Geometry	2-1
Ma-101(C)	Introduction to Engineering Mathematics	3-0
Mc-101(C)	Engineering Mechanics I	2-2
Ch-101(C)	General Chemistry	3-2
EE-171(C)	Electric Circuits and Fields	3-4
		13-9

SECOND TERM

ME-500(C)	Strength of Materials	3-0
Ma-102(C)	Differential Equations and Series	5-0
Mc-102(C)	Engineering Mechanics II	2-2
Ch-111(A)	Fuel and Oil Chemistry	2-2
EE-271(C)	AC Circuits	3-2
ME-601(C)	Materials Testing Laboratory	0-2
		15-8

THIRD TERM

Ph-610(B)	Atomic Physics	3-0
Ma-103(B)	Functions of Several Variables and Vector Analysis	5-0
Mc-201(A)	Methods in Dynamics	2-2
Mt-201(C)	Introductory Physical Metallurgy	3-2
EE-272(B)	AC Circuits	2-2
		15-6

FOURTH TERM

Ma-104(A)	Partial Differential Equations and Related Topics	5-0
Mt-202(C)	Ferrous Physical Metallurgy	3-2
ME-111(C)	Engineering Thermodynamics	4-2
EE-371(C)	DC Machinery	3-2
		15-6

Intersessional Field Trip; summer leave period.

SECOND YEAR (NL2)

FIRST TERM

EE-471(C)	Transformers and Asynchronous Machines	3-4
ME-122(C)	Engineering Thermodynamics	3-2
Mt-203(B)	Physical Metallurgy (Special Topics)	2-2
EE-273(C)	Electrical Measurements I	2-3
*IE-101(C)	Principles of Industrial Organization (Lecture)	0-1
		10-12

SECOND TERM

EE-472(C)	Synchronous Machines and Synchros	3-4
EE-971(A)	Seminar	1-0
Mt-301(B)	High Temperature Materials	3-0
ME-221(C)	Marine Power Plant Equipment	3-2
ME-421(C)	Hydromechanics	3-2
		13-8

THIRD TERM

EE-571(B)	Transmission Lines and Filters	3-4
EE-771(B)	Electronics	3-2
EE-971(A)	Seminar	1-0
ME-222(C)	Marine Power Plant Equipment	3-4
*IE-103(C)	Applied Industrial Organization (Lecture)	0-1
*SL-101	New Weapons Development I (Lecture)	0-1
		10-12

FOURTH TERM

EE-651(B)	Transients and Servos	3-4
EE-772(B)	Electronics	3-2
EE-971(A)	Seminar	1-0
EE-274(B)	Electrical Measurements II	2-3
NE-103(C)	Engineering Department Organization	2-0
*IE-104(C)	Technical Lectures	0-1
*SL-102	New Weapons Development II (Lecture)	0-1
		11-11

*Lecture course only; no academic credit.

This curriculum normally leads to the degree of Bachelor of Science in Electrical Engineering for students who attain the required quality point rating.

ADVANCED CURRICULUM (THREE YEARS)

Designed for students, selected from the NL group at the end of the first year, whose performance and records qualify them for advanced study.

FIRST YEAR

Same as basic curriculum.

SECOND YEAR (NLA2)

FIRST TERM

EE-471(C)	Transformers, Asynchronous Machines and Synchros	3-4
EE-273(C)	Electrical Measurements I	2-3
ME-122(C)	Engineering Thermodynamics	3-2
Mt-203(B)	Physical Metallurgy (Special Topics)	2-2
*IE-101(C)	Principles of Industrial Organization (Lecture)	0-1
		10-12

SECOND TERM

Ma-106(A)	Complex Variables and Laplace Transform	4-0
EE-472(C)	Synchronous Machines	3-4
EE-971(A)	Seminar	1-0
ME-221(C)	Marine Power Plant Equipment	3-2
ME-421(C)	Hydromechanics	3-2
		14-8

THIRD TERM

EE-571(B)	Transmission Lines and Filters	3-4
EE-771(B)	Electronics	3-2
EE-971(A)	Seminar	1-0
ME-222(C)	Marine Power Plant Equipment	3-4
*IE-103(C)	Applied Industrial Organization (Lecture)	0-1
*SL-101	New Weapons Development I (Lecture)	0-1
		10-12

*Lecture course—no academic credit.

FOURTH TERM

EE-671(A)	Transients	3-4
EE-772(B)	Electronics	3-2
EE-971(A)	Seminar	1-0
ME-310(B)	Heat Transfer	3-2
ME-223(B)	Marine Power Plant Analysis	2-4
*IE-104(C)	Technical Lectures	0-1
*SL-102	New Weapons Development II (Lecture)	0-1
		12-14

Intersessional Field Trip; summer leave period.

THIRD YEAR (NLA3)

(For Classes Graduating in 1954 and Subsequent Years.)

FIRST TERM

Ma-105(A)	Fourier Series and Boundary Value Problems	4-0
EE-871(A)	Electrical Machine Design	4-0
Ph-361(A)	Electromagnetism	3-0
NE-101(C)	Main Propulsion Plants	3-0
EE-672(A)	Servomechanisms	3-3
		17-3

SECOND TERM

EE-872(A)	Electrical Machine Design	4-0
EE-971(A)	Seminar	1-0
EE-274(B)	Electrical Measurements II	2-3
Ph-362(A)	Electromagnetic Waves	3-0
EE-972(A)	Thesis	2-6
		12-9

THIRD TERM

EE-873(A)	Electrical Machine Design	4-0
EE-971(A)	Seminar	1-0
EE-972(A)	Thesis	2-12
NE-102(C)	Auxiliary Machinery	3-0
		10-12

FOURTH TERM

EE-874(A)	Electrical Machine Design	4-0
EE-971(A)	Seminar	1-0
NE-103(C)	Engineering Department Administration	2-0
EE-972(A)	Thesis	2-8
Ma-301(B)	Statistics	3-2
		12-10

This curriculum normally leads to the degree of Master of Science in Electrical Engineering for those who attain the required point rating and complete a satisfactory thesis.

GAS TURBINES

OBJECTIVE

To qualify the officer for duties involving evaluation of future trends in gas turbines and jet propulsion, research and development in these as applied to naval vessel propulsion, and liaison with civilian establishments producing gas turbines and jet propulsion engines for the Navy.

The students for the gas turbines program are normally selected, after the end of the first term, from the mechanical engineering (NH) group. Volunteers for this specialized program must have excellent previous academic records, and high grades for the first term. Mathematics and mechanics are particularly important as prerequisites.

FIRST YEAR (NJ)

FIRST TERM

Ch-101(C)	General Chemistry	3-2
EE-171(C)	Electric Circuits and Fields	3-4
Ma-100(C)	Vector Algebra and Geometry	2-1
Ma-101(C)	Introduction to Engineering Mathematics	3-0
Ma-201(C)	Graphical and Mechanical Computation	0-2
Mc-101(C)	Engineering Mechanics I	2-2
		13-11

SECOND TERM

Ae-100(C)	Basic Aerodynamics	3-4
EE-251(C)	AC Circuits	3-4
Ma-102(C)	Differential Equations and Series	5-0
Mc-102(C)	Engineering Mechanics II	2-2
		13-10

THIRD TERM

Ch-411(C)	Physical Chemistry	3-2
EE-451(C)	Transformers and Synchros	2-2
Ma-103(B)	Functions of Several Variables and Vector Analysis	5-0
Mc-201(A)	Methods in Dynamics	2-2
Mt-201(C)	Introductory Physical Metallurgy	3-2
		15-8

FOURTH TERM

Ch-412(C)	Physical Chemistry	3-2
Ch-611(C)	Thermodynamics	3-2
EE-452(C)	Polyphase Transformers, Synchronous Machines, and Induction Motors	3-4
Ma-104(C)	Partial Differential Equations and Related Topics	5-0
		14-8

Intersessional Field Trip; summer leave period.

SECOND YEAR (NJ2)

FIRST TERM

Ae-501(A)	Hydro-Aero Mechanics I	4-0
Ch-541(A)	Reaction Motors	2-2
Ch-612(C)	Thermodynamics	3-2
Ma-105(A)	Fourier Series and Boundary Value Problems	4-0
ME-511(C)	Strength of Materials	5-0
*IE-101(C)	Principles of Industrial Organization (Lecture)	0-1
		18-5

SECOND TERM

Ae-502(A)	Hydro-Aero Mechanics II	4-0
Ch-111(A)	Fuel and Oil Chemistry	2-2
Ma-106(A)	Complex Variables and Laplace Transform	4-0
ME-611(C)	Materials Testing Laboratory	2-2
Mt-202(C)	Ferrous Physical Metallurgy	3-2
		15-6

THIRD TERM

Ae-451(C)	Gas Turbines I	3-0
Ae-503(A)	Compressibility I	4-0
Ch-701(C)	Chemical Engineering Calculations	3-2
ME-622(B)	Experimental Stress Analysis	2-2
Mt-203(B)	Physical Metallurgy (Special Topics)	2-2
*IE-103(C)	Applied Industrial Organization (Lecture)	0-1
*SL-101	New Weapons Development I (Lecture)	0-1
		14-8

FOURTH TERM

Ae-431(A)	Internal Flow in Aircraft Engines	4-0
Ae-452(C)	Gas Turbines II	3-0
EE-751(C)	Electronics	3-4
ME-310(B)	Heat Transfer	3-2
Mt-301(A)	High Temperature Materials	3-0
*IE-104(C)	Technical Lectures	0-1
*SL-102	New Weapons Development II (Lecture)	0-1
		16-8

Intersessional Field Trip; summer leave period.

*Lecture course—no academic credit.

NOTE: The curriculum for the first two years is now under revision. The above-listed courses were taken by the group now at M.I.T.

THIRD YEAR (NJ3)

At Massachusetts Institute of Technology

FALL SEMESTER

2.49 Fluid Mechanics, Advanced
2.213 Gas Turbines
2.521 Heat Transfer, Advanced
Thesis

SPRING SEMESTER

2.491 Compressible Fluid Mechanics
2.28 Fluid Machinery
16.56 Jet Propulsion Engines
Thesis

This curriculum leads to the degree of Master of Science, conferred by the civilian institution.

MECHANICAL ENGINEERING

OBJECTIVE

To prepare officers in advanced mechanical engineering, for technical and administrative duties ashore and afloat, involving research, development, design, and inspection of naval machinery and engineering plants.

BASIC CURRICULUM (TWO YEARS)

Designed to supply broad coverage in a variety of subjects which are essential to understanding of modern naval engineering.

FIRST YEAR (NH)

FIRST TERM

Ch-101(C)	General Chemistry	3-2
EE-171(C)	Electric Circuits and Fields	3-4
Ma-100(C)	Vector Algebra and Geometry	2-1
Ma-101(C)	Introduction to Engineering Mathematics	3-0
Ma-201(C)	Graphical and Mechanical Computation	0-2
Mc-101(C)	Engineering Mechanics I	2-2
		13-11

SECOND TERM

Ch-111(A)	Fuel and Oil Chemistry	2-2
EE-251(C)	AC Circuits	3-4
Ma-102(C)	Differential Equations and Series	5-0
Mc-102(C)	Engineering Mechanics II	2-2
Ph-610(B)	Atomic Physics	3-0
		15-8

THIRD TERM

EE-351(C)	DC Machinery	2-2
EE-451(C)	Transformers and Synchros	2-2
Ma-103(B)	Functions of Several Variables and Vector Analysis	5-0
Mc-201(A)	Methods in Dynamics	2-2
Mt-201(C)	Introductory Physical Metallurgy	3-2
		14-8

Intersessional Field Trip; summer leave period.

FOURTH TERM

EE-452(C)	Polyphase Transformers, Synchronous Machines and Induction Motors	3-4
ME-111(C)	Engineering Thermodynamics	4-2
ME-511(C)	Strength of Materials	5-0
Mt-202(C)	Ferrous Physical Metallurgy	3-2
		15-8

SECOND YEAR (NH2)

FIRST TERM

ME-122(C)	Engineering Thermodynamics	3-2
ME-421(C)	Hydromechanics	3-2
ME-522(C)	Strength of Materials	4-0
ME-611(C)	Materials Testing Laboratory	2-2
Mt-203(B)	Physical Metallurgy (Special Topics)	2-2
*IE-101(C)	Principles of Industrial Organization (Lecture)	0-1
		14-9

SECOND TERM

ME-221(C)	Marine Power Plant Equipment	3-2
ME-422(B)	Hydromechanics	2-2
ME-622(B)	Experimental Stress Analysis	2-2
ME-711(B)	Mechanics of Machinery	3-2
Mt-301(A)	High Temperature Materials	3-0
		13-8

THIRD TERM

ME-217(C)	Internal Combustion Engines (Diesel)	3-2
ME-222(C)	Marine Power Plant Equipment	3-4
ME-712(A)	Dynamics of Machinery	3-2
NE-102(C)	Auxiliary Machinery	3-0
*IE-103(C)	Applied Industrial Organization (Lecture)	0-1
*SL-101	New Weapons Development I (Lecture)	0-1
		12-10

FOURTH TERM

EE-751(C)	Electronics	3-4
ME-223(B)	Marine Power Plant Analysis	2-4
ME-820(C)	Machine Design	2-4
NE-103(C)	Engineering Department Administration	2-0
*IE-104(C)	Technical Lectures	0-1
*SL-102	New Weapons Development II (Lecture)	0-1
		9-14

*Lecture course—no academic credit.

This curriculum normally leads to the degree of Bachelor of Science in Mechanical Engineering, for students who attain the required quality point rating.

ADVANCED CURRICULUM (THREE YEARS)

Designed for students, chosen from the NH Group at the end of the first year, whose performance and records qualify them for advanced study.

FIRST YEAR

Same as basic curriculum.

SECOND YEAR (NHA2)

FIRST TERM

ME-112(B)	Thermodynamics	4-2
ME-512(A)	Strength of Materials	5-0
ME-611(C)	Materials Testing Laboratory	2-2
Mt-203(B)	Physical Metallurgy (Special Topics)	2-2
NE-101(C)	Main Propulsion Plants	3-0
*IE-101(C)	Principles of Industrial Organization (Lecture)	0-1
		16-7

SECOND TERM

Ma-104(A)	Partial Differential Equations and Related Topics	5-0
ME-211(C)	Marine Power Plant Equipment	3-2
ME-411(C)	Hydromechanics	3-2
ME-711(B)	Mechanics of Machinery	3-2
		14-6

THIRD TERM

ME-212(C)	Marine Power Plant Equipment	3-4
ME-513(A)	Theory of Elasticity	3-0
ME-412(A)	Hydromechanics	4-2
ME-712(A)	Dynamics of Machinery	3-2
*IE-103(C)	Applied Industrial Organization (Lecture)	0-1
*SL-101	New Weapons Development I (Lecture)	0-1
		13-10

FOURTH TERM

Ae-431(A)	Internal Flow in Aircraft Engines	4-0
Ma-301(B)	Statistics	3-2
ME-217(C)	Internal Combustion Engines (Diesel)	3-2
ME-310(B)	Heat Transfer	3-2
*IE-104(C)	Technical Lectures	0-1
*SL-102	New Weapons Development II (Lecture)	0-1
		13-8

*Lecture course—no academic credit.
Intersessional Field Trip; summer leave period.

THIRD YEAR (NHA3)

FIRST TERM

Ch-561(A)	Physical Chemistry	3-2
ME-215(A)	Marine Power Plant Analysis and Design	2-4
ME-612(A)	Experimental Stress Analysis	3-2
ME-811(C)	Machine Design	3-2
Mt-301(A)	High Temperature Materials	3-0
		14-10

SECOND TERM

EE-751(C)	Electronics	3-4
ME-216(A)	Marine Power Plant Analysis and Design	2-4
ME-812(B)	Machine Design	3-4
	Thesis	0-4
		8-16

THIRD TERM

Ch-521(A)	Plastics	3-2
NE-102(C)	Auxiliary Machinery	3-0
	Thesis	2-14
		8-16

FOURTH TERM

EE-651(B)	Transients and Servos	3-4
NE-103(C)	Engineering Department Administration	2-0
Ph-450(B)	Underwater Acoustics	3-2
	Thesis	2-8
		10-14

This curriculum normally leads to the degree of Master of Science in Mechanical Engineering for those who attain the required quality point rating and complete a satisfactory thesis.

MECHANICAL ENGINEERING (EQUALIZATION)

OBJECTIVE

To supplement previous technical education of certain engineering duty officers, and to prepare these officers for engineering assignments under cognizance of the Bureau of Ships, involving inspection, installation, operation, maintenance and repair of naval machinery and equipment.

FIRST YEAR (NQ)

FIRST TERM

Ch-101(C)	General Inorganic Chemistry	3-2
EE-151(C)	DC Circuits and Fields	3-4
Ma-100(C)	Vector Algebra and Geometry	2-1
Ma-140(C)	Survey of Calculus	3-0
Ma-201(C)	Graphical and Mechanical Computation	0-2
		11-9

SECOND TERM

Ch-521(A)	Plastics	3-2
EE-251(C)	AC Circuits	3-4
Ma-171(C)	Special Topics in Calculus I	3-0
Mc-101(C)	Engineering Mechanics I	2-2
		11-8

THIRD TERM

EE-351(C)	DC Machinery	2-2
Ma-172(C)	Special Topics in Calculus II	3-0
Mc-102(C)	Engineering Mechanics II	2-2
ME-500(C)	Strength of Materials	3-0
ME-601(C)	Materials Testing Laboratory	0-2
Mt-201(C)	Introductory Physical Metallurgy	3-2
		13-8

FOURTH TERM

EE-451(C)	Transformers and Synchros	2-2
Ma-173(B)	Special Topics in Calculus III	3-0
ME-111(C)	Engineering Thermodynamics	4-2
ME-700(C)	Kinematics of Machinery	3-2
Mt-202(C)	Ferrous Physical Metallurgy	3-2
		15-8

Intersessional Field Trip; summer leave period.

SECOND YEAR (NQ2)

FIRST TERM

EE-452(C)	Polyphase Transformers, Synchronous Machines, and Induction Motors	3-4
Ma-174(B)	Special Topics in Calculus IV	3-0
ME-122(C)	Engineering Thermodynamics	3-2
Mt-301(A)	High Temperature Materials	3-0
NE-101(C)	Main Propulsion Plants	3-0
*IE-101(C)	Principles of Industrial Organization (Lecture)	0-1
		15-7

SECOND TERM

Ch-111(A)	Fuel and Oil Chemistry	2-2
EE-751(C)	Electronics	3-4
ME-221(C)	Marine Power Plant Equipment	3-2
ME-421(C)	Hydromechanics	3-2
		11-10

THIRD TERM

ME-222(C)	Marine Power Plant Equipment	3-4
ME-422(B)	Hydromechanics	2-2
Mt-203(B)	Physical Metallurgy (Special Topics)	2-2
NE-102(C)	Auxilary Machinery	3-0
Ph-610(B)	Atomic Physics	3-0
*IE-103(C)	Applied Industrial Organization (Lecture)	0-1
*SL-101	New Weapons Development I (Lecture)	0-1
		13-10

FOURTH TERM

ME-217(C)	Internal Combustion Engines (Diesel)	3-2
ME-223(B)	Marine Power Plant Analysis	2-4
ME-830(C)	Machine Design	4-2
NE-103(C)	Engineering Department Administration	2-0
*IE-104(C)	Technical Lectures	0-1
*SL-102	New Weapons Development II (Lecture)	0-1
		11-10

*Lecture course—no academic credit.

This curriculum normally leads to the degree of Bachelor of Science in Mechanical Engineering, for students who attain the required quality point rating.

MECHANICAL ENGINEERING (NUCLEAR POWER)

OBJECTIVE

To prepare a small group of officers in marine engineering, for technical and administrative duties ashore and afloat, involving employment of naval machinery and engineering plants, including installations powered by nuclear energy.

FIRST YEAR (NN)

FIRST TERM

Ch-101(C)	General Inorganic Chemistry	3-2
EE-171(C)	Electric Circuits and Fields	3-4
Ma-100(C)	Vector Algebra and Geometry	2-1
Ma-101(C)	Introduction to Eng. Mathematics	3-0
Ma-201(C)	Graphical and Mechanical Computation	0-2
Mc-101(C)	Eng. Mechanics I	2-2
		13-11

SECOND TERM

Ch-111(A)	Fuel and Oil Chemistry	2-2
EE-251(C)	AC Circuits	3-4
Ma-102(C)	Differential Equations and Series	5-0
Mc-102(C)	Eng. Mechanics II	2-2
Ph-610(B)	Atomic Physics	3-0
		15-8

THIRD TERM

EE-351(C)	DC Machinery	2-2
EE-451(C)	Transformers and Synchros	2-2
Ma-103(B)	Functions of Several Variables; Vector Analysis	5-0
Mc-201(A)	Methods in Dynamics	2-2
Mt-201(C)	Introductory Physical Metallurgy	3-2
		14-8

FOURTH TERM

EE-452(C)	Polyphase Transformers, Synchronous Machines and Induction Motors	3-4
ME-111(C)	Eng. Thermodynamics	4-2
Mt-202(C)	Ferrous Physical Metallurgy	3-2
ME-511(C)	Strength of Materials	5-0
		15-8

Intersessional Field Trip; summer leave period.

A small input to this curriculum is chosen at end of first year, from students in the NH curriculum.

SECOND YEAR (NN2)

FIRST TERM

ME-112(B) Eng. Thermodynamics	4-2
ME-512(A) Strength of Materials	5-0
Mt-203(B) Physical Metallurgy (Special Topics)	2-2
NE-101(C) Main Propulsion	3-0
Elective	3-0
*IE-101(C) Principles of Industrial Organization	0-1
	17-5

SECOND TERM

ME-211(C) Marine Power Plant Equipment	3-2
ME-411(C) Hydromechanics	3-2
Ma-104(A) Partial Differential Equations and related topics	5-0
ME-611(C) Materials Testing Laboratory	2-2
ME-711(B) Mechanics of Machinery	3-2
	16-8

THIRD TERM

Ch-411(C) Physical Chemistry	3-2
ME-212(C) Marine Power Plant Equipment	3-2
ME-412(C) Hydromechanics	3-2
Ph-361(A) Electromagnetism	3-0
Elective	3-0
	15-6

*Lecture course—no academic credit.

FOURTH TERM

Ch-412(C) Physical Chemistry	3-2
EE-751(C) Electronics	3-4
ME-360(B) Heat Transfer	4-2
Ph-642(A) Nuclear Physics	3-0
*IE-104(C) Technical Lectures	0-1
*SL-102(C) New Weapons Development	0-1
	13-10

Intersessional Field Trip at an A.E.C. Installation.
Summer leave period.

THIRD YEAR (NN3)

FIRST TERM

Ch-551(A) Radiochemistry	2-2
EE-671(A) Transients	3-4
ME-215(A) Marine Power Plant Analysis and Design	2-4
Mt-301(A) High Temperature Materials	3-0
Ph-643(A) Nuclear Physics Lab.	0-3
	10-13

SECOND TERM

EE-672(A) Servomechanisms	3-3
ME-811(C) Machine Design	3-2
*Ph-(A) Reactor Technology	3-3
*Ph-(A) Biological Effects of Radiation	3-0
Elective	3-0
	15-8

THIRD TERM

Ch-521(A) Plastics	3-2
*ME-(A) Nuclear Power Plants	3-0
*Mt-(A) Chem. and Met. Seminar	2-0
NE-102(C) Auxiliary Machinery	3-0
Thesis (A)	2-6
	13-8

FOURTH TERM

*ME-(A) Nuclear Power Plants	3-0
Mt-402(A) Effects of Radiation on Materials	3-0
NE-103(C) Eng. Department Administration	2-0
Thesis (A)	4-8
	12-8

*This course to be established.

This curriculum normally leads to the degree of Master of Science for those who attain the required quality point rating and complete a satisfactory thesis.

METALLURGICAL ENGINEERING

OBJECTIVE

To prepare a small group of officers in advanced metallurgical engineering for technical and administrative duties involving research in metals and alloys, development of metals and metallurgy to meet naval needs and uses of metals and alloys in naval equipment.

FIRST YEAR (NM)

FIRST TERM

Ch-101(C) General Chemistry	3-2
EE-171(C) Electric Circuits and Fields	3-4
Ma-100(C) Vector Algebra and Geometry	2-1
Ma-111(C) Introduction to Engineering Mathematics	3-1
Ma-201(C) Graphical and Mechanical Computations	0-2
Mc-101(C) Engineering Mechanics I	2-2
	13-12

SECOND TERM

Ch-221(C) Qualitative Analysis	3-2
EE-251(C) AC Circuits	3-4
Ma-112(B) Differential Equations and Boundary Value Problems	4-0
Mc-102(C) Engineering Mechanics II	2-2
ME-500(C) Strength of Materials	3-0
ME-601(C) Materials Testing Laboratory	0-2
	15-10

THIRD TERM

Ch-231(C)	Quantitative Analysis	2-3
Ch-411(C)	Physical Chemistry	3-2
Ma-113(B)	Vector Analysis and Introduction to Partial Differential Equations	3-0
Mt-201(C)	Introductory Physical Metallurgy	3-2
Ph-610(B)	Atomic Physics	3-0
		14-7

FOURTH TERM

Ch-412(C)	Physical Chemistry	3-2
Ch-611(C)	Thermodynamics	3-2
Ma-114(A)	Partial Differential Equations and Functions of a Complex Variable	3-0
Mt-202(C)	Ferrous Physical Metallurgy	3-2
Mt-203(B)	Physical Metallurgy (Special Topics)	2-2
		14-8

Intersessional Field Trip; summer leave period.

SECOND YEAR (NM2)

FIRST TERM

Ch-612(C)	Thermodynamics	3-2
Cr-271(B)	Crystallography and X-ray Technics	3-2
EE-314(C)	DC and AC Machinery	3-4
Mt-102(C)	Production of Steel	3-0
Mt-301(A)	High Temperature Materials	3-0
*IE-101(C)	Principles of Industrial Organization (Lecture)	0-1
		15-9

SECOND TERM

ME-421(C)	Hydromechanics	3-2
ME-700(C)	Kinematics of Machinery	2-3
Mt-204(A)	Physical Metallurgy	3-4
Mt-205(A)	Advanced Physical Metallurgy	3-4
		11-13

THIRD TERM

Ch-521(A)	Plastics	3-2
ME-422(B)	Hydromechanics	2-2
ME-622(B)	Experimental Stress Analysis	2-2
Mt-103(C)	Production of Non-Ferrous Metals	3-0
Mt-302(A)	Alloy Steels	4-2
*IE-103(C)	Applied Industrial Organization (Lecture)	0-1
*SL-101	New Weapons Development I (Lecture)	0-1
		14-10

FOURTH TERM

Ch-531(A)	Physical Chemistry (for Metallurgical students)	2-0
Ma-301(B)	Statistics	3-2
ME-310(B)	Heat Transfer	3-2
Mt-206(A)	Advanced Physical Metallurgy	3-4
Mt-303(A)	Metallurgy Seminar	2-0
Mt-401(A)	Physics of Metals	3-0
*IE-104(C)	Technical Lectures	0-1
*SL-102	New Weapons Development II (Lecture)	0-1
		16-10

*Lecture course—no academic credit.

Intersessional Field Trip for students selected for a third year; summer leave period.

THIRD YEAR (NM3)

At Carnegie Institute of Technology

FALL TERM

S291 Statistical Quality Control
GE 655a Metallurgical Problems
GE 657a Alloy Steels
GE 674a Graduate Seminar
E 647 Non-Ferrous Metallography
GE 664a Adv. Physical Metallurgy
E 651 Mech. Metallurgy
GS 485 Physics of Metals

This curriculum normally leads to the degree of Master of Science, conferred by the civilian institution.

SPRING TERM

S 292 Statistical Quality Control
GE 655b Metallurgical Problems
GE 657b Alloy Steels
GE 674b Graduate Seminar
GE 664b Advanced Physical Metallurgy
E 648 Non-Ferrous Metallography
GE 663 Crystallography

Note: This curriculum will be discontinued on graduation of the presently enrolled students in June 1954.

PETROLEUM ENGINEERING

OBJECTIVE

To prepare a small group of officers in the technology of petroleum production, refining, and handling, for duties involving development, application, specifications, and inspection of fuels and lubricants in the Naval Establishment.

FIRST YEAR (NP)

FIRST TERM

Ch-101(C)	General Inorganic Chemistry	3-2
EE-171(C)	Electric Circuits and Fields	3-4
Ma-100(C)	Vector Algebra and Geometry	2-1
Ma-111(C)	Introduction to Engineering Mathematics	3-1
Ma-201(C)	Graphical and Mechanical Computation	0-2
Mc-101(C)	Engineering Mechanics I	2-2
		13-12

SECOND TERM

Ch-221(C)	Qualitative Analysis	3-2
Ge-101(C)	Physical Geology	3-0
Cr-301(B)	Crystallography and Mineralogy	3-4
Ma-112(B)	Differential Equations and Boundary Value Problems	4-0
ME-500(C)	Strength of Materials	3-0
ME-601(C)	Materials Testing Laboratory	0-2
		16-8

THIRD TERM

Ch-231(C)	Quantitative Analysis	2-3
Ch-301(C)	Organic Chemistry	3-2
Ch-411(C)	Physical Chemistry	3-2
Ge-241(C)	Geology of Petroleum	2-2
Mt-201(C)	Introductory Physical Metallurgy	3-2
		13-11

FOURTH TERM

Ch-111(A)	Fuel and Oil Chemistry	2-2
Ch-412(C)	Physical Chemistry	3-2
GE-302(C)	Determinative Mineralogy	1-4
Ge-401(C)	Petrology and Petrography	2-3
Mt-202(C)	Ferrous Physical Metallurgy	3-2
		11-13

Intersessional Field Trip; summer leave period.

SECOND YEAR (NP2)

At University of California

FALL TERM

Chem. 8 Short survey of Organic Chemistry
Chem. 143 Introduction to Chemical Engineering
Mech.Eng. 103 Elem. Fluid Mechanics
Pet.Eng. 131A Oil Reservoir Eng.
Pet.Eng. 198A Group study in Pet. Production

SPRING TERM

Math. 130E Statistical inference for Engineers
Chem. 146A Chemical Engineering Unit Operations
Mech.Eng. 161 Applied Fluid Mechanics
Pet.Eng. 125 Petroleum Production Economics
Pet.Eng. 131B Oil Reservoir Eng.

Summer leave period; field trip.

THIRD YEAR (NP3)

At University of California

FALL TERM

Chem. 146B Chemical Engineering Unit Operations
Mech.Eng. 164 Instrumentation and Automatic Control
Pet.Eng. 209A Seminar in Petroleum Processing I
Pet.Eng. 298A Group study
Pet.Eng. 299A Individual study or research

SPRING TERM

Math. 264 Statistical problems of Mass Production and Quality Control
Elective
Pet.Eng. 209B Seminar in Petroleum Processing II
Pet.Eng. 298B Group study
Pet.Eng. 299B Individual study or research
Comprehensive examination

Elective to be chosen by student, subject to approval of University of California Faculty and Superintendent, U. S. Naval Postgraduate School; technical subjects such as Atomic Physics or Chemical Engineering Thermodynamics.

This curriculum normally leads to the degree of Master of Engineering for students who qualify in accordance with University Graduate School requirements.

NUCLEAR ENGINEERING (EFFECTS)

OBJECTIVE

To educate officers in the fundamental sciences, particularly those associated with nuclear physics, in order that they may understand atomic processes and the effects of atomic weapons.

This curriculum has been established as a joint curriculum for selected officers of the Army, Navy, Air Force, Marine Corps and Coast Guard.

FIRST YEAR (RZ)

FIRST TERM

Ma-100(C)	Vector Algebra and Geometry	2-1
Ma-181(C)	Directional Derivatives and Locus Integrals	3-1
Mc-101(C)	Engineering Mechanics I	2-2
Mr-101(C)	Fundamentals of Atmospheric Circulation	3-0
Ph-250(C)	Geometrical and Physical Optics	3-2
		13-6

SECOND TERM

Ch-102(C)	General Inorganic Chemistry	4-2
Es-271(C)	Electronics I	3-3
Ma-182(B)	Differential Equations and Vector Analysis	5-0
Mc-102(C)	Engineering Mechanics II	2-2
		14-7

THIRD TERM

Ch-213(C)	Quantitative Analysis	3-2
Es-272(C)	Electronics II	3-2
Ge-101(C)	Physical Geology	3-0
Ma-183(B)	Complex Variables and the Differential Equations of Theoretical Physics	5-0
Ph-143(A)	Analytical Mechanics	3-0
		17-4

FOURTH TERM

Ch-315(C)	Organic Chemistry	3-0
Ma-184(A)	Laplace Transforms and Matrices	3-0
Mc-311(A)	Vibrations	3-2
Ph-351(B)	Electricity and Magnetism	5-0
Ph-441(A)	Longitudinal Waves in Fluids	4-0
		18-2

Summer field trip to installations connected with the atomic weapons program.

SECOND YEAR (RZ2)

FIRST TERM

Ch-442(C)	Physical Chemistry	4-2
Ma-301(B)	Statistics	3-2
ME-150(C)	Thermodynamics	4-2
Ph-641(B)	Atomic Physics	3-3
		14-9

SECOND TERM

**Biology I		6-0
Ch-551(A)	Radiochemistry	2-2
ME-350(C)	Heat Transfer	2-2
Ph-541(B)	Kinetic Theory and Statistical Mechanics	4-0
Ph-740(A)	Introduction to Quantum Mechanics	3-0
		17-4

THIRD TERM

**Biology II		6-0
Ch-591(A)	Blast and Shock Effects	3-0
ME-550(B)	Elastic Body Mechanics	5-0
Ph-642(A)	Nuclear Physics	3-0
*SL-101(C)	New Weapons Development I	0-1
	Thesis	0-5
		17-6

FOURTH TERM

**Biology III		6-0
Ph-643(A)	Nuclear Physics Lab.	0-3
*SL-102(C)	New Weapons Development II	0-1
	Thesis	0-25
		6-29

*Lecture course—no academic credit.

**Biology courses to be taught at Monterey by the University of California Extension.

Note: The Radiological Defense curriculum, the precursor of the above course, is now in its final year at the University of California (Berkeley). Graduation of the present RZ3 group in June 1954 will terminate the course at the University of California (Berkeley).

OPERATIONS ANALYSIS

OBJECTIVE

To educate officers in the basic sciences and to provide a thorough grounding in the theory and methods of operational analysis in order that they may direct the analytical approach to complex naval problems.

FIRST YEAR (RO)

FIRST TERM

Ch-103(C)	Elementary Physical Chemistry	3-2
Ma-100(C)	Vector Algebra and Geometry	2-1
Ma-191(C)	Basic Concepts and Interpretations of Mathematical Analysis	5-2
Ph-240(C)	Refraction, Interference and Diffraction	3-3
*IE-101(C)	Principles of Industrial Organization	0-1
		13-9

SECOND TERM

Ma-192(C)	Ordinary Differential Equations and Vector Analysis	5-0
Ma-381(C)	Elementary Probability and Statistics	4-2
Ph-141(B)	Analytical Mechanics	4-0
Ph-341(C)	Electricity and Magnetism	4-2
		17-4

THIRD TERM

Ma-193(B)	Partial Differential Equations	5-0
Ma-382(A)	Probability	3-0
Oa-191(C)	Introduction to Operations Analysis	3-0
Ph-142(B)	Analytical Mechanics	4-0
Ph-361(A)	Electromagnetism	3-0
*IE-103(C)	Applied Industrial Organization	0-1
		18-1

FOURTH TERM

Es-466(C)	Introduction to Radar	2-2
Ma-195(A)	Matrix Theory and Integration Theory	5-0
Ma-383(A)	Statistics	3-2
Oa-192(B)	Theory of Search	3-0
Ph-362(A)	Electromagnetic Waves	3-0
*IE-104(C)	Technical Lectures	0-1
		16-5

*Lecture course—no academic credit.

Summer period is devoted to operations analysis work at various plants and naval installations.

SECOND YEAR (RO2)

FIRST TERM

Ma-496(A)	High Speed Computing Machines	3-2
Ma-501(A)	Theory of Games	3-2
Oa-193(B)	Effectiveness of Weapons	4-0
Ph-421(A)	Acoustics	3-0
Ph-541(B)	Kinetic Theory and Statistical Mechanics	4-0
		17-4

SECOND TERM

Ae-104(C)	Aircraft Performance Evaluation	3-0
Oa-194(A)	Optimal Weapons Systems I	4-0
Oa-201(A)	Logistics Analysis	3-2
Ph-425(A)	Acoustics	3-2
Ph-641(B)	Atomic Physics	3-3
		16-7

THIRD TERM

Mr-120(C)	Operational Aspects of Meteorology	3-0
Oa-195(A)	Optimal Weapons Systems II	3-0
Oa-202(A)	Econometrics	3-0
Ph-642(A)	Nuclear Physics	3-0
Ph-643(A)	Nuclear Physics Lab	0-3
*SL-101(C)	New Weapons Development I	0-1
Oa-901(A)	Thesis	0-6
		12-10

FOURTH TERM

Ma-385(A)	Statistical Decision Functions	3-0
Oa-891(A)	Seminar	2-4
Oa-401(A)	Theory of Information Communication	3-0
Oa-902(A)	Thesis	0-8
*SL-102(C)	New Weapons Development II	0-1
		8-13

*Lecture course—no academic credit.

ORDNANCE ENGINEERING

BASIC OBJECTIVE

To educate officers in the basic sciences and technical fields related to ordnance in order to better equip them to handle ordnance problems ashore and afloat. The knowledge acquired will be generally applied through the medium of the Bureau of Ordnance Establishment to the end that the best and most advanced ordnance is available to the fleet.

ORDNANCE ENGINEERING (General)

OBJECTIVE

To further the aims of the basic objective by giving the officer students a fundamental course in ordnance in order that intelligent understanding of the various fields of ordnance may be obtained.

FIRST YEAR (O)

FIRST TERM

Ch-101(C)	General Inorganic Chemistry	3-2
EE-151(C)	DC Circuits and Fields	3-4
Ma-100(C)	Vector Algebra and Geometry	2-1
Ma-111(C)	Introduction to Engineering Mathematics	3-1
Mc-101(C)	Engineering Mechanics I	2-2
Or-101(C)	Ordnance I	2-1
		15-11

SECOND TERM

Ch-711(C)	Chemical Engineering Calculations	3-2
EE-241(C)	AC Circuits	3-2
Ma-112(B)	Differential Equations and Boundary Value Problems	4-0
Mc-102(C)	Engineering Mechanics II	2-2
Or-102(C)	Ordnance II	3-2
		15-8

THIRD TERM

Ch-631(A)	Thermodynamics	3-2
EE-461(C)	Transformers and Synchros	3-2
Ma-113(B)	Vector Analysis and Introduction to Partial Differential Equations	3-0
Mc-401(A)	Exterior Ballistics	3-0
Or-103(C)	Ordnance III	2-2
Ph-610(B)	Atomic Physics	3-0
*IE-103(C)	Applied Industrial Organization	0-1
*SL-101(C)	New Weapons Development I	0-1
		17-8

FOURTH TERM

Ch-401(A)	Physical Chemistry	3-2
EE-462(B)	Asynchronous Motors and Special Machines	4-2
Ma-114(A)	Partial Differential Equations and Functions of Complex Variables	3-0
Or-104(C)	Ordnance IV	2-1
Ph-450(B)	Underwater Acoustics	3-2
*IE-104(C)	Technical Lectures	0-1
*SL-102(C)	New Weapons Development II	0-1
		15-9

*Lecture course—no academic credit.

Summer field trip to representative ordnance installations.

SECOND YEAR (O2)

FIRST TERM

Ch-541(A)	Reaction Motors	2-2
EE-751(C)	Electronics	3-4
Ma-115(A)	Differential Equations for Automatic Control	3-0
ME-500(C)	Strength of Materials	3-0
ME-601(C)	Materials Testing Lab	0-2
Mt-201(C)	Introduction to Physical Metallurgy	3-2
*IE-101(C)	Principles of Industrial Organization	0-1
		14-11

SECOND TERM

Ch-521(A)	Plastics	3-2
EE-665(B)	Lines, Filters and Transients	4-2
Mc-402(A)	Dynamics of Missiles and Gyros	3-0
Mt-202(C)	Ferrous Physical Metallurgy	3-2
Ph-250(C)	Geometric and Physical Optics	3-2
		16-8

THIRD TERM			FOURTH TERM		
EE-745(A)	Electronic Control and Measurement	3-3	Ch-571(A)	Explosives	3-2
Es-446(C)	Introduction to Radar	2-2	EE-672(A)	Servo Mechanisms	3-3
Ma-301(B)	Statistics	3-2	Ma-401(A)	Mechanical Computation by Physical Means	2-2
Mc-431(B)	Strength of Guns	3-0	Mc-421(A)	Interior Ballistics	2-0
Mt-203(B)	Physical Metallurgy (Special Topics)	2-2	Mt-301(A)	High Temperature Materials	3-0
*SL-101(C)	New Weapons Development I	0-1	Oa-151(B)	Survey of Weapons Evaluation	3-0
			*SL-102(C)	New Weapons Development II	0-1
		13-10			16-8

*Lecture course—no academic credit.

Summer course in Industrial Administration at Stanford University.

ORDNANCE ENGINEERING (Aviation)

OBJECTIVE

To further the aims of the basic objective by emphasizing the aviation aspects of ordnance, including the limitations and peculiar advantages that are inherent in the aviation field.

FIRST YEAR (OE)

FIRST TERM			SECOND TERM		
Ch-101(C)	General Inorganic Chemistry	3-2	Ae-100(C)	Basic Aerodynamics	3-4
EE-151(C)	DC Circuits and Fields	3-4	Ch-711(C)	Chemical Engineering Calculations	3-2
Ma-100(C)	Vector Algebra and Geometry	2-1	EE-241(C)	AC Circuits	3-2
Ma-111(C)	Introduction to Engineering Mathematics	3-1	Ma-112(B)	Differential Equations and Boundary Value Problems	4-0
Mc-101(C)	Engineering Mechanics I	2-2	Mc-102(C)	Engineering Mechanics II	2-2
Or-101(C)	Ordnance I	2-1			
		15-11			15-10

THIRD TERM			FOURTH TERM		
Ae-121(C)	Technical Aerodynamics	3-2	Ae-136(B)	Aircraft Performance	3-2
Ch-631(A)	Thermodynamics	3-2	Ch-401(A)	Physical Chemistry	3-2
EE-461(C)	Transformers and Synchros	3-2	EE-462(B)	Asynchronous Motors and Special Machines	4-2
Ma-113(B)	Vector Analysis and Introduction to Partial Differential Equations	3-0	Ma-114(A)	Partial Differential Equations and Functions of Complex Variables	3-0
Mc-401(A)	Exterior Ballistics	3-0	Or-104(C)	Ordnance IV	2-1
*SL-101(C)	New Weapons Development I	0-1	*SL-102(C)	New Weapons Development II	0-1
*IE-103(C)	Applied Industrial Organization	0-1	*IE-104(C)	Technical Lectures	0-1
		15-8			15-9

*Lecture course—no academic credit.

Summer field trip to representative ordnance installations.

SECOND YEAR (OE2)

FIRST TERM			SECOND TERM		
Ae-501(A)	Hydro-Aero Mechanics I	4-0	Ae-502(A)	Hydro-Aero Mechanics II	4-0
Ch-541(A)	Reaction Motors	2-2	EE-665(B)	Lines, Filters and Transients	4-2
EE-751(C)	Electronics	3-4	Mc-402(A)	Dynamics of Missiles and Gyros	3-0
Ma-115(A)	Differential Equations for Automatic Controls	3-0	Mt-202(C)	Ferrous Physical Metallurgy	3-2
Mt-201(C)	Introduction to Physical Metallurgy	3-2	Or-102(C)	Ordnance II	3-2
*IE-101(C)	Principles of Industrial Organization	0-1	*Ae-001(C)	Aeronautical Lecture	0-1
		15-9			17-7

THIRD TERM

Ae-146(C)	Aircraft Dynamics	3-2
Ae-503(A)	Compressibility	4-0
EE-745(A)	Electronic Control and Measurement	3-3
Ma-301(B)	Statistics	3-2
Or-241(C)	Guided Missiles I	2-0
*SL-101(C)	New Weapons Development I	0-1
		15-8

FOURTH TERM

Ch-571(A)	Explosives	3-2
EE-672(A)	Servomechanisms	3-3
Es-456(C)	Introduction to Radar (Airborne)	2-2
Ma-401(A)	Mechanical Computation by Physical Means	2-2
Oa-151(C)	Survey of Weapons Evaulation	3-0
Or-242(B)	Guided Missiles II	2-0
*SL-102(C)	New Weapons Development II	0-1
		15-10

*Lecture course—no academic credit.

Summer course in Industrial Administration at Stanford University.

THIRD YEAR (OE3)

At Massachusetts Institute of Technology

FALL SEMESTER

- 16.15 Advanced Stability and Control of Aircraft
- 16.39 Vector Kinematics and Gyroscopic Instrument Theory
- 16.41 Fire Control Principles
- 16.43 Fire Control Instrument Lab
- 16.47 Rockets, Guided Missiles and Projectiles

SPRING SEMESTER

- 16.40 Automatic Control Equipment for Aircraft
- 16.42 Fire Control Systems
- 16.44 Fire Control Instruments Laboratory (Advanced)
- Thesis

ORDNANCE ENGINEERING (Explosives)

OBJECTIVE

To carry out the basic objective in the field of explosives by education in the chemical field as applied to explosives and propellants.

FIRST YEAR (OP)

FIRST TERM

Ch-101(C)	General Inorganic Chemistry	3-2
EE-151(C)	DC Circuits and Fields	3-4
Ma-100(C)	Vector Algebra and Geometry	2-1
Ma-111(C)	Introduction to Engineering Mathematics	3-1
Mc-101(C)	Engineering Mechanics I	2-2
Or-101(C)	Ordnance I	2-1
		15-11

SECOND TERM

Ch-221(C)	Qualitative Analysis	3-2
Ch-711(C)	Chemical Engineering Calculations	3-2
EE-241(C)	AC Circuits	3-2
Ma-112(B)	Differential Equations and Boundary Value Problems	4-0
Or-102(C)	Ordnance II	3-2
		16-8

THIRD TERM

Ch-231(C)	Quantitative Analysis	2-4
Ch-311(C)	Organic Chemistry	3-2
Ch-411(C)	Physical Chemistry	3-2
Ma-113(B)	Vector Analysis and Introduction to Partial Differential Equations	3-0
Or-103(C)	Ordnance III	2-2
*IE-103(C)	Applied Industrial Organization	0-1
		13-11

*Lecture course—no academic credit.

FOURTH TERM

Ch-312(C)	Organic Chemistry	3-2
Ch-412(C)	Physical Chemistry	3-2
Ch-521(A)	Plastics	3-2
Ch-611(C)	Thermodynamics	3-2
Ma-114(A)	Partial Differential Equations and Functions of Complex Variables	3-0
Or-104(C)	Ordnance IV	2-1
*IE-104(C)	Technical Lectures	0-1
		17-10

Summer field trip to representative ordnance installations.

SECOND YEAR (OP2)

FIRST TERM

Ch-541(A)	Reaction Motors	2-2
Ch-612(C)	Thermodynamics	3-2
Cr-271(B)	Crystallography and X-ray Techniques	3-2
EE-751(C)	Electronics	3-4
Mt-201(C)	Introduction to Physical Metallurgy	3-2
IE-101(C)	Principles of Industrial Organization	0-1
		14-13

SECOND TERM

Ch-413(A)	Advanced Physical Chemistry	2-2
EE-651(C)	Transients and Servos	3-4
ME-500(C)	Strength of Materials	3-0
ME-601(C)	Materials Testing Lab	0-2
Mt-202(C)	Ferrous Physical Metallurgy	3-2
Ph-610(B)	Atomic Physics	3-0
		14-10

THIRD TERM

Ch-111(A)	Fuel and Oil Chemistry	2-2
Ch-321(A)	Organic Qualitative Analysis	2-2
Ch-323(A)	Chemistry of High Polymers	3-0
EE-745(A)	Electronic Control and Measurement	3-3
Ma-301(B)	Statistics	3-2
*SL-101(C)	New Weapons Development I	0-1
		13-10

*Lecture course—no academic credit.

FOURTH TERM

Ch-322(A)	Advanced Organic Chemistry	3-2
Ch-571(A)	Explosives	3-2
Ch-800(A)	Chemistry Seminar	2-0
Mc-421(A)	Interior Ballistics	2-0
Oa-151(B)	Survey of Weapons Evaluation	3-0
Ph-450(B)	Underwater Acoustics	3-2
*SL-102(C)	New Weapons Development II	0-1
		16-7

Summer course in Industrial Administration at Stanford University.

THIRD YEAR (OP3)

At Lehigh University

FALL SEMESTER

Ch-440	Advanced Physical Chemistry
Ch-357	Qualitative Organic Analysis
Ch-402	Advanced Inorganic Chemistry
Ch-2	Chemistry Research
	Elective (approved advanced course in chemistry or related field)

SPRING SEMESTER

Ch-441	Advanced Physical Chemistry
Ch-358	Advanced Organic Chemistry
Ch-432	Advanced Analytical Chemistry
Ch-2	Chemistry Research
	Elective (approved advanced course in chemistry or related field)

ORDNANCE ENGINEERING (Fire Control)

OBJECTIVE

To carry out the aims of the basic objective in the fire control field by intensive instruction in the applicable basic sciences so that a fundamental grasp of fire control theory is obtained.

FIRST YEAR (OF)

FIRST TERM

Ch-101(C)	General Inorganic Chemistry	3-2
EE-151(C)	DC Circuits and Fields	3-4
Ma-100(C)	Vector Algebra and Geometry	2-1
Ma-111(C)	Introduction to Engineering Mathematics	3-1
Mc-101(C)	Engineering Mechanics I	2-2
Or-101(C)	Ordnance I	2-1
		15-11

SECOND TERM

Ch-711(C)	Chemical Engineering Calculations	3-2
EE-241(C)	AC Circuits	3-2
Ma-112(B)	Differential Equations and Boundary Value Problems	4-0
Mc-102(C)	Engineering Mechanics II	2-2
Or-102(C)	Ordnance II	3-2
		15-8

THIRD TERM

Ch-631(A)	Thermodynamics	3-2
EE-461(C)	Transformers and Synchros	3-2
Ma-113(B)	Vector Analysis and Introduction to Partial Differential Equations	3-0
Mc-401(A)	Exterior Ballistics	3-0
Or-103(C)	Ordnance III	2-2
Ph-610(B)	Atomic Physics	3-0
*IE-103(C)	Applied Industrial Organization	0-1
*SL-101(C)	New Weapons Development I	0-1
		17-8

FOURTH TERM

Ch-401(A)	Physical Chemistry	3-2
EE-462(B)	Asynchronous Motors and Special Machines	4-2
Ma-114(A)	Partial Differential Equations and Functions of Complex Variables	3-0
Or-104(C)	Ordnance IV	2-1
Ph-450(B)	Underwater Acoustics	3-2
*IE-104(C)	Technical Lectures	0-1
*SL-102(C)	New Weapons Development II	0-1
		15-9

*Lecture course—no academic credit.
Summer field trip to representative ordnance installations.

SECOND YEAR (OF2)

FIRST TERM

Ch-541(A)	Reaction Motors	2-2
EE-751(C)	Electronics	3-4
Ma-115(A)	Differential Equations for Automatic Controls	3-0
ME-500(C)	Strength of Materials	3-0
ME-601(C)	Materials Testing Lab	0-2
Mt-201(C)	Introduction to Physical Metallurgy	3-2
IE-101(C)	Principles of Industrial Organization	0-1
		14-11

SECOND TERM

EE-665(B)	Lines, Filters and Transients	4-2
Mc-402(A)	Dynamics of Missiles and Gyros	3-0
Mt-202(C)	Ferrous Physical Metallurgy	3-2
Ph-250(C)	Geometrical and Physical Optics	3-2
Or-231(B)	Advanced Fire Control	2-0
		15-6

THIRD TERM

EE-745(A)	Electronic Control and Measurement	3-3
Es-447(C)	Electronic Pulse Techniques	3-0
Ma-301(B)	Statistics	3-2
Mt-203(C)	Physical Metallurgy (Special Topics)	2-2
Or-241(C)	Guided Missiles I	2-0
*SL-101(C)	New Weapons Development I	0-1
		13-8

FOURTH TERM

Ch-571(A)	Explosives	3-2
EE-672(A)	Servomechanisms	3-3
Ma-401(A)	Mechanical Computation by Physical Means	2-2
Mc-421(A)	Interior Ballistics	2-0
Oa-151(C)	Survey of Weapons Evaluation	3-0
Or-242(B)	Guided Missiles II	2-0
*SL-102(C)	New Weapons Development II	0-1
		15-8

*Lecture course—no academic credit.
Summer course in Industrial Administration at Stanford University.

THIRD YEAR (OF3)

At Massachusetts Institute of Technology

FALL SEMESTER

16.39T Vector Kinematics and Gyroscopic Instrument Theory
16.41 Fire Control Principles
16.43 Fire Control Instrument Lab
6.291 Principles of Radar
6.536 Machine Computation
Thesis

SPRING SEMESTER

16.42 Fire Control Systems
16.44T Advanced Fire Control Instruments Lab
6.292 Principles of Radar
Thesis

ORDNANCE ENGINEERING (Industrial)

OBJECTIVE

To educate ordnance engineers in the principles of industrial management in order that effective direction of ordnance production activities may be obtained.

First two years are the same as the ORDNANCE ENGINEERING (General) Curriculum.

THIRD YEAR (03)
At Purdue University

FALL SEMESTER

GE 128 Motion and Time Study
GE 183 Production Planning
GE 184 Tool Design
GE 117 Industrial Personnel Relations
GE 91 Elementary Accounting
Psych 173 Personnel Psychology

SPRING SEMESTER

GE 185 Production Control
GE 186 Plant Layout
GE 299 Thesis
Psych 175 Psychology of Industrial Training

ORDNANCE ENGINEERING (Jet Propulsion)

OBJECTIVE

To educate officers in the fundamentals of jet propulsion and its applications to ordnance use.

FIRST YEAR (OJ)

FIRST TERM

Ch-101(C)	General Inorganic Chemistry	3-2
EE-151(C)	DC Circuits and Fields	3-4
Ma-100(C)	Vector Algebra and Geometry	2-1
Ma-111(C)	Introduction to Engineering Mathematics	3-1
Mc-101(C)	Engineering Mechanics I	2-2
Or-101(C)	Ordnance I	2-1
		15-11

SECOND TERM

Ae-100(C)	Basic Aerodynamics	3-4
Ch-711(C)	Chemical Engineering Calculations	3-2
EE-241(C)	AC Circuits	3-2
Ma-112(B)	Differential Equations and Boundary Value Problems	4-0
Mc-102(C)	Engineering Mechanics II	2-2
*Ae-001(C)	Aeronautical Lecture	0-1
		15-11

THIRD TERM

Ae-121(C)	Technical Aerodynamics	3-2
Ch-631(A)	Thermodynamics	3-2
Ma-113(B)	Vector Analysis and Partial Differential Equations	3-0
Mc-401(A)	Exterior Ballistics	3-0
Or-103(C)	Ordnance III	2-2
*SL-101(C)	New Weapons Development I	0-1
*IE-103(C)	Applied Industrial Organization	0-1
		14-8

FOURTH TERM

Ae-136(B)	Aircraft Performance Flight Analysis	3-2
Ch-401(A)	Physical Chemistry	3-2
Ma-114(A)	Partial Differential Equations and Functions of Complex Variables	3-0
ME-500(C)	Strength of Materials	3-0
ME-601(C)	Materials Testing Lab	0-2
Or-104(C)	Ordnance IV	2-1
*SL-102(C)	New Weapons Development II	0-1
*IE-104(C)	Technical Lectures	0-1
		14-9

*Lecture course—no academic credit.
Summer field trip to representative ordnance installations

SECOND YEAR (OJ2)

FIRST TERM

Ae-501(A)	Hydro-Aero Mechanics I	4-0
Ch-541(A)	Reaction Motors	2-2
EE-751(C)	Electronics	3-4
Mt-201(C)	Introduction to Physical Metallurgy	3-2
IE-101(C)	Principles of Industrial Organization	0-1
		12-9

SECOND TERM

Ae-502(A)	Hydro-Aero Mechanics II	4-0
EE-651(C)	Transients and Servos	3-4
Mc-402(A)	Dynamics of Missiles and Gyros	3-0
Mt-202(C)	Ferrous Physical Metallurgy	3-2
Or-102(C)	Ordnance II	3-2
		16-8

THIRD TERM

Ae-146(A)	Dynamics	3-2
Ae-503(A)	Compressibility I	4-0
EE-745(A)	Electronic Control and Measurement	3-3
Ma-301(B)	Statistics	3-2
Mt-203(C)	Physical Metallurgy (Special Topics)	2-2
*SL-101(C)	New Weapons Development I	0-1
		15-10

FOURTH TERM

Ch-301(C)	Organic Chemistry	3-2
Ch-571(A)	Explosives	3-2
Mc-421(A)	Interior Ballistics	2-0
Mt-301(A)	High Temperature Materials	3-0
Oa-151(C)	Survey of Weapons Evaluation	3-0
*SL-102(C)	New Weapons Development II	0-1
		14-5

*Lecture course—no academic credit.

Summer course in Industrial Administration at Stanford University.

THIRD YEAR (OJ3)

At California Institute of Technology

Ae-261 Hydrodynamics of Compressible Fluids
Ae-271 Experimental Methods in Aeronautics
JP-121 Rockets
JP-130 Thermal Jets
JP-200 Chemistry Problems in Jet Propulsion
JP-280 Research in Jet Propulsion
Ae-290 Aeronautical Seminar

ORDNANCE ENGINEERING (Special Physics)

OBJECTIVE

To educate officers in the fundamentals of nuclear physics in order to develop an understanding of the capabilities and limitations of atomic weapons.

FIRST YEAR (OX)

FIRST TERM

Ch-101(C)	General Inorganic Chemistry	3-2
Es-141(C)	DC Electricity	4-4
Ma-100(C)	Vector Algebra and Geometry	2-1
Ma-181(C)	Directional Derivatives and Locus Integrals	3-1
Mr-101(C)	Fundamentals of Atmospheric Circulation	3-0
Or-101(C)	Ordnance I	2-1
		17-9

SECOND TERM

Es-142(C)	AC Electricity	4-3
Ma-182(C)	Differential Equations and Vector Analysis	5-0
Ph-141(B)	Analytical Mechanics	4-0
Ph-250(C)	Geometrical and Physical Optics	3-2
		16-5

THIRD TERM

EE-451(C)	Transformers and Synchros	2-2
Es-113(C)	Circuit Analysis and Measurements	3-3
Es-261(C)	Electron Tubes and Circuits	3-2
Ma-183(B)	Complex Variables and the Differential Equations of Theoretical Physics	5-0
Ph-142(B)	Analytical Mechanics	4-0
*SL-101(C)	New Weapons Development I	0-1
		17-8

FOURTH TERM

EE-651(B)	Transients and Servos	3-4
Es-262(C)	Electron Tubes and Circuits	3-2
Ma-194(A)	Laplace Transforms, Matrices and Variations	5-0
Ph-351(B)	Electrostatics and Magnetostatics	5-0
*SL-102(C)	New Weapons Development II	0-1
		16-7

*Lecture course—no academic credit.

SECOND YEAR (OX2)
At Massachusetts Institute of Technology

SUMMER SEMESTER

6.80 Electrical Measurements Laboratory
8.08 Electronics

FALL SEMESTER

6.633 Electronic Circuit Theory
8.05 Atomic Physics
8.07 Thermodynamics and Statistical Mechanics
8.71 Introduction to Theoretical Physics I (Mechanics)
L17 Scientific German

SPRING SEMESTER

6.20 Electronic Control and Measurement
6.623 Pulse Circuits, Principles
8.101 Atomic Structure Laboratory
or
8.102 Electronic Devices Laboratory
8.06 Nuclear Physics
8.72 Introduction to Theoretical Physics II (Electromagnetic Theory)

Summer trip to AEC installations.

THIRD YEAR (OX3)
At Massachusetts Institute of Technology

FALL SEMESTER

8.361 Quantum Theory of Matter
8.511 Nuclear Physics I
8.57 Neutron Physics
N21 Nuclear Reactor Engineering I
Thesis

SPRING SEMESTER

8.512 Nuclear Physics II
N.20 Biological Effects of Nuclear Radiations
N.22 Nuclear Reactor Engineering II
Thesis

CURRICULA CONDUCTED ENTIRELY AT OTHER INSTITUTIONS

The short titles and descriptive names of the courses are taken from the college catalogue concerned. Further information must be sought in such catalogue.

All of these curricula are subject to changes from year to year, due to scheduling problems at the institution, the backgrounds of individual students, sponsoring bureau requirements, etc.

Each curriculum is assigned to one of the curricular officers of the Engineering School for supervision and administration of the Postgraduate School functions, including liaison between the sponsoring bureau or office and the college, initiation of changes to the curriculum, contact with students and college faculty, etc.

TABULATION OF CURRICULA

Curriculum	Group Designator	Institution	Cognizant P.G. School Curricular Officer
Business Administration	ZKC	Columbia University	Communications
Business Administration	ZKH	Harvard University	Communications
Business Administration	ZKS	Stanford University	Communications
Cinematography	ZCP	University of Southern California	Communications
Civil Engineering			
Advanced (Sanitary)	ZGM	University of Michigan	Naval Engineering
(Soil Mechanics and Foundations)	ZGR	Rensselaer Polytechnic Institute	Naval Engineering
(Structures)	ZGI	University of Illinois	Naval Engineering
(Waterfront Facilities)	ZGP	Princeton University	Naval Engineering
Qualification	ZG	Rensselaer Polytechnic Institute	Communications
Comptrollership	ZS	George Washington University	Communications
Hydrographic Engineering	ZV	Ohio State University	Aerological Engineering
Journalism	ZNF	Harvard University	Communications
Law	ZHC	Catholic University	Communications
Law	ZHG	Georgetown University	Communications
Law	ZHH	Harvard University	Communications
Law	ZHW	George Washington University	Communications
Law	ZHY	Yale University	Communications
Management and Industrial Engineering	ZT	Rensselaer Polytechnic Institute	Naval Engineering
Metallurgical Engineering	ZNM	Carnegie Institute of Technology	Naval Engineering
Naval Architecture and Marine Engineering	ZNB	Webb Institute of Naval Architecture	Naval Engineering
Naval Construction and Engineering	ZNB	Massachusetts Institute of Technology	Naval Engineering
Naval Intelligence	ZI	Naval Intelligence School	Communications
Nuclear Engineering (Advanced)	ZNE	Massachusetts Institute of Technology	Naval Engineering
Oceanography	ZO	Scripps Institution of Oceanography	Aerological Engineering
Personnel Administration and Training	ZP	Stanford University	Communications
Petroleum Logistics	ZL	University of Pittsburgh	Naval Engineering
Photography	ZCR	Rochester Institute of Technology	Communications
Public Information	ZIB	Boston University	Communications
Religion	ZU	Various Universities	Communications
Special Mathematics	ZMI	University of Illinois	Communications
Textile Engineering	ZM	Georgia Institute of Technology	Communications

DESCRIPTION

BUSINESS ADMINISTRATION (ZKC, ZKH, ZKS)

A two-year curriculum consisting generally of courses in the fields of finance, business organization, marketing, statistics, public relations, administrative practices, geography, etc. The summer between academic years is spent in individual assignments with industrial companies.

To develop the ability in officers to analyze business organization, problems and conditions, to acquire an appreciation for and an understanding of business as a whole, and to administer effectively future assignments which may require personal dealings with business and industrial concerns or utilization of business techniques.

CINEMATOGRAPHY (ZCP)

A twelve-month curriculum, to prepare officers for assignments to duty in connection with the production of training films and motion picture reports, conducted at the University of Southern California. Patterned to meet the needs and background of the individual student, it consists of such courses as Cinematic Effects, Laboratory Practice and Procedure, Film and Education, Sound, Filmic Expression and Cinmea History and Criticism. Sponsored by Chief of Naval Operations.

CIVIL ENGINEERING (Qualification) (ZG)

Seventeen months of instruction at Rensselaer Polytechnic Institute to qualify officers for civil engineering duties. Successful completion of this course normally leads to appointment in the Civil Engineering Corps. At present this is the only program for transfer of line officers to the Civil Engineer Corps.

CIVIL ENGINEERING (Advanced)
(ZGR, ZGM, ZGI, ZGP)

A graduate program, at the Master of Science level, covering four specialties, or options, and consisting of twelve to fifteen months at selected civilian institutions. Sponsored by the Bureau of Yards and Docks, the program includes the following specialties: (a) Soil Mechanics and Foundations, (b) Structures, (c) Sanitary, and (d) Waterfront Facilities. Students selected for this program will normally be CEC officers of the ranks of lieutenant and lieutenant (jg) who have a degree in Civil Engineering and have completed three years of commissioned service.

COMPTROLLERSHIP (ZS)

A 9½ months' course at George Washington University leading to a Master's degree in Business Administration. Formal academic courses are given in General Accounting, Industrial and Governmental Economics, Statistics and Reports Control, Managerial Accounting, Internal Control and Auditing, Governmental Budget Formulation and Execution, Advanced Management, Human Relations in Administration, Management Engineering and Seminar in Comptrollership. In addition, comptrollers from major industries and officers and civilians working at the department level present practical aspects of comptrollership.

HYDROGRAPHIC ENGINEERING (ZV)

A one-year course in Hydrographic Engineering given at Ohio State University to officers nominated by the Hydrographer. The curriculum presents a sound fundamental theoretical knowledge of geodesy, cartography and photogrammetry, particularly as applied to hydrographic surveying, and the compilation and production of charts and maps. The course majors in one of these three fields in order to enable the graduate to perform future hydrographic duties at the Hydrographic Office, on hydrographic survey expeditions or on major fleet staffs.

JOURNALISM (ZNF)

A one-year curriculum at Harvard University for qualified officers nominated by the Chief of Information and cleared by the Nieman Foundation. Normally only one such officer can be enrolled at a time; he actually attends Harvard as a postgraduate student but associates with the Nieman Fellows in their course of study. To promote and elevate the journalistic qualifications of a small, select group.

LAW (ZHC, ZHG, ZHW, ZHH, ZHY)

A three-year curriculum generally following that taken by civilian students working for a degree of Bachelor of Laws but emphasizing Admiralty Law, International Law, Legislative Drafting and Administrative Law where such courses are available. Summer employment is in the Office of Judge Advocate General and at the School of Naval Justice, Newport, R. I. This program has, in the past, been given at Georgetown, Catholic and George Washington universities; the students commencing in 1953 and subsequent years, however, will take the program at Harvard and Yale universities.

MANAGEMENT AND INDUSTRIAL ENGINEERING (ZT)

A nine-month course at Rensselaer Polytechnic Institute to prepare selected officers for managerial and executive billets in the Navy's industrial organization. The course majors in advanced production and industrial engineering as applied to managerial problems.

NAVAL CONSTRUCTION AND ENGINEERING (ZNB)

A three-year course at Massachusetts Institute of Technology or at Webb Institute of Naval Architecture to qualify officers for naval construction and engineering assignments. Successful completion of this curriculum normally leads to "Engineering Duty" designation.

NAVAL INTELLIGENCE (ZI)

Six months of instruction at the U. S. Naval School, Naval Intelligence, to train selected officers in all phases of intelligence. Following the intelligence course the students normally study a foreign language to qualify as an interpreter-translator. The length of time devoted to language study is dependent upon the language studied and the previous linguistic training of the student.

NUCLEAR ENGINEERING (Advanced) (ZNE)

A fifteen-month program at the Massachusetts Institute of Technology covering applied Nuclear Physics, Reactor Technology, and other subjects pertaining to Nuclear Engineering. The students for this program are selected by the Bureau of Ships.

OCEANOGRAPHY (ZO)

A one-year course at Scripps Institute of Oceanography to prepare officers for assignment to billets requiring specialized knowledge in the field of oceanography. Provided the student has adequate educational background, completion of the curriculum normally leads to a Master of Science degree.

PERSONNEL ADMINISTRATION AND TRAINING (ZP)

A one-year curriculum to prepare officers for assignment in personnel administration and supervision or administration of training activities, at Stanford University. It includes instruction in Statistical Methods; General, Educational and Social Psychology; General and Educational Sociology; General School Supervision; Counselling Techniques; Guidance; Personnel Management; Administration; and Business and Professional Speaking; Personnel Test and Measurements; Record Studies.

PETROLEUM LOGISTICS (ZL)

A two-year program consisting of one full year at the University of Pittsburgh followed by a year with a major oil company. It prepares selected senior officers for assignment to Munition Board or similar high-level logistics billets.

PHOTOGRAPHY (ZCR)

A two-year curriculum to prepare selected officers for technical duties involving photography; includes basic courses in the materials, processes and technical practices of photography including general chemistry, mathematics and physics, followed by specialized courses in the various photographic fields.

This course of instruction, conducted at Rochester Institute of Technology (ZCR Group), is patterned to meet the needs and background of the individual enrolled.

PUBLIC INFORMATION (ZIB)

A twelve-month postgraduate course in public information for information-specialist naval officers conducted at Boston University. Two officers are trained per year, one for a billet designated 1100 and one for a billet designated 1300. Students enrolled will be experienced naval officers with previous education and/or experience in the fields of Public Information and Public Relations. The course leads to the degree of Master of Science in Public Relations.

RELIGION (ZU)

Each student officer enrolled in this curriculum pursues courses of instruction in such subjects as Psychology, Speech, Education, Theology, Pauline Studies and Visual Aids.

An officer selected for this curriculum will be enrolled in the University of his choice if practicable. In recent years, officers have been enrolled at Fordham University, Harvard University and Union Theological Seminary. They have been collectively designated as the ZU Group.

SPECIAL MATHEMATICS (ZMI)

A two-year curriculum at the University of Illinois, sponsored by the Chief of Naval Operations, to further the education of specially selected officers, in higher mathematics, with emphasis on mathematical logic, mathematical statistics, and the application of digital computers.

STRUCTURAL DYNAMICS (ZSD)

An eighteen-month course at the University of Illinois designated primarily to provide a type of specialized professional training at the graduate level needed by some of the officers of the U. S. Navy Civil Engineering Corps and the U. S. Army Corps of Engineers, to assist them in handling design problems created by the advent of atomic weapons. The emphasis is on subject matter intended to lead to a better understanding of the effects of dynamic loads on structures. This will end with the students graduating in winter of 1953-54, and will be replaced by Civil Engineering (Structures) (ZGI).

TEXTILE ENGINEERING (ZM)

A two-year program of study at the Georgia Institute of Technology, to prepare officers for assignments involving manufacture, procurement, receipt, storage and issue of clothing and textiles.

The curriculum best suited to the individual's background and needs is determined in consultation with school authorities after his arrival. Normally includes such courses as Weaving, Fabrics Analysis, Chemical Textile Testing, Physical Textile Testing, Fabric Design, Circular Knitting, Bleaching and Dyeing, and Quality Control.

DETAILS OF CURRICULA CONDUCTED ENTIRELY AT CIVILIAN INSTITUTIONS

No details available for Cinematography (ZCP), Business Administration (ZK), Law (ZH), Personnel Administration and Training (ZP), Photography (ZCR), Religion (ZU), Special Mathematics (ZMI), and Textile Engineering (ZM).

CIVIL ENGINEERING

CIVIL ENGINEERING (Qualification)

At Rensselaer Polytechnic Institute

Refresher Period 8 weeks

11.90 Mathematics (CEC)
17.05 Mechanics and Strength of Materials
5.08 Surveying Curves and Earthwork (CEC)

SUMMER SESSION

10.11 Engineering Geology
5.78 Reinforced Concrete I
5.76 Elementary Structural Analysis

FALL TERM

5.09 Contracts and Specifications
5.05 Photogrammetry
5.15 Highways and Airports Eng. (CEC)
7.72 Utilization of Electrical Energy for Naval Establishments (CEC)
5.77 Structural Design I
5.80 Stresses in Highway and Railroad Bridges
6.55 Personnel Management and Industrial Relations (CEC)

SPRING TERM

5.32 Soil Mechanics (CEC)
5.75 Building Construction
5.79 Reinforced Concrete II
5.82 Indeterminate Structures I
12.42 Heating and Ventilation (CEC)
13.541 Metallurgy and Welding (CEC)
G5.82 Ship Repair and Shipbuilding Facilities (CEC)

SECOND SUMMER SESSION

5.59 Sanitary Engineering
7.69 Power Plants (CEC) Electrical Engineering
12.48 Power Plants (CEC) Mechanical Engineering
5.35 Foundation Engineering
5.16 Topographical Survey (Field Trip)
5.18 Route Survey (Field Trip)
Degree: BCE at end of Spring Term

CIVIL ENGINEERING (Advanced)

Four "options" or specialties are conducted at the graduate level, in accordance with the revised policy of the Bureau of Yards and Docks; these specialties supercede the former single Civil Engineering (Advanced) program.

SOIL MECHANICS AND FOUNDATIONS

Conducted at Rensselaer Polytechnic Institute

SUMMER TERM

12.48-7.69 Power Plant Theory (CEC)
G11.41 Advanced Calculus
or
G11.45 Applied Mathematics
Soil Mechanics and Foundations Refresher

FALL TERM

10.12 Advanced Geology
G5.30 Graduate Soil Mech. I
G5.32 Graduate Foundations I
G5.87 Prestressed Concrete
G17.51 Adv. Strength of Mat.
G5.49 Thesis

SPRING TERM

G5.31 Graduate Soil Mechanics II
G5.33 Graduate Foundations II
G5.37 Graduate Soil Mechanics III
G5.84 Planning Principles
G5.82 Shipbuilding and Ship Repair Facilities (CEC)
G5.36 Soil Mechanics Seminar
G5.49 Thesis
Degree: Master of Civil Engineering.

STRUCTURES

At University of Illinois

Objective: To provide advanced technical instruction for selected CEC officers in the field of structural design.

FIRST SUMMER

Math 343 Advanced Calculus
CE461 Structural Theory and Design
CE493 Special Problems

FALL SEMESTER

CE481 Numerical and Approx. Methods of Structural Analysis
CE486 Investigations in Reinforced Concrete Members
CE493 Special Problems
CE461 Structural Theory and design
CE373 Int. to Soil Mechanics
TAM421 Mechanics of Materials
TAM461 Inelastic Behavior of Eng. Materials

SPRING SEMESTER

CE482 Buckling, Vibrations and Impact
CE484 Behavior of Structures under Dynamic Load
CE467 Investigations in Reinforced Concrete Members
CE493 Special Problems
CE374 Applied Soil Mechanics
TAM462 Inelastic Behavior of Eng. Materials

The student selects courses from those tabulated above to suit his background needs and to carry the normal load to five units per term.

SECOND SUMMER

CE462 Structural Theory and Design
CE491 Thesis
TAM424 Properties of Eng. Materials
Degree: Master of Science in Civil Engineering.

SANITARY ENGINEERING

At University of Michigan

Objective: To provide advanced technical instruction in the field of water supply and sewage.

SUMMER

Chem.23 Introduction to Analytical Chemistry
Selected cognate subject such as Conservation of Natural Resources, W194S.

FALL

Bact.111E Bacteriology for Engineers
E.H.225 Sanitary Chemistry (Water and Sewage)
C.E.152 Sewerage and Sewage Treatment
C.E.155 Municipal and Industrial Sanitation
One of following
C.E.140 Hydrology
or
P.H.S.200 Introd. to Public Health Statistics
or
E.H.241 Principles and Methods of Industrial Health

SPRING

Chem.61 Organic Chemistry
C.E.152 Water Purification and Treatment
C.E.157 Industrial Waste Treatment
C.E.254 Sanitary Eng. Design
C.E.250 Sanitary Eng. Research With approval, E.H.226 and either P.H.P.231 or E.H.228 may be substituted for chem. 61.
E.H.226 Water and Sewage Plant Operation
E.H.228 Radiological Health
P.H.H.P.231 Statistics Applied to Stream Analysis.
Degree: M.S.E.

WATERFRONT FACILITIES

At Princeton University

Objective: To provide advanced technical instruction in waterfront development, including planning, design, construction, rehabilitation and maintenance of waterfront facilities.

SUMMER

Mathematics Refresher
Mechanics Refresher
Structural Theory Refresher

FALL TERM

Port and Harbor Engineering Seminar
Waterfront Structures Seminar
Eng.505 Graduate Structures
Eng.405 Soil Mechanics (audit) if no background therein.
Public Affairs 507 Problems in Administration
Thesis—Independent research in preparation.

SPRING TERM

Waterfront Structures Seminar
Eng.502 Soil Mechanics, Foundations, and Earth Structures Problems
Politics 512 Public Administration
Thesis
Degree: Master of Science.

COMPTROLLERSHIP

At George Washington University

Objective: To develop in officers of mature judgement and a broad background of professional experience the ability to interpret and analyze operational statistics for the purpose of developing standards of performance; to provide a periodic review of operations in order to denote areas of management which are not meeting standards; to review budget estimates; and to plan programs for the improvement of management economy and efficiency through better organization, administration and procedures and better utilization of manpower, materials, facilities, funds and time. The course is designed to give graduates a working knowledge of managerial controls adequate for assignment to comptroller duties as a normal preparation for command and executive billets in the shore establishment.

This course of instruction is convened six weeks before the beginning of the academic year for a refresher period, during which the officer students are to complete basic undergraduate courses in Accounting, Statistics and Economic Theory prior to the start of graduate studies with the Fall Term.

FALL TERM

ACCTG 3 General Accounting
ACCTG 211 Managerial Accounting
ACCTG 211 Seminar in Governmental Budgeting
STAT 120 Statistics and Reports Control
BUS ADM 261 Advanced Management
BUS ADM 263 Administrative Review and Program Analysis
BUS ADM 265 Seminar in Comptrollership

SPRING TERM

ACCTG 272 Internal Control and Auditing
ACCTG 222 Seminar in Governmental Budgeting
BUS ADM 168 Management Engineering
BUS ADM 262 Advanced Management
BUS ADM 264 Administrative Review and Program Analysis
BUS ADM 266 Seminar in Comptrollership
ECON 195 Industrial and Governmental Economics
Degree: Master in Business Administration.

MANAGEMENT AND INDUSTRIAL ENGINEERING

At Rensselaer Polytechnic Institute

Objective: To prepare officers to fill managerial and executive billets in the Navy's industrial organization.

FALL TERM

6.34 Production Planning and Control
6.52 Personnel Management and Industrial Relations I
G6.02 Cost Analysis
G6.25 Economic Analysis
3.26 Personnel Tests and Measurement
G6.05 Law for Engineers

SPRING TERM

6.25 Statistical Analysis
6.54 Personnel Management and Industrial Relations II
G6.18 Production Management
6.60 Business and Government
6.62 Management Seminar
Degree: Bachelor of Management Engineering

NAVAL CONSTRUCTION AND ENGINEERING

At Massachusetts Institute of Technology

Objective: To qualify officers for naval construction and engineering assignments.
Hull Design and Construction Subspecialty (XIII-A-1)

FIRST SUMMER

2.046 Strength of Materials
8.03 Physics (Electricity)
13.20 Elementary Ship Design
M73 Review of Mathematics

FIRST YEAR

FALL

2.081 Strength of Materials
2.402 Heat Engines
3.391 Properties of Metals
10.311 Heat Transfer
13.17 History of Warships
M351 Adv. Calculus for Engineers

SPRING

1.401T Structures
1.612 Fluid Mechanics
13.01 Statics of Ship Design
13.12 Warship General Arrangement
13.21 Warship Form Design
M352 Adv. Calculus for Engineers
Intersessional Field Trip; summer leave.

SECOND YEAR

FALL

1.63T Applied Hydromechanics
6.181 Electrical Engineering
13.02 Dynamics of Ship Design
13.13 Warship Structural Theory I
13.22 Warship General Design
13.75 Warship Propulsion

SPRING

1.42 Structures
1.683 Experimental Hydromechanics
3.392 Properties of Metals
6.191 Electrical Engineering
13.14 Warship Structural Theory II
13.24 Warship Structural Design II
13.76 Warship Propulsion II
Intersessional Field Trip; summer leave.

THIRD YEAR

FALL

2.216 Experimental Stress Analysis
6.351 Engineering Acoustics
13.15 Warship Basic Design I
13.16 Warship Basic Design II
13.25 Warship Structural Design II
13.54 Marine Eng. Dynamics
Thesis

SPRING

1.58 Elastic Stability of Flat Plates
13.26 Preliminary Design of Warships
14.113 Economics and Labor Relations
13.04 Ship Design, Advanced
Thesis
Degree: Naval Engineer.

Note: Three other subspecialties are offered, all of which contain basic ship design, but proportionately greater amounts of other phases of marine engineering. These are:

XIII-S-2 Marine Electrical Engineering
XIII-A-3 Electronics Engineering
XIII-A-4 Ship Propulsion Engineering

NAVAL CONSTRUCTION AND ENGINEERING

(Hull Design and Construction)

At Webb Institute of Naval Architecture

This three-year curriculum is basically equivalent to the Hull Design and Construction Subspecialty at M.I.T. The schedule provides for a long winter practical work period (field trip), each year, during which the students work in a naval shipyard or other suitable installation.

FIRST SUMMER

Practical Naval Architecture I
Calculus Review
Mechanics Review

FIRST YEAR

Calculus III and IV
Differential Equations
Theoretical Fluid Mechanics I and II
Ship Model Testing
Thermodynamics I and II
Mechanical Processes
Mechanics of Materials I and II
Laying Off
Practical Naval Architecture II and III
Theoretical Naval Architecture I and II
Naval Architecture Design I and II
Ship Resistance and Propellers I

SECOND YEAR

Advanced Theoretical Fluid Mechanics
Metallurgy
Advanced Structures I and II
Structures Lab
Electrical Engineering IV
Ship Resistance and Propellers II
Naval Architecture Design III
Theoretical Naval Architecture III
Theory of Warship Design I and II
Warship Design I and II
Internal Combustion Engines
Marine Engineering III and IV

THIRD YEAR

Economics I and II
Advanced Structures III
Kinematics and Machine Design
Vibrations
Theory of Warship Design III and IV
Warship Design III and IV
Marine Engineering V and VI
Thesis
Degree: Master of Science

NUCLEAR ENGINEERING (Advanced)

At Massachusetts Institute of Technology

FIRST SUMMER

8.05 Atomic Physics
10.31 Chemical Engineering
10.32 Chemical Engineering
8.06N Nuclear Physics (Special Seminar)

FALL

2.521 Adv. Heat Transfer
3.396 Technology of Nuclear Reactor Materials
8.511 Nuclear Physics I
N.21 Nuclear Reactor Eng. I
8.57 Neutron Physics (Engineering Emphasis)

SPRING

2.783 Control Probs. in Mech. Engineering
8.512 Nuclear Physics II
N20 Biological Effects of Nuclear Radiation
N22 Nuclear Reactor Eng. II
Thesis

SECOND SUMMER

Thesis

Degree: M.S. in Chemical Engineering

PETROLEUM LOGISTICS

At University of Pittsburgh and in Petroleum Industry

Formerly Petroleum Engineering (Advanced)

Objective: To equip senior officers with a broad understanding of the petroleum industry, its problems and economics, for duties on the Munitions Board and other high-level logistics agencies where liaison with civilian industry is required.

FIRST YEAR

FALL

Pet. Eng. 101 Drilling and Development
Pet. Eng. 104 Business of Oil and Gas Production
Pet. Eng. 105 Petroleum Testing
Pet. Eng. 106 Petroleum Production Lab.
Pet. Eng. 110 Fundamentals of Reservoir Eng.
Chem. Eng. 17 Petroleum Processes
Geology 2 Historical Geology

SPRING

Pet. Eng. 102 Petroleum Production Practice
Pet. Eng. 107 Gathering, Transportation and Storage
Pet. Eng. 108 Reservoir Eng. Seminar
Pet. Eng. 200 Research and Thesis
Pet. Eng. 227 Valuation of Oil and Gas Properties
Geology 121 Geology of Oil and Gas
Geography 53 World Resources and Industry

SUMMER

Transportation 109 Principles of Transportation
Pet. Eng. 200 Thesis

SECOND YEAR

Assigned to various petroleum industrial concerns under instruction. This period is devoted to intensive study of operations and procedure in office and field, in close contact with the management.

Degree: M.S. on completion of Summer Term of academic work.

PUBLIC INFORMATION

At Boston University

Objective: To advance the qualifications of a small group of officers in public relations.

The following is a typical curriculum composed of representative courses which are described in the Boston University Bulletin, catalogue issue 1952-1953.

ZIB GROUP

FIRST SEMESTER

PR-441 Publicity: Principles and Practice II
PR-461 Government Relations
PR-701 Comtemporary Problems in Public Relations
PR-721 Methods in Social Science Research
PR-741 Propaganda—Its Analysis and Use

SECOND SEMESTER

PR-445 Advanced Techniques in Public Relations Media
PR-702 Contemporary Problems in Public Relations II
PR-761 Factors Influencing Morale
PR-801 Special Problems in Public Relations

SUMMER SESSION

PR-825 Thesis Seminar
Degree: M.S. in Public Relations

THE ENGINEERING SCHOOL

Description of Courses at Monterey

Descriptive name of course is followed by two numbers, separated by a hyphen. The first number signifies classroom hours; the second, laboratory hours.

THE ACADEMIC LEVEL OF A COURSE IS INDICATED BY A LETTER IN PARENTHESES AFTER THE COURSE NUMBER AS FOLLOWS:

(A) Full graduate course

(B) Partial graduate course

(C) Undergraduate course

One term credit-hour is given for each hour of lecture or recitation, and half of this amount for each hour of laboratory work. A term credit-hour is equivalent to two thirds of the conventional college semester credit hour because the Engineering School term is of ten weeks' duration in contrast to the usual college semester of 15 or 16 weeks.

AEROLOGY

Mr Courses

Fundamentals of Atmospheric Circulation	Mr-101(C)
Radiological Defense	Mr-110(C)
Operational Aspects of Meteorology and Oceanography	Mr-120(C)
Introduction to Synoptic Meteorology	Mr-200(C)
Weather Maps and Codes	Mr-201(C)
Surface Weather Map Analysis	Mr-202(C)
Weather Analysis and Forecasting	Mr-203(C)
Upper-Air Analysis and Forecasting	Mr-204(C)
Advanced Weather Analysis and Forecasting	Mr-215(B)
Advanced Weather Analysis and Forecasting	Mr-216(B)
Upper-Air Analysis and Forecasting	Mr-217(B)
Advanced Weather Analysis and Forecasting	Mr-226(B)
Upper-Air Analysis and Forecasting	Mr-227(B)
Southern Hemisphere and Tropical Meteorology	Mr-228(B)
Selected Topics in Meteorology	Mr-229(B)
Operational Forecasting	Mr-230(A)
Synoptic Meteorology I	Mr-301(C)
Synoptic Meteorology II	Mr-302(C)
Synoptic Meteorology III	Mr-303(C)
Dynamic Meteorology I	Mr-321(A)
Dynamic Meteorology II	Mr-322(A)
Dynamic Meteorology III (Turbulence and Diffusion)	Mr-323(A)
Meteorological Charts and Diagrams	Mr-402(C)
Introduction to Physical Meteorology	Mr-403(C)
Meteorological Instruments	Mr-410(C)
Thermodynamics of Meteorology	Mr-411(B)
Physical Meteorology	Mr-412(A)
The Upper Atmosphere	Mr-422(A)
Climatology	Mr-510(C)
Applied Climatology	Mr-520(B)
Sea and Swell Forecasting	Mr-610(C)
Sea and Swell Forecasting	Mr-620(B)
Seminar	Mr-810(A)

Mr-101(C) Fundamentals of Atmospheric Circulation — 3-0

Primarily designed to give non-aerological student officers a survey of meteorology. The topics included are essentially the same as in Mr-200; however, there is greater emphasis on large and small scale circulations.

Text: Petterssen: Introduction to Synoptic Meteorology.

Prerequisite: None.

Mr-110(C) Radiological Defense — 2-0

Basic theory of atomic weapons and effects as applied to aerological aspects of atomic and radiological warfare. Principles of operation of various instruments utilized in field.

Texts: Nucleonics for the Navy; appropriate NWP's.

Prerequisite: Ph-191(C) or equivalent.

Mr-120(C) Operational Aspects of Meteorology and Oceanography — 3-0

Distribution of physical properties of the atmosphere and the oceans, with resultant circulation patterns. Methods of prediction of weather and sea conditions, with application to naval operations.

Texts: Berry, Bollay, Beers: Handbook of Meteorology; selected NavAer publications.

Prerequisite: None.

Mr-200(C) Introduction to Synoptic Meteorology — 3-0

Composition and vertical structure of the atmosphere, physical processes, general circulation, air masses, fronts, cyclones, and anticyclones, and weather forecasting.

Text: Petterssen: Introduction to Synoptic Meteorology.

Prerequisite: None.

Mr-201(C) Weather Maps and Codes — 2-12

Elementary principles of meteorology are outlined by lectures and motion pictures. Methods, instruments, and conventions used in observing the state of the atmosphere from the surface and aloft are discussed and the data encoded for transmission and analysis. Data are decoded and plotted. A series of aircraft flights are made.

Texts: Radio Weather Aids, H.O. 206; various Navy and Weather Bureau code publications.

Prerequisite: None.

Mr-202(C) Surface Weather Map Analysis 2-12

Lectures cover the following topics: Weather producing processes; graphical representation of atmospheric properties and processes; geostrophic and gradient wind scales; representativeness and diurnal variation of meteorological elements; anatomy and synoptic characteristics of fronts, wave cyclones and occlusions.

In laboratory, a selected series and current daily weather maps are analyzed, making use of upper wind data; local weather is observed and map analyses discussed. A series of flights are made by the students to compare observed flight conditions with those indicated on the weather map.

Texts: Berry, Bollay, Beers: Handbook of Meteorology; departmental notes.

Prerequisites: Mr-200(C), Mr-201(C).

Mr-203(C) Weather Analysis and Forecasting 2-12

A continuation of Mr-202(C). Lectures cover the following: inversions and cross-sections; fog and fog forecasting; kinematics of fronts and pressure systems; construction of trajectories; constant-level and constant pressure charts; and differential analyses.

In laboratory, advanced methods of current weather map analysis and forecasting are presented. Relation of upper air observations to the overall structure of the atmosphere, daily forecasts, map discussions and flight cross-sections are covered. Flight cross-sections are verified through a series of flights over various routes.

Texts: Berry, Bollay, Beers: Handbook of Meteorology; selected NavAer publications.

Prerequisites: Mr-202(C), Ma-162(C).

Mr-204(C) Upper-Air Analysis and Forecasting 2-12

A continuation of Mr-203(C). Lectures cover the following: stability analysis, deepening and filling, prognostic upper-air charts, forecasting displacement of fronts and pressure systems, air-mass stability and frontal-passage forecasts, and middle-latidude forecasting techniques.

In laboratory, the relationship between various upper-air charts and the sea-level chart. Preparation of differential, jet stream and isotach analyses, and prognostic upper-air charts. Daily forecasts and map discussions are continued, with verification based on computation of winds and pressure surfaces from aircraft in flight.

Texts: Berry, Bollay, Beers: Handbook of Meteorology; Riehl et al: Forecasting in Middle Latitudes; selected NavAer publications.

Prerequisites: Mr-203(C), Mr-301(C), Mr-402(C), Ma-163(C).

Mr-211(C) Weather Codes, Maps, and Elementary Surface Analysis 2-12

Lectures include: techniques of weather observations and the encoding, decoding and plotting of data; fundamentals of map analysis; weather producing processes; graphical representation of atmospheric properties and processes; geostrophic and gradient wind scales. An Aerology series of motion pictures is shown. In laboratory, weather data are decoded and plotted, weather observations are made, an elementary series of maps is analyzed and aircraft flights are made for familiarization.

Texts: Departmental notes.

Prerequisites: None.

Mr-212(C) Surface Weather Map Analysis 2-12

Continuation of Mr-211(C). Lectures include: representativeness and diurnal variation of meteorological elements; anatomy and synoptic characteristics of fronts, wave cyclones and occlusions; inversions and cross-sections; fog and fog forecasting; construction of trajectories. In laboratory, current daily weather maps are analyzed making use of upper-air data, and map analyses are discussed. A series of flights are made by the students to compare observed flight conditions with those indicated on the weather map.

Texts: Berry, Bollay, Beers; Handbook of Meteorology; Departmental Notes; Selected NavAer Publications.

Prerequisites: Mr-200(C); Mr-211(C); Mr-402(C).

Mr-213(C) Weather Analysis and Forecasting 2-12

A continuation of Mr-212(C). Lectures cover the following: constant level and constant pressure charts; differential analyses; upper-level patterns and trends, long and short waves, blocks and closed circulations, and the jet streams; prognostic upper-air charts; forecasting displacement of fronts and pressure systems; deepening and filling; air mass, stability and frontal passage forecasts; temperature and precipitation forecasting.

Laboratory work includes: relationship between upper-air charts and the sea-level chart; differential, jet stream and isotach analyses; prognostic surface and upper-air charts; flight cross-sections; daily forecasts and map discussions; special weather sequences for selected areas of the world; verification of flight cross-sections and forecasts based on computation of winds and pressure surfaces and observation of weather from aircraft in flight.

Texts: Berry, Bollay, Beers: Handbook of Meteorology; Riehl et al: Forecasting in Middle Latitudes; Selected NavAer Publications.

Prerequisites: Mr-212(C); Mr-311(B); Ma-163(C).

Mr-215(B) Advanced Weather Analysis and Forecasting 0-12

Various analysis and forecasting techniques developed in previous synoptic and theoretical courses applied to laboratory and inflight solution of selected forecast problems. Special weather sequences for selected localities of the world, arctic, tropics and Southern Hemisphere are analyzed.

Text: None.

Prerequisites: Mr-204(C), Mr-302(C), Oc-201(C).

Mr-216(B) Advanced Weather Analysis and Forecasting 2-12

Continuation of Mr-215 (B). Lectures cover the following: general operational weather problems; weather briefing for overseas flight clearances, carrier strikes and amphibious operations; pressure pattern flight; single station forecasting, CAA and general flight manuals, instructions and supplements; fleet and area commanders' instructions; and detailed climatology of major areas of interest.

In laboratory, analysis and forecast of the weather in accordance with recent advanced methods using all available sources of information. Coordinated with Mr-217(B). Verification of flight forecasts and cross sections based on actual inflight observations and computations.

Texts: NavAer 50-110R-50: Weather Briefing Manual; other selected NavAer publications; lecture notes.

Prerequisites: Mr-215(B), Mr-303(C), Mr-403(C).

Mr-217(B) Upper-Air Analysis and Forecasting 0-8

Constant-pressure, Jet-stream, and isotach analysis presented and supplemented by surface map analysis in Mr-216(B). Time cross-sections and constant absolute vorticity trajectories computed. Computations necessary for pressure-pattern flight carried out and checked by inflight observations.

Text: None.

Prerequisites: Mr-303(C), Mr-215(B), Mr-403(C).

Mr-226(B) Advanced Weather Analysis and Forecasting 2-9

Lectures review the following: fundamental weather-producing processes; principles of surface map analysis, constant-pressure and differential analyses and preparation of surface and upper-air prognostic charts. In the laboratory, upper-air observations and analyses used to determine air mass characteristics, three-dimensional weather analysis stressed by use of upper-air charts, differential analyses, and vertical cross sections in conjunction with surface charts. Daily forecasts of surface and upper-air conditions are prepared and discussed.

Texts: Berry, Bollay, Beers: Handbook of Meteorology; selected NavAer and AROWA publications; departmental notes.

Prerequisites: Mr-411(B), Mr-412(A), Ma-103(B).

Mr-227(B) Upper-Air Analysis and Forecasting 2-9

A continuation of Mr-226(B). Lectures review forecasting displacement of fronts and pressure systems, deepening and filling of pressure systems, and latest forecasting methods based on three-dimensional analysis, with emphasis on the role of the jet stream. In the laboratory, principles outlined in lectures are applied to analysis of synoptic charts and preparation of prognostic charts. A special period is devoted to practical trials of new or untested synoptic techniques.

Texts: Same as for Mr-226(B), plus Riehl et al: Forecasting in Middle Latitudes.

Prerequisites: Mr-226(B), Mr-321(A), Mr-228(B).

Mr-228(B) Southern Hemisphere and Tropical Meteorology 2-0

Southern Hemisphere synoptic meteorology, tropical synoptic models (with emphasis on the tropical cyclone), and tropical forecasting.

Texts: Berry, Bollay, Beers: Handbook of Meteorology; selected U. S. Navy and Weather Bureau publications.

Prerequisite: Mr-321(A) concurrently.

Mr-229(B) Selected Topics in Meteorology 2-0

General circulation of the atmosphere, single-station analysis and forecasting, arctic and antarctic meteorology, extended-range forecasting, and recent developments as time permits.

Texts: Selected U. S. Navy and Weather Bureau publications.

Prerequisite: Mr-321(A), Mr-228(B), Ma-134(B).

Mr-230(A) Operational Forecasting 0-10

Presentation and application of recent developments in the technique of preparing surface and upper-level prognostic charts. Preparation of forecast from prognostic charts. Streamline and jet-stream analysis, time cross-sections, constant absolute vorticity trajectories, time and space differential analysis techniques. Instruction in the preparation of aerological annexes to Naval Operations Plans.

Text: Riehl et al: Forecasting in Middle Latitudes.

Prerequisites: Mr-227(B), Mr-422(A), Mr-520(B).

Mr-301(C) Synoptic Meteorology I 4-0

The General Circulation, production and transformation of air masses; the equations of motion, wind and pressure systems, the thermal wind, differential analysis, and frontogenesis.

Texts: Berry, Bollay, Beers: Handbook of Meteorology; departmental notes.

Prerequisites: Mr-200(C), Ph-191(C), Ma-162(C).

Mr-302(C) Synoptic Meteorology II 4-0

A continuation of Mr-301(C), covering the following topics: frontal characteristics, theoretical and synoptic analysis of pressure changes, and methods of long-range forecasting.

Texts: Same as for Mr-301(C).

Prerequisites: Mr-301(C), Mr-402(C).

Mr-303(C) Synoptic Meteorology III 4-0

A continuation of Mr-302(C), covering Southern Hemisphere meteorology, tropical analysis and forecasting, arctic and antarctic meteorology, objective forecasting methods, and marine meteorology.

Texts: Same as for Mr-302(C) plus selected NavAer and AROWA pamphlets.

Prerequisites: Mr-302(C), Mr-403(C), Ma-381(C).

Mr-311(B) Synoptic Meteorology Ia 5-0

The general circulation; production and transformation of air masses; the equations of motion, wind and pressure systems, the thermal wind, and differential analysis; frontogenesis, fronts, and frontal characteristics.

Texts: Berry, Bollay, Beers: Handbook of Meteorology; Departmental Notes.

Prerequisites: Mr-200(C); Mr-402(C); Ma-163(C) concurrent.

Mr-312(B) Synoptic Meteorology IIa 5-0

Theoretical and synoptic analysis of pressure changes; methods of long-range forecasting; Southern Hemisphere, tropical, and polar analysis and forecasting; objective forecasting methods.

Texts: Same as for Mr-311(B), plus selected NavAer and AROWA pamphlets.

Prerequisites: Mr-311(B); Ma-361(C) concurrent.

Mr-321(A) Dynamic Meteorology I 3-0

The equations of motion in the absolute and relative reference frames. Solutions in particular atmospheric cases. Geostrophic and gradient winds measured in surfaces of constant property. Streamlines and trajectories. The thermal wind equation in various forms. Surfaces of discontinuity. Solenoids and the circulation theorems.

Texts: Holmboe, Forsythe and Gustin: Dynamic Meteorology; Petterssen: Weather Analysis and Forcasting.

Prerequisites: Mr-411(B), Mr-412(A), Ma-103(B).

Mr-322(A) Dynamic Meteorology II 3-0

A continuation of Mr-321(A), covering the topics listed below. Continuity and tendency equations. Convergence and divergence in general and in application to circular and wave-shaped systems. The vorticity theorem with applications to certain types of atmospheric flow. Frontogenesis and frontolysis in relation to linear velocity fields. Perturbation techniques in the solution of the equations of motion.

Texts: Same as for Mr-321(A) plus Haurwitz: Dynamic Meteorology.

Prerequisites: Mr-321(A), Ma-134(B).

Mr-323(A) Dynamic Meteorology III 3-0
(Turbulence and Diffusion)

A continuation of Mr-322(A) and considers the following topics: General effects of viscosity, equations of motion for laminar and turbulent flow, wind variation in the surface layer, energy changes in wind systems, transfer of properties by turbulent mass exchange, diurnal temperature variation; transformation of air masses; and introduction to the statistical theory of turbulence.

Texts: Berry, Bollay, Beers: Handbook of Meteorology; Sutton: Micrometeorology; Brunt: Physical and Dynamical Meteorology.

Prerequisites: Mr-321(A), Ma-134(B).

Mr-402(C) Meteorological Charts and Diagrams 3-0

A treatment of elementary thermodynamics and its application in meteorology, with particular emphasis on thermodynamic charts and diagrams. Atmospheric stability, instability phenomena, and the forecasting techniques are discussed.

Text: Haltiner: Mimeographed notes titled Elementary Meteorological Thermodynamics.

Prerequisites: Ph-191(C), Ma-162(C).

Mr-403(C) Introduction to Physical Meteorology 4-0

This course divides naturally into two parts: (a) properties of radiation in general, solar and terrestrial radiations and their contributions to certain large and small scale atmospheric energy problems; (b) laminar and turbulent flow. The Navier-Stokes equations and their modification by Reynolds. Structure of the mean wind in the surface and frictional layers. Diurnal variation of certain properties affected by turbulence. Air mass modification by turbulence. Diffusion from point and line sources.

Texts: Berry, Bollay, Beers: Handbook of Meteorology; mimeographed notes.

Prerequisites: Mr-302(C), Ma-163(C).

Mr-410(C) Meteorological Instruments 2-3

Standard naval meteorological instruments including those required for aircraft observations are studied and used by the students in the laboratory and while airborne. Additional instrumentation peculiar to (1) cold climates, (2) high elevations, and (3) micrometeorological elements is investigated generally. Special attention is paid to errors and reliability of observation.

Texts: Middleton: Meteorological Instruments; Aerographer's Manual; U. S. Weather Bureau: Circular "P"; From: Instrument Work Book.

Prerequisite: Ph-191(C).

Mr-411(B) Thermodynamics of Meteorology 5-2

The physical variables; the equation of state; first law of thermodynamics; properties of gases; properties of water and moist air; thermodynamic diagrams; air-mass identification indices; geopotential determinations; instability phenomena and criteria.

Texts: Holmboe, Forsythe, Gustin: Dynamic Meteorology; U. S. Department of Commerce Publication: The Thunderstorm.

Prerequisites: Ma-132(C), Ph-196(C).

Mr-412(A) Physical Meteorology 3-0

Radiation in general. Solar radiation and the measurement of the solar constant. The geographic and seasonal distribution of insolation. Absorption, scattering and diffuse reflection of solar radiation in the atmosphere. Terrestrial radiation and the atmospheric radiation chart. Computations of atmospheric radiation heat loss or gain. Applications to air-mass modification and to minimum temperature forecasting with arbitrary sky condition and turbulence effects. The heat budget of the earth-atmosphere system. Selected topics on atmospheric optics.

Texts: Berry, Bollay, Beers: Handbook of Meteorology; Elsasser: Heat Transfer by Infra-red Radiation in the Atmosphere; Albright: Physical Meteorology.

Prerequisites: Ph-196(C), Ma-132(C).

Mr-422(A) The Upper Atmosphere 5-0

Quantum theory. The nature of the stratosphere as determined from several lines of observation. The ionosphere and related optical and electrical activity. The sun and its effect on atmospherics. Terrestrial magnetic variations. Atmospheric oscillations of tidal origin. The aurora. Composition of the atmosphere.

Texts: Mitra: The Upper Atmosphere; Semat: Atomic Physics.

Prerequisites: Mr-322(A), Mr-323(A).

Mr-510(C) Climatology 2-0

The distribution with respect to season, geography and orography of the major meteorological elements. Definitions of climatic zones and types according to Koppen, and their meteorological descriptions. Micrometeorology. Regional climatology of the oceans. Climatology as a tool in objective forecasting.

Text: Haurwitz and Austin: Climatology.

Prerequisites: Mr-203(C), Mr-301(C).

Mr-520(B) Applied Climatology 2-2

Review of methods of classifying climates. Synoptic climatology. Statistical evaluation of climatological data. Methods of presenting climatological data to non-aerological personnel. Objective forecasting techniques. Application of above during laboratory period.

Texts: Conrad and Pollack: Methods in Climatology; Jacobs: Wartime Developments in Applied Climatology.

Prerequisites: Ma-331(A), Mr-510(C) or equivalent.

Mr-610(C) Sea and Swell Forecasting 2-2

Wind wave generation, propagation and decay; forecasting surface deep-water waves from meteorological data, their transformation and refraction in shallow water, breakers and surf; statistical properties of waves.

Texts: H.O. 604: Techniques for Forecasting Wind Waves and Swell; H.O. 234: Breakers and Surf, Principles in Forecasting.

Prerequisites: Mr-302(C), Oc-201(C).

Mr-620(B) Sea and Swell Forecasting 2-2

Similar to Mr-610(C), but emphasis on new developments, including statistical theory of wave generation.

Texts: H.O. 604: Techniques for Forecasting Wind Waves and Swell; H.O. 234: Breakers and Surf; mimeographed notes.

Prerequisite: Oc-111(B).

Mr-810(A) Seminar 2-0

Students study and prepare synopses of current publications or original data concerning meteorology and present them for group discussion.

Text: None.

Prerequisites: Mr-229(B), Mr-422(A). Mr-520(B).

AERONAUTICS

Ae Courses

Ae-001(C) Aeronautical Lecture Series 0-2

Lectures on general aeronautical engineering subjects by prominent authorities from the Bureau of Aeronautics, research laboratories and the industry.

Text: None.

Prerequisite: None.

Ae-001(C) Aeronautical Lecture Series 0-1

Lectures on electrical engineering subjects in connection with aeronautical engineering by prominent authorities from the Bureau of Aeronautics, research laboratories, and the industry.

Text: None.

Prerequisite: None.

Ae-100(C) Basic Aerodynamics 3-4

Properties of fluids; statics; velocity and pressure; Bernoulli's theorem; cavitation; theory of lift; blade screws and propellers; viscous flows; vortices; laminar and turbulent boundary layer flows; separation phenomena; surface friction; resistance of floating bodies; dynamics of compressible fluids. The laboratory periods include experimental work in the wind tunnel, allied to the topics above; technical analysis and report writing.

Texts: Dodge, Thompson: Fluids Mechanics; Rouse: Elementary Fluids Mechanics.

Prerequisite: None.

Ae-104(C) Aircraft Performance Evaluation 3-0

Fundamentals of technical aerodynamics; aircraft aerodynamic characteristics, performance analysis and propulsion characteristics; operational analysis of aircraft in fuel consumption, range, and performance.

Texts: Dwinnell: Principles of Aerodynamics; NavAer publications.

Prerequisites: Oa-103(B); Ph-541(B).

Ae-121(C) Technical Aerodynamics 3-2

Characteristic flows and pressures about bodies; surface friction; wake drag; aerodynamic characteristic of airfoil sections; three-dimensional airfoil theory; induced drag; interference drag; high lift devices; velocity polar. The laboratory periods include wind tunnel experiments, analysis and technical report writing on topics allied to the above class work.

Texts: Dwinnell: Principles of Aerodynamics; Pope: Wind Tunnel Testing.

Prerequisite: Ae-100(C).

Ae-131(C) Technical Aerodynamics Performance 4-2

The aerodynamic characteristics of the airplane; propeller and engine characteristics; sea level performance; performance at altitudes; superchargers;

range and endurance; special performance problems; charts. The laboratory periods are devoted to computations and performance analysis.

Texts: The same as in Ae-121(C).

Prerequisite: Ae-121(C).

Ae-132(B) Flight Analysis 3-2

Parametric study of aircraft performance; flight test procedure; flight data reduction; special flight problems. Laboratory periods are devoted to problems dealing with the above.

Text: Hamlin: Flight Testing.

Prerequisite: Ae-131(C).

Ae-136(B) Aircraft Performance—Flight Analysis 3-2

Aerodynamic characteristics of composite aircraft; propeller and engine characteristics; aircraft performance; range and endurance; special performance problems; performance parameters; flight test reduction and analysis. Laboratory analysis of performance of an aircraft will be made based upon wind tunnel tests; analysis of practical problems from flight test.

Texts: Pope: Wind Tunnel Testing; Hamlin: Flight Testing.

Prerequisite: Ae-121(C).

Ae-141(A) Dynamics I 3-4

Fundamental definitions; the forces and moments on the entire airplane; the equations of motion; the moments of the wing, tail and other parts of the airplane; C.G. location, effect on static stability; neutral points; maneuver points; fixed control and free control stability; elevator, aileron rudder effectiveness; control design features; maneuverability and controllability; turns and loops. The laboratory work consists of wind tunnel experimentation and analysis of the above topics on models.

Texts: Higgins: USNPS Notes; Perkins: Aircraft Stability and Controllability; Hamlin: Flight Testing.

Prerequisite: Ae-131(C).

Ae-142(A) Dynamics II 3-4

The Euler equations of motion; the moments of inertia of aircraft; the aerodynamic reactions and derivatives; solution of the symmetrical or longitudinal motion, analysis; solution of the asymmetrical or lateral motion, analysis; effect of control freedom, of controls and response; spins. The laboratory work consists of wind tunnel experimentation on models to study some of the above problems.

Texts: The same as in Ae-141(C).

Prerequisite: Ae-141(A).

Ae-146(A) Dynamics 3-2

Fundamental definitions, forces and moments of composite aircraft; equations of motion; static stability and trim; effects of CG location; static margins; free control stability; dynamic longitudinal stability; dynamic lateral stability, force and moment; derivatives; stability charts; controllability; maneuverability; three-dimensional motions; spins.

Laboratory work consists of experimentation and analysis of static and dynamic stability of some particular aircraft.

Texts: Same as in Ae-141(A).

Prerequisite: Ae-131(C) or Ae-136(B).

Ae-151(B) Flight Testing and Evaluation I 2-0

The technical aerodynamics of airplanes, especially performance and test methods.

Texts: Dommasch, Sherby and Connolly: Airplane Aerodynamics; NATC Patuxent, Flight Test Manual; NavAer publications.

Prerequisite: Ae-132(B).

Ae-152(B) Flight Testing and Evaluation II 2-0

This is a continuation of Ae-151(B) in the same field.

Texts: Same as Ae-151(B).

Prerequisite: Ae-151(B).

Ae-153(B) Flight Testing and Evaluation III 2-0

A continuation of Ae-152(B).

Texts: The same as in Ae-152(B).

Prerequisite: Ae-152(B).

Ae-161(B) Flight and Evaluation Laboratory I 0-4

Flight Test program accompanying Ae-151(B).

Ae-161(B) Flight Testing and Evaluation Laboratory II 0-4

Flight Test program accompanying Ae-152(B).

Ae-163(B) Flight Testing and Evaluation Laboratory III 0-8

Flight Test program accompanying Ae-153(B).

Ae-200(C) Statics of Aircraft 3-2

This course parallels Mc-101, extending the coverage of rigid body statics graphically and analytically to meet design requirements of aircraft components. Topics include: plane, compound and complex trusses; centroids, moments of inertia, properties of aircraft sections; moments of inertia of aircraft, balance diagrams; simple, compound and complex space frames; load lines, shear and bending moment diagrams; influence lines.

Texts: Bruhn: Analysis and design of Airplane Structures; Niles and Newell: Airplane Structures, 3rd Ed., Vol. 1; Timoshenko and Young: Static.

Prerequisites: To be taken with Mc-101, with same prerequisites.

Ae-211(C) Stress Analysis I 4-0

Elastic body analysis applied to aircraft structures and machines. Topics are: the elementary state of stress in ties, struts, shear members, circular shafts, simple beams, short beam-struts, cores, simple columns, thin cylinders; extended discussion of deflection of straight beams, frames with straight members; statically indeterminate cases using diagrammatic and moment-distribution methods.

Text: Bruhn: Analysis and Design of Airplane Structures; Niles and Newell: Airplane Structures, 3rd Ed., Vol. I; Timoshenko: Strength of Materials, Vol. I.

Prerequisite: Ae-200(C).

Ae-212(C) Stress Analysis II 4-2

A continuation of Ae-211. The general state of plane stress in complicated components of air frames and machines, and the stability of continuous beam columns. Topics are: plane stress, principal stresses, Mohr circle of stress, stress ellipse; shear stress developed in bending, effect on deflection; shear flow in bending under transverse loads, center of twist; bending beams with open or hollow sections; torsion of shafts of non-circular section, membrane analogy, torsional shear flow; torsion and bending; built-up beams, shear-resistant webs, tension field webs, wooden beams; beam-columns and ties.

Texts: Bruhn: Analysis and Design of Airplane Structures; Niles and Newell: Airplane Structures, Vols. I and II; Timoshenko: Strength of Materials, Vols. I and II.

Prerequisite: Ae-211(C)

Ae-213(B) Stress Analysis III 4-2

A continuation of Ae-212. Strain energy, curved bars and frames. Topics are: strain energy, applications to impact loading; Castigliano theorem; displacements in trusses, trusses with redundant members; virtual energy, applications, Maxwell-Mohr method; law of reciprocal deflection, influence line applications; energy methods applied to buckling; curved bars, stresses and deflections; rotating machine parts.

Texts: The same as in Ae-212(C).

Prerequisite: Ae-212(C).

Ae-214(A) Stress Analysis IV 3-0

A continuation of Ae-213. The general three dimensional state of stress, strain and displacement in elastic media. Thin stiff plates under lateral load in bending. Axially symmetrical plates and membranes. Discontinuity effects in shells. Beams on elastic foundation, applications to cylinder and hemisphere or flat plate or hollow ring. Thick walled spheres and cylinders under inner and outer pressures, application to rotating discs.

Texts: The same as in Ae-213(B).

Prerequisite: Ae-213(B).

Ae-215(A) Advanced Stress Analysis 4-0

A continuation of Ae-214. Rectangular plates in pure bending, in bending and under middle surface loading; buckling, crippling; selected topics from theory of elasticity and plasticity; advanced stability considerations.

Texts: The same as in Ae-214 plus Sechler and Dunn: Airplane Structural Analysis and Design.

Prerequisite: Ae-214(A).

Ae-311(C) Airplane Design I 2-4

Detail methods of layout and analysis of a light plane.

Design requirements are for the condition of high angle of attack; prepare equipment list and balance diagram; correct airfoil characteristics for structural use; construct three-view drawing; run the balance calculation and the preliminaries to the wing design.

Texts: The same as in Ae-213(B); also Teichmann: Airplane Design Manual; Sechler and Dunn: Airplane Structural Analysis and Design; C.A.R. 04: C.A.M. 04: Navy Specifications Manual.

Prerequisite: Ae-213(B).

Ae-312(B) Airplane Design II 1-4

A continuation of Ae-311(C). Wing spar analysis, wing truss analysis, fuselage analysis including Maxwell diagram. Design: one wing-spar on basis, shear-resistant web, tension-field web, composite spar of two materials; elevator torque tube in bending and twist for given loading condition; several members of the fuselage truss as columns and as ties; indicated fittings.

Texts: The same as in Ae-311(C).

Prerequisite: Ae-311(C).

Ae-410(B) Thermodynamics (Aeronautical) 3-2

This course extends the study of fundamental thermodynamics in preparation for advanced work in aerothermodynamics and aircraft propulsion. Topics include one-dimensional compressible flow, internal combustion engine and turbine cycles and elements of heat transfer.

Texts: Kiefer, Stuart and Kinney: Engineering Thermodynamics; Stoever: Applied Heat Transmission; Keenan and Kaye: Gas Tables.

Prerequisite: ME-131(C).

Ae-411(B) Aircraft Engines 3-2

This course extends the study of combustion with particular reference to piston engine and gas turbine applications. Topics are: fuel mixtures; ignition; flame propagation and stability; utilization, conversion and mechanical aspects; survey of current engine design and construction.

Texts: Lichty: Internal Combustion Engines; Taylor and Taylor: Internal Combustion Engines; USNPS stencils.

Prerequisite: Ae-410(B).

Ae-421(B) Aircraft Propulsion 3-2

Sea level and altitude performance characteristics of piston engines, propellers, turbo-jet and turbo-prop engines. Topics are: maximum performance; cruise control; laboratory and flight testing; test data correction methods; aircraft performance review with particular reference to the propulsion system. The practical work of this course consists of supervised analysis of test data taken at various Naval Air Test Centers.

Texts: Fraas: Aircraft Power Plants; Nelson: Airplane Propeller Principles; USNPS stencils.

Prerequisites: Ae-411(B), Ae-131(C).

Ae-431(A) Internal Flow in Aircraft Engines 4-0

This is a fundamental course in the application of thermoaerodynamics to the study of flow in machines. Topics are: momentum theorem; thrust equations; flow equations; relative and absolute flow, relative flow in machines; energy equations; thermodynamic flow equations; axial-flow compressors; centrifugal compressors; axial-flow turbines; centrifugal turbines.

Texts: ATSC: Jet Propulsion; Zucrow: Jet Propulsion and Gas Turbines; USNPS stencils.

Prerequisite: Ae-503(A).

Ae-451(C) Gas Turbines I 3-0

A seminar on the theory, design, and control of gas turbines, stationary and marine.

Text: None.

Prerequisites: Ae-502(A), Ae-410(B) or ME-132(C).

Ae-452(C) Gas Turbines II 3-0

A seminar in continuation of Ae-451(C).

Text: None.

Prerequisite: Ae-451(C).

Ae-501(A) Hydro-Aero Mechanics I 4-0

This is the first of a sequence of four courses which study in detail the rational mechanics of fluid media; Vector calculus and aerodynamical applications; fluid kinematics and flow description; stream and velocity potential functions; dynamic equations for a perfect fluid; solution by scalar and vector methods; properties of elemental and combined flows; two-dimensional problems; use of complex numbers in flow description; conformal transformation; complex integration; Blasius equations; Kutta-Joukowski theorem; lift and pitching moment on an infinite wing.

Texts: Glauert: Airfoil and Airscrew Theory; Streeter: Fluid Dynamics.

Prerequisite: Ae-131(C).

Ae-502(A) Hydro-Aero Mechanics II 4-0

Helmholtz vortex theory; the three-dimensional airfoil; induced velocity, angle of attack, drag; lift distribution; least induced drag; tapered and twisted airfoils; Chordwise and spanwise load distribution, tunnel-wall effect; viscous fluids.

Texts: The same as in Ae-501(A).

Prerequisite: Ae-501(A).

Ae-503(A) Compressibility I 4-0

Compressible flow; thermodynamic fundamentals; adiabatic flow equations; propagation of plane disturbances; one-dimensional channel flow; oblique shock waves and shock reflections; optical measurement techniques.

Texts: Kuethe and Schetze: Foundations of Aerodynamics; Liepmann and Puckett: Aerodynamics of a Compressible Fluid; Sauer: Theoretical Gas Dynamics; Ferri: Elements of Aerodynamics of Supersonic Flow.

Prerequisites: Ae-410(B), Ae-502(A).

Ae-504(A) **Compressibility II** 3-2

Two and three-dimensional compressible flows; two-dimensional linearized theory and application to airfoils in compressible flow; three-dimensional linearized theory; hodograph methods; method of characteristics; exact solutions in two-dimensional flow; transonic flow problems. Transonic and supersonic wind tunnel tests are conducted in conjunction with class discussion.

Texts: The same as in Ae-503(A)

Prerequisite: Ae-503(A).

Ae-508(A) **Compressibility** 3-2

Thermoaerodynamic fundamentals of flow in compressible fluids; adiabatic equations; propagation of plane disturbances; one-dimensional channel flow; oblique shock waves, reflections; transonic flow shock waves, reflections; transonic flow problems. Laboratory periods are used in transonic and supersonic wind tunnel tests and in measurements by optical instrumentation.

Texts: The same as in Ae-503(A).

Prerequisites: Ae-410(B); Ae-502(A).

CHEMISTRY

Ch Courses

Ch-101(C) General Inorganic Chemistry 3-2

A study of the principles governing the chemical behavior of matter and includes topics such as kinds of matter, stoichiometric calculations, utility of the mole concept, kinetic theory, atomic structure, speed of chemical reactions, chemical equilibrium, introduction to organic chemistry and specialized topics (explosives, corrosion, etc.). Elementary physical chemistry experiments such as determination of molecular formulas, pH, reaction rates, etc., are performed in the laboratory.

Text: Hildebrand: Principles of Chemistry.

Prerequisite: None.

Ch-102(C) General Inorganic Chemistry 4-2

Topics include properties of matter, atomic and molecular structure, valence, weight relations in chemical reactions, oxidation-reduction, electrochemistry, gases, solutions, chemical equilibrium, reactions of metallic ions and ionic equilibria encountered in qualitative analysis. The laboratory work is qualitative analysis performed on a semimicro scale.

Text: Pauling: General Chemistry; Curtman: Introduction to Semimicro Qualitative Analysis.

Prerequisite: None.

Ch-103(C) Elementary Physical Chemistry 3-2

A course in theoretical chemistry for operations analysis curriculum; a study of principles governing the behavior of matter when subjected to various influences. Modern concept of the structure of matter, kinetic theory, dynamic equilibria in various systems, etc. In the development of the subject the mathematical approach is emphasized. Discussion of the various topics utilizes examples selected from situations of interest to officers in the military services.

The laboratory work consists of experiments, largely quantitative, illustrating the principles discussed in the lectures.

The course is designed to serve both as a refresher and a terminal background course for officers whose major interest lies in fields other than chemistry, physics, or related sciences.

Text: Hildebrand: Principles of Chemistry.

Ch-111(A) Fuel and Oil Chemistry

The occurrence, classification and refining of petroleum, theory of combustion of fuels, theory of lubrication, physical and chemical properties of fuels and lubricants and their correlation with performance, and the analysis of Orsat data. Laboratory work consists of conducting standard tests on fuels and lubricants, and Orsat analysis of combustion gases.

Text: Gruse and Stevens: Chemical Technology of Petroleum.

Prerequisite: Ch-101(C).

Ch-121(B) General and Petroleum Chemistry 4-2

Topics covered in this course are: classification of matter, atomic theory, atomic structure, gas laws, thermochemistry, chemical equilibria, chemical kinetics, elementary stoichiometry, organic chemistry, occurrence, classification and refining of petroleum, theory of combustion, theory of lubrication, physical and chemical properties of fuels and lubricants and their correlation with performance, and analysis of Orsat data. Laboratory work consists of experiments illustrating topics covered in lectures and standard tests on fuels and lubricants.

Texts: Hildebrand: Principles of Chemistry; Gruse and Stevens: Chemical Technology of Petroleum.

Prerequisite: None.

Ch-213(C) Quantitative Analysis 2-3

A review of the theoretical principles underlying analytical chemical methods, and the calculations involved in quantitative determinations. The laboratory work consists of typical volumetric and gravimetric determinations.

Text: Pierce and Haenisch: Quantitative Analysis.

Prerequisite: Ch-102(C).

Ch-221(C) Qualitative Analysis 3-2

The first part of a course in analytical chemistry, including the treatment of ionization, chemical equilibrium, solubility product, complex-ion formation and oxidation-reduction reactions, as they apply to qualitative analysis. The laboratory work consists of the separation and detection of selected ions on a semimicro scale.

Text: Curtman: Introduction to Semimicro Qualitative Analysis.

Prerequisite: Ch-101(C) or Ch-121(B).

Ch-231(C) Quantitative Analysis 2-3

A continuation of Ch-221(C), dealing with the principles and calculation involved in quantitative analysis. The laboratory work consists of typical volumetric and gravimetric determinations.

Text: Pierce and Haenisch: Quantitative Analysis.

Prerequisite: Ch-101(C) or Ch-121(B), Ch-221(C).

Ch-301(C) Organic Chemistry 3-2

An introduction to the properties, reactions and relationships of the principal classes of aliphatic and aromatic organic compounds. The laboratory work includes preparative experiments and experiments illustrating typical organic reactions.

Text: Schwenck and Martin: Basic Organic Chemistry.

Prerequisite: Ch-101(C) or Ch-121(B).

Ch-311(C) Organic Chemistry 3-2

The first half of a course in organic chemistry, consisting of the study of the properties and reactions of aliphatic compounds. The laboratory work is designed to illustrate typical organic reactions.

Text: Brewster: Organic Chemistry—A Brief Course.

Prerequisite: Ch-101(C).

Ch-312(C) Organic Chemistry 3-2

A continuation of Ch-311(C), dealing chiefly with aromatic compounds. Organic synthetic methods are emphasized in the laboratory.

Text: Brewster: Organic Chemistry—A Brief Course.

Prerequisite: Ch-311(C).

Ch-315(C) Organic Chemistry 3-0

An introduction to the properties, reactions, and relationships of the principal classes of organic compounds, as a basis for work in the biological sciences.

Text: Schwenck and Martin: Basic Organic Chemistry.

Prerequisites: Ch-102(C); Ch-213(C).

Ch-321(A) Organic Qualitative Analysis 2-2

Identification of organic compounds on the basis of physical properties, solubility behavior, classification reactions and the preparation of derivatives.

Text: Shriner and Fuson: Identification of Organic Compounds.

Prerequisite: Ch-301(C), Ch-312(C) or Ch-315(C).

Ch-322(A) Organic Chemistry, Advanced 3-2

A more detailed consideration of reactions used in organic syntheses, with particular attention to reaction mechanisms and electronic configurations.

Text: Fuson: Advanced Organic Chemistry; Alexander: Principles of Ionic Organic Reactions.

Prerequisite: Ch-301(C), Ch-312(C) or Ch-315(C).

Ch-323(A) The Chemistry of High Polymers 3-0

Mechanism of polymerization; addition and condensation polymers; phenoplastics; aminoplastics; elastomers; natural high polymers and their modification; structure and physical properties of high polymers.

Text: Ritchie: Chemistry of Plastics and High Polymers.

Prerequisite: Ch-301(C), Ch-312(C) or Ch-315(C), Ch-521(A)

Ch-401(A) Physical Chemistry 3-2

Physical chemistry for ordnance students; a study of the laws governing behavior of matter. Gases, liquids, solids, chemical kinetics, thermochemistry, and chemical thermodynamics with emphasis placed on chemical equilibrium in gaseous mixtures. Numerical problems on gas mixtures, equilibria in explosion products, and flame temperatures form an integral part of the course.

The laboratory work consists of experiments illustrating principles discussed in the lectures.

Texts: Daniels: Outlines of Physical Chemistry; Daniels, Mathews and Williams: Experimental Physical Chemistry.

Prerequisites: Ch-101 or equivalent; Ch-613 or equivalent.

Ch-411(C) Physical Chemistry 3-2

Gases, solids, physical properties and molecular structure, thermodynamics, thermochemistry, liquids and solutions. The laboratory work consists of experiments which illustrate principles discussed in the lectures.

Texts: Daniels: Outlines of Physical Chemistry Daniels, Mathews, Williams and Staff: Experimental Physical Chemistry.

Prerequisite: Ch-101(C) or Ch-121(B).

Ch-412(C) Physical Chemistry 3-2

Continuation of Ch-411(C). Chemical equilibrium, chemical kinetics, electrical conductance, electromotive force, colloids and atomic and nuclear structure. Related laboratory work is included.

Texts: Daniels: Outlines of Physical Chemistry; Daniels, Mathews, Williams and Staff: Experimental Physical Chemistry.

Prerequisite: Ch-411(C).

Ch-413(A) Physical Chemistry (Advanced) 2-2

A graduate course covering selected topics in physical chemistry, such as electrochemistry, electronic configurations and dipole moments, and the physical chemistry of the solid and liquid states. The laboratory work consists of experiments designed to supplement the material covered in the lectures.

Prerequisites: Two terms of physical chemistry, one term of thermodynamics.

Ch-442(C) Physical Chemistry 4-2

A short course in physical chemistry for chemistry majors. Gases, solids, thermochemistry, liquids, solutions, chemical equilibrium, chemical kinetics, electrochemistry and colloids. Laboratory experiments which illustrate principles discussed in the lectures are performed.

Texts: Daniels: Outlines of Physical Chemistry; Daniels, Mathews, Williams and Staff: Experimental Physical Chemistry.

Prerequisite: Ch-101(C) or equivalent.

Ch-521(A) Plastics 3-2

A study of the nature and types of plastics, including alkyds, polyesters, silicone-base plastics, and rubbers, both natural and synthetic. Emphasis is placed on application, limitations as engineering materials, and correlation between properties and chemical structure. Service applications are cited as examples whenever possible. The laboratory exercises consist of the preparation of typical plastics, a study of their properties, and identification tests.

Text: Richardson and Wilson: Fundamentals of Plastics.

Prerequisite: Ch-101(C) or Ch-121(B).

Ch-531(A) Physical Chemistry 2-0
(for Metallurgy Students)

A continuation of the study of physical chemistry, emphasizing aspects of importance in metallurgy. Chemical equilibria in smelting and refining processes, in deoxidation and in carburizing; principles of controlled atmospheres; activity and activity coefficients in metal solutions; concentration gradients and diffusion effects.

Prerequisite: Physical chemistry; Mt-202.

Ch-541(A) Reaction Motors 2-2

A course covering the classification of reaction motions, basic mechanics, nozzle theory, propellent performance calculations, liquid and solid pro pellent motors, rocket testing, ramjet, pulse jet, military applications. Laboratory period is devoted to working problems.

Text: Sutton: Rocket Propulsion Elements. ATSC Jet Propulsion.

Prerequisite: Ch-101 or equivalent and one term of thermodynamics.

Ch-551(A) Radiochemistry 2-2

A seminar course with discussions on important aspects of radioactivity from standpoint of the chemical transformations which accompany it and which it may induce; possible health hazards associated with radioactivity, safety measures and decontamination problems; techniques for measurement and study of ionizing radiation.

Prerequisite: Physical chemistry.

Ch-561(A) Physical Chemistry 3-2

A course in physical chemistry for students who are non-chemistry majors. Gases, liquids, chemical thermodynamics, thermochemistry, chemical equilibrium and chemical kinetics. Numerical problems on gas mixtures, combustion, equilibria in combustionproducts and flame temperatures are emphasized. Related laboratory experiments are included.

Texts: Daniels: Outlines of Physical Chemistry; Daniels, Mathews, Williams and Staff: Experimental Physical Chemistry.

Prerequisite: Ch-111(A) or Ch-121(B).

Ch-571(A) Explosives 3-2

Modes of behavior and principles of use of explosive substances as related to their chemical and physical properties; underlying principles of explosives testing and evaluation; theory of detonation; propagation of flame front in propellants; trends in new explosive investigation, selection, and development.

Prerequisites: One term each of Thermodynamics and Physical Chemistry.

Ch-581(A) Chemistry of Special Fuels 2-2

A brief survey of the organic and physical chemistry necessary for an appreciation of the problems associated with special fuels. The nature of conventional fuels and of high-energy fuels, their limitations, and possible future developments; methods of reaction of rate control; etc.

Prerequisite: Physical Chemistry.

Ch-591(A) Blast and Shock Effects 3-0

Propagation of shock waves in homogeneous media; scaling laws for damage for air, underwater and underground explosions, thermal radiation and incendiary effects; ionizing radiation effects; principles of protection of personnel against damage.

Text: AFSWP-Hirschfeller: The Effects of Atomic Weapons.

Prerequisite: Physical Chemistry, Thermodynamics.

Ch-611(C) Thermodynamics 3-2

Study of the fundamentals of thermodynamics, the concept of energy and its classification and transformation, concept of entropy, the first and second laws and their application, thermodynamic properties of substances, deal gases, thermochemistry. The laboratory period is devoted to problem working.

Text: Kiefer, Stewart and Kinney: Principles of Engineering Thermodynamics.

Prerequisite: Ch-101.

Ch-612(C) Thermodynamics 3-2

A continuation of Ch-611, covering the application of thermodynamic principles to processes involving non-deal gases, complex systems in chemical equilibrium, and the flow of compressible fluids. The laboratory period is devoted to problem working.

Texts: Kiefer, Stewart and Kinney: Principles of Engineering Thermodynamics.

Prerequisite: Ch-611(C).

Ch-613(A) Chemical Engineering Thermodynamics 3-2

Designed for non-chemical majors, the course extends previous studies in mechanical engineering thermodynamics to include the thermodynamics analysis and solution of chemical engineering problems. Emphasizing applications of principles by solution of problems, the subject matter includes specialized treatment of the thermal and thermodynamic properties of materials; thermochemistry; equilibrium and the phase rule; phase relations; chemical equilibria and energy relations, particularly at higher temperatures and pressures.

Texts: Smith: Introduction to Chemical Engineering Thermodynamics; Perry: Chemical Engineers Handbook.

Prerequisite: One term of Physical Chemistry and one term of Thermodynamics.

Ch-631(A) Chemical Engineering Thermodynamics 3-2

An extension of Ch-711(C) to include such thermodynamic analyses as are fundamental and requisite to the solution of many ordnance problems; preparation for subsequent study of reaction motors and interior ballistics.

In addition to treatment of the First and Second Laws of Thermodynamics, the subject matter includes thermodynamic properties of matter, compression and expansion processes, phase equilibria, criteria of equilibrium, fugacity, chemical reaction equilibria.

Texts: Smith: Introduction to Chemical Thermodynamics; Robinson: Thermodynamics of Firearms; Keenan and Keyes: Thermodynamic Properties of Steam; Keenan and Kaye: Gas Tables.

Prerequisite: Ch-711(C), or Ch-701(C).

Ch-701(C) Chemical Engineering Calculations 3-2

Recognition and solution of engineering problems involving mass and energy relationships in chemical and physical-chemical reactions. Problems, chosen from engineering practice whenever possible, are based on combustion, distillation, absorption, evaporation, humidification, and other unit operations and processes.

Texts: Hougen and Watson: Chemical Process Principles, Part I; Lewis and Radasch: Industrial Stoichiometry; Perry: Chemical Engineers Handbook.

Prerequisite: Ch-101(C), or Ch-121(B)

Ch-711(C) Chemical Engineering Calculations 3-2

An introductory course in chemical engineering, with part of the numerical problems selected from ordnance application; material and energy balances in various unit operations and in typical chemical reactions, processes and plants; principles of thermochemistry; composition of equilibrium mixtures.

Texts: Hougen and Watson: Chemical Process Principles, Part I; Robinson: Thermodynamics of Firearms.

Prerequisite: Ch-101(C).

Ch-721(C) Unit Operations 3-0

An introduction to the study of the unit operations of chemical engineering. Materials handling, screening, size reduction and handling of solids; classification methods; transportation of fluids; measurements of flow of fluids.

Texts: Brown and Associates: Unit Operations.

Prerequisite: Ch-701, Ch-411.

Ch-722(C) Unit Operations 3-0

A continuation of Ch-721. Filtration, solid-liquid and liquid-liquid extractions; fractionation, stripping and rectifying columns.

Text: Brown and Associates: Unit Operations.

Ch-800(A) Chemistry Seminar

This course involves library investigations of assigned topics, and reports on articles in the current technical journals.

COMMUNICATIONS

Co Courses

Co-101(C) Typing and Radiotelegraph Code 0-4

The first course in the operating communication series. Designed to teach student officers the touch system of typing in order to facilitate participation in courses Co-102(C) and Co-115(C) and to provide a necessary basic skill of communication officers. When students attain a typing proficiency of 30 WPM they are started on radio telegraph code.

Text: Lessenberry: 20th Century Typing.

Prerequisite: None.

Co-102(C) Radiotelegraph Code and Procedure 0-3

A continuation of Co-101(C), planned to bring student operating ability in Morse Code up to a level that will permit them to operate on slow-speed W/T circuits. Actual operation of slow-speed W/T circuits provides experience in logkeeping, message-servicing and circuit discipline.

Text: Classified official publications.

Prerequisite: Co-101(C).

Co-103(C) Visual and Radiotelephone Procedure 1-3

The third course in the operating communication series, designed to develop student ability by actual operation in sending and receiving flashing light, flaghoist, semaphore and radiotelephone message.

Text: Classified official publications.

Prerequisite: Co-102(C).

Co-104(C) Military Communication Organizations 1-1

The final course of the operational communication series. Covers the organization of naval communications afloat and ashore. Laboratory periods are devoted to seminar presentation of papers prepared by each student on a communication subject, and to lectures by representatives of other military communication organizations.

Text: Classified official publications.

Prerequisite: None.

Co-111(C) Radio Telegraph and Visual Procedure 2-2

Principles of effective message drafting, procedures of radiotelegraph, visual and radiotelephone communication; use of operating signals, call signs, routing indicators and delivery groups.

Text: Classified official publications.

Prerequisite: None.

Co-112(C) Tape Relay and Toll Traffic Procedures 2-1

Tape relay procedures and instructions for handling and abstracting toll traffic.

Text: Classified official publications.

Prerequisite: None.

Co-113(C) International and Commercial Communications 1-1

Survey of international communication agreements, world-wide frequency allocations, navigational radio aids and NATO naval communications. The operations of various commercial companies and their inter-relationship with U. S. naval communications is presented through the medium of lectures.

Text: Classified official publications.

Prerequisite: None.

Co-114(C) Correspondence and Mail 1-1

Lectures and written exercises on correspondence and filing, covering the duties of the communication officer in connection with the Postal Service.

Text: Classified official publications.

Prerequisite: None.

Co-115(C) Cryptosystems 0-3

Practical instruction in the selection and manipulation of cryptographic aids and devices.

Text: Classified official publications.

Prerequisite: Co-101(C).

Co-121(C) Security of Classified Matter and Registered Publication Handling 2-1

Directives and instructions governing the security of classified matter including armed forces censorship. Emphasis is placed on the Registered Publication System and the detailed duties and responsibilities of the Registered Publication Custodian.

Text: Classified official publications.

Prerequisite: None.

Co-122(C) Communication Planning 2-1

Study of the basic communication doctrine of the naval establishment.

Text: Classified official publications.

Prerequisite: None.

Co-123(C) Communication Planning 2-2

Application of the basic communication doctrine for naval forces, including the actual preparation of communication plans and their usual appendices for specific types of naval operations.

Text: Classified official publications.

Prerequisite: Co-122(C).

Co-124(C) Communication Planning 1-2

Completes the formal study of communication planning, covering the application of principles previously studied to the development of typical communication plans for amphibious operations. The completion of this course realizes the objective of furnishing the student with background knowledge required to draft a communication plan to support any mission assigned or derived.

Text: Classified official publications.

Prerequisite: Co-133(C), Co-122(C), Co-123(C).

Co-131(C) Tactics 2-2

The first of a series designed to give the student officer a working knowledge of naval tactics and effective tactical publications. This course covers the maneuvering board and its uses, the basic rules for ship and formation maneuvers, the function of CIC, and screening instructions. The intimate relationship between tactics and communications is stressed in all courses of this series.

Text: Classified official publications.

Prerequisite: None.

Co-132(C) Tactics 2-2

The second of the tactical series; application of the principles learned in Co-131(C) to the various naval striking and support forces. The principles of scouting are also studied.

Text: Classified official publications.

Prerequisite: Co-131(C).

Co-133(C) Tactics 2-2

The third in the tactical series, introducing the officer to the tactical problems involved in amphibious operations and procedures developed to solve them. It provides a foundation for Co-123(C).

Text: Classified official publications.

Prerequisite: Co-131(C), Co-132(C).

Co-134(C) Tactics 2-2

The final course in the tactical series, covering submarine warfare, anti-submarine warfare, and escort of convoy.

Text: Classified official publications.

Prerequisite: Co-131(C), Co-132(C).

Co-135(C) Correspondence Course in Strategy and Tactics

The officer student is required to complete at least four assignments of the U. S. Naval War College Correspondence Course in Strategy and Tactics prior to the completion of his instruction at the Postgraduate School. This provides experience in using the Armed Forces Estimate Form and the Armed Forces Operation Plan Form.

Co-150(C) Communication Procedures 80 classroom hours

Instructions for the various means of communications, including the principles of effective message drafting and the use of operating signals, call signs and procedure signs. The study of toll traffic and visual signalling is included.

Text: Classified official publications.

Prerequisite: None.

Co-151(C) Security 32 classroom hours

The need for adequate security measures, the rules governing physical security, communication security, and the duties of the Registered Publication Custodian.

Text: Classified official publications.

Prerequisite: None.

Co-152(C) Cryptography 34 classroom hours

The overall cryptoplan of the U. S. Navy and instruction in the use of cryptoaids. Use of authentication and recognition signals is also included.

Text: Classified official publications.

Prerequisite: None.

Co-153(C) Communication Plans 62 classroom hours

The basic U. S. naval communication doctrine and frequency plans. The principles of typical communication plans are studied with emphasis on those for carrier task force and amphibious operations. The NATO communications are also included. Practical works are used extensively to explain and emphasize material covered.

Text: Classified official publications.

Prerequisite: None.

Co-154(C) Miscellaneous Communication Subjects 20 classroom hours

Administrative subjects of fleet and shipboard organizations, Navy correspondence and filing practices, and the U. S. Postal Service. Familiarization with communication equipments and elementary electronics is also included.

Text: Classified official publications.

Prerequisite: None.

Co-155(C) Typing, Radiotelegraph Code and Radiotelephone Operating 32 classroom hours

The touch typing system; basic instruction in radiotelegraph code; practical operating experience in radiotelegraph and radiotelephone. The time devoted to radiotelegraph is varied as necessary to obtain the maximum of this training commensurate with the individual student's initial proficiency in typing and his progress during the first part of the course.

Text: Classified official publications.

Prerequisite: None.

Co-160(C) Tactics 76 classroom hours

By study of the principal tactical publications of the U. S. Navy, motion pictures thereon, and practical works, the officer student acquires sufficient knowledge and background to effectively use the Navy's basic tactical publications and to fully appreciate the relationship between communications and tactical operations.

Text: Classified official publications.

Prerequisite: None.

CRYSTALLOGRAPHY

Cr Courses

Cr-271(B) Crystallography and X-Ray Techniques 3-2

The essential concepts of crystallography, including: symmetry, point groups, plane lattices, space lattices, space groups, coordinate systems, indices, crystal classes, crystal systems, common forms and combinations in the various systems, the stereographic projection, modern x-ray diffraction and radiographic apparatus and techniques, the theory of x-ray diffraction, powder methods, single crystal and moving film methods, high temperature diffraction techniques, back reflection and transmitted beam methods. The laboratory work includes a study of crystal models for symmetry, forms, and combinations; the construction of stereographic projections; and actual practice in making and interpreting of x-ray diffraction photographs.

Text: Dana, Ford: Textbook of Mineralogy; Barrett: Structure of Metals.

Prerequisite: Ch-101(C).

Cı-301(B) Crystallography and Mineralogy 3-4

Designed primarily for the student who will continue with courses in mineralogy, geology, and petrology. The student is introduced to the fundamental concepts of crystallography, including: symmetry, point groups, plane lattices, space lattices, space groups, coordinate systems, indices, crystal classes, crystal systems, common form and combinations in the various systems and classes, the stereographic projection, and the theory of x-ray diffraction and the application of x-ray powder methods as applied to identification of minerals. The laboratory work includes a study of crystal models for symmetry forms, and combinations; the practical application and construction of stereographic projections; determination of minerals by x-ray powder diffraction patterns.

Text: Dana, Ford: Textbook of Mineralogy.

Prerequisite: Ch-101(C).

Cr-311(B) Crystallography and Mineralogy 3-2

Subject matter similar to Cr-301, but designed for students who will continue with courses in chemistry.

Text: Dana, Ford: Textbook of Mineralogy.

Prerequisite: Ch-101(C).

ELECTRICAL ENGINEERING

EE Courses

Fundamentals of Electrical Engineering	EE-111(C)
DC Circuits and Fields	EE-151(C)
Electric Circuits and Fields	EE-171(C)
DC Machines and AC Circuits	EE-231(C)
AC Circuits	EE-241(C)
AC Circuits	EE-251(C)
AC Circuits	EE-271(C)
AC Circuits	EE-272(B)
Electrical Measurements I	EE-273(C)
Electrical Measurements II	EE-274(B)
DC and AC Machinery	EE-314(C)
DC Machinery	EE-351(C)
DC Machinery	EE-371(C)
Transformers and Synchros	EE-451(C)
Polyphase Transformers, Synchronous Machines, and Induction Motors	EE-452(C)
Asynchronous Motors	EE-455(C)
Transformers and Synchros	EE-461(C)
Asynchronous Motors and Special Machines	EE-462(B)
Transformers and Asynchronous Machines	EE-471(C)
Synchronous Machines and Synchros	EE-472(C)
Synchros	EE-473(B)
Transmission Lines and Filters	EE-551(B)
Transmission Lines and Filters	EE-571(B)
Servomechanisms	EE-611(B)
Transients and Servos	EE-651(B)
Filters and Transients	EE-655(B)
Lines, Filters and Transients	EE-665(B)
Transients	EE-671(A)
Servomechanisms	EE-672(A)
Electronics	EE-711(C)
Power Electronics	EE-731(C)
Electronic Control and Measurement	EE-745(A)
Electronics	EE-751(C)
Electronics	EE-753(C)
Electronic Control and Measurement	EE-755(A)
Electronics	EE-771(B)
Electronics	EE-772(B)
Electrical Machine Design	EE-871(A)
Electrical Machine Design	EE-872(A)
Electrical Machine Design	EE-873(A)
Electrical Machine Design	EE-874(A)
Seminar	EE-971(A)
Thesis	EE-972(A)

EE-111(C) Fundamentals of Electrical Engineering 3-2

Basic concepts of direct-current circuits and static electric and magnetic fields are considered. Electrical units, resistivity, electromotive forces, basic measurements and metering equipment, Kirchoff's laws, magnetism, typical magnetic circuits and simple electrostatic fields are studied.

Text: Dawes: Electrical Engineering, Vol. I.

Prerequisites: Differential and Integral Calculus; Elementary Physics.

EE-151(C) Direct-Current Circuits and Fields 3-4

Designed to provide a good background in electricity and magnetism, this course covers systems of units, Kirchoff's laws, direct-current measurements, magnetism and magnetic circuits, electrostatics, capacitance and inductance. The emphasis is on fundamental concepts with considerable time spent in working problems.

Text: Corcoran: Basic Electrical Engineering.

Prerequisites: Differential and Integral Calculus; Elementary Physics.

EE-171(C) Electric Circuits and Fields 3-4

As a foundation in electricity and magnetism for a curriculum majoring in electrical science, the basic laws are studied in detail. Units, Kirchoff's laws, electrostatic fields, magnetic fields, ferromagnetism, direct-current networks, direct-current measurements, calculation of resistance, capacitance and inductance are covered. Basic laboratory experiments deal with measurements, the proper use of metering equipment and magnetic circuits. Supervised problem work is included.

Text: Corcoran: Basic Electrical Engineering.

Prerequisites: Differential and Integral Calculus; Elementary Physics.

EE-231(C) DC Machines and AC Circuits 3-2

General principles of DC machines, their control and application. The qualitative characteristics of the various machines are developed from basic principles, then a study of the theory of alternating currents is begun. Experiments are performed to demonstrate the general machine characteristics and the use of control devices.

Text: Dawes: Electrical Engineering, Vols. I and II.

Prerequisite: EE-111(C).

EE-241(C) Alternating Current Circuits 3-2

For those curricula that do not require an extensive coverage. Consists of an elementary treatment of single-phase series and parallel circuits, resonance, vector representation and vector algebra, the most commonly used network theorems, non-sinusoidal wave analysis, coupled circuits, and balanced polyphase circuits. Laboratory and problem work illustrate the basic theory.

Text: Kerchner and Corcoran: Alternating Current Circuits.

Prerequisite: EE-151(C).

EE-251(C) Alternating Current Circuits 3-4

This course presents the essentials of alternating current circuits. Single-phase circuits, resonance, vector representation and complex numbers, basic metering, coupled circuits, and balanced polyphase circuits are treated. The elements of non-sinusoidal wave analysis are included. Laboratory experiments cover series and parallel resonance, single-phase and polyphase metering and elementary bridge measurements. Time is allotted for supervised problem work.

Text: Kerchner and Corcoran: Alternating Current Circuits.

Prerequisite: EE-151(C).

EE-271(C) Alternating Current Circuits 3-2

The basic theory of the alternating current circuit for those curricula that require an extensive coverage. Single-phase series and parallel circuits, resonance, vector algebra and vector representation of electrical magnitudes, network theorems, non-sinusoidal wave analysis, balanced polyphase circuits and power measurements in polyphase circuits. Problems and laboratory work illustrate the basic theory.

Text: Kerchner and Corcoran; Alternating Current Circuits.

Prerequisite: EE-171(C).

EE-272(B) Alternating Current Circuits 2-2

A continuation of EE-271. Unbalanced polyphase circuits, instruments and measurements, coupled circuits, bridge theory and symmetrical components. Problems and laboratory work illustrate the basic principles.

Text: Kerchner and Corcoran; Alternating Current Circuits.

Prerequisite: EE-271(C).

EE-273(C) Electrical Measurements I 2-3

An introduction to the measurement of the fundamental quantities; current, voltage, capacitance, inductance, and the magnetic properties of materials. Direct current bridges, the measurement of high resistance, characteristics of direct-current galvanometers, potentiometer principles, commercial potentiometer types, direct current indicating instruments.

Text: Stout: Basic Electrical Measurements.

Prerequisite: EE-272(C).

EE-274(B) Electrical Measurements II 2-3

A continuation of EE-273(C). Alternating current bridge circuits, components, and accessories. Measurement of the properties of dielectrics.

Text: Stout: Basic Electrical Measurements.

Prerequisite: EE-273(C).

EE-314(C) AC and DC Machinery 3-4

The fundamentals of representative direct-current and alternating-current machines are studied in classroom and supplemented with laboratory experiments. The theory, practical construction, types of windings and the performance of direct-current generators and motors, alternators, transformers, synchronous motors, induction motors, and single-phase motors are briefly covered.

Text: Dawes: Electrical Engineering, Vols. I and II.

Prerequisites: Es-111(C), Es-112(C).

EE-351(C) DC Machinery 2-2

Fundamentals of direct current machinery with emphasis upon operating characteristics and applications. The external characteristics are developed from basic relations. Problems and laboratory work supplement that of the classroom.

Text: Dawes: Electrical Engineering, Vol. I.

Prerequisite: EE-151(C) or EE-171(C).

EE-371(C) DC Machinery 3-2

A thorough presentation of the theory and performance of direct current machines and control devices. Armature windings, armature reaction and commutation are fully covered. The operating characteristics of generators and motors are developed from basic relations so as to provide a foundation for subsequent work in design. Problems are assigned to illustrate the application of the theory. Laboratory work supplements the work of the classroom.

Text: Langsdorf: Principles of DC Machines.

Prerequisite: EE-171(C).

EE-451(C) Transformers and Synchros 2-2

The theory, construction and performance of single-phase transformers and polyphase transformer connections are covered in the first part of the course. Approximately the latter half of the term is given to the study of synchros, their theory, construction and performance under normal and abnormal conditions. Laboratory experiments parallel the classroom study.

Text: Hehre and Harness: Electrical Circuits and Machinery, Vol. II.

Prerequisite: EE-251(C).

EE-452(C) Polyphase Transformers, Synchronous Machines and Induction Motors 3-4

A continuation of EE-451(C). It completes a general presentation of AC machinery for those curricula that do not require an extensive treatment. Alternators, synchronous motors, polyphase and single-phase induction motors are presented. A brief survey of induction generators, induction regulators and the commutator type AC motor is included. Laboratory and problem work illustrate the basic theory.

Text: Hehre and Harness: Electrical Circuits and Machinery, Vol. II.

Prerequisite: EE-451(C).

EE-455(C) Asynchronous Motors 2-2

An elementary presentation of the principles and operating characteristics of the induction motor and of single-phase commutator motors. Emphasis is placed upon the unbalanced operation of the two-phase symmetrical induction motor. Laboratory and problem work supplement the theory.

Text: Hehre and Harness: Electrical Circuits and Machinery, Vol. II.

Prerequisite: EE-451(C).

EE-461(C) Transformers and Synchros 3-2

For those curricula which do not require an extensive coverage of these topics. Single-phase transformer principles, constructional features and operating characteristics. Special transformers. Synchro and induction motor windings. Single-phase and polyphase synchro constructional features. Mathematical analysis of the torque, current and voltage characteristics of synchros operating under normal and fault conditions. Synchros in control circuits. Laboratory and problem work illustrate the basic principles.

Text: Hehre and Harness: Electrical Circuits and Machinery, Vol. II.

Prerequisite: EE-241(C) or EE-251(C).

EE-462(B) Asynchronous Motors and Special Machines 4-2

Basic principles and operating characteristics of single-phase and polyphase induction motors and single-phase commutator motors. Operation of two-phase induction motors with unbalanced voltages and variable phase angles. Theory and operating characteristics of amplidyne and rototrol generators. Operation of direct current motors on variable voltage. Calculation of the transfer function for motors and generators. Laboratory and problem work illustrate the basic principles.

Text: Hehre and Harness: Electrical Circuits and Machinery, Vol. II.

Prerequisite: EE-461(C).

EE-471(C) Transformers and Asynchronous Machines 3-4

For those curricula giving advanced work in electrical engineering. Basic theory and operating characteristics of single-phase and polyphase transformers, special transformers, polyphase and single-phase induction motors, induction generators and commutator type alternating current motors. Motor and generator armature windings, voltage and mmf waves. Laboratory and problem work illustrate the basic theory.

Text: Bryant and Johnson: Alternating Current Machinery.

Prerequisite: EE-272(B).

EE-472(C) Synchronous Machines and Synchros 3-4

A continuation of EE-471(C). Alternator and synchronous motor theory and operating characteristics based on cylindrical rotor and two-reaction theories. Armature windings. Voltage, current and mmf waves. Load saturation characteristics, regulation and losses. Frequency changers. Parallel operation of synchronous machines. Synchro principles and mathematical analysis of operating characteristics for normal and fault conditions. Laboratory and problem work illustrate the basic principles.

Text: Bryant and Johnson: Alternating Current Machinery.

Prerequisite: EE-471(C).

EE-473(B) Synchros 2-2

Basic theory and mathematical analysis of single-phase and polyphase operating characteristics. Voltage, current and torque relations under normal and fault conditions. Equivalent circuits and vector diagrams, control circuits using synchros. Laboratory and problem work supplement the study of basic principles.

Text: None.

Prerequisite: EE-271(C) or EE-251(C).

EE-551(B) Transmission Lines and Filters 3-2

An intermediate level course for those curricula which do not require the more thorough treatment given in EE-571(B). Transmission line parameters, general transmission line equations for distributed parameters, infinite line, open and short circuited lines, loading, reflection and equivalent circuits. Impedance transformation and impedance matching with stubs and networks. Constant K, M-derived and composite filters. Problems and laboratory work illustrate the basic theory.

Text: Ware and Reed: Communication Circuits.

Prerequisite: EE-251(C).

EE-571(B) Transmission Lines and Filters 3-4

A more thorough coverage of transmission line and filter theory and more emphasis on transmission at power frequencies than given in EE-551(B). Transmission line parameters, general transmission line equations, transmission line vector diagrams and charts. Losses, efficiency and regulation. Loading, open-circuited lines, short-circuited lines and reflection. Equivalent circuits. Impedance transformation, impedance matching with networks and stubs. Transient voltages and currents on lines. Constant K, M-derived and composite filters for low pass, high pass, band pass and band elimination. Problems and laboratory work illustrate the basic principles.

Texts: Woodruff: Electric Power Transmission and Distribution; Ware and Reed: Communication Circuits.

Prerequisite: EE-271(C).

EE-611(B) Servomechanisms 3-4

This course presents the essential basic principles of servomechanisms. The topics covered are the amplidyne, the elements of electrical transients, the synchro, and an introduction to servomechanism devices. Problems and laboratory work supplement the classroom theory.

Text: Kurtz and Corcoran: Introduction to Electric Transients.

Prerequisite: EE-314(C).

EE-651(B) Transients and Servomechanisms 3-4

Basic principles of electric transients and servomechanisms. DC and AC transients in series, parallel, series-parallel and coupled circuits. The solution of the differential equations by classical and Laplace operational methods. Servomechanisms with viscous damping and differential and integral control. Problems and laboratory experiments illustrate the theory.

Texts: Gardner and Barnes: Transients in Linear Systems; Lauer, Lesnick and Matson: Servomechanisms Fundamentals.

Prerequisite: EE-451(C).

EE-655(B) Filters and Transients 3-2

Basic principles of filters and electrical transients. T and Pi section filters and composite filters. DC and AC transients in series, parallel, series-parallel and coupled circuits. The solution of the differential equations by classical methods and Laplace operational methods.

Texts: Kerchner and Corcoran: Alternating Current Circuits; Kurtz and Corcoran: Introduction to Electrical Transients.

Prerequisite: EE-251(C).

EE-665(B) Lines, Filters and Transients 4-2

The basic principles of each subject are presented. The topics covered are: Transmission line parameters, infinite lines, open and shorted lines, reflection, matching, stubs, T and Pi sections, constant K and M-derived sections and composite filters; DC and AC transients in series, parallel, series-parallel and coupled circuits for particular boundary conditions using the Laplace transform methods. An introduction to transfer functions and elementary machine transients is included.

Texts: Gardner and Barnes: Transients in Linear Systems; Kurtz and Corcoran: Introduction to Electric Transients; Ware and Reed: Communication Circuits.

Prerequisites: EE-241(C) and Ma-114(A) or equivalent.

EE-671(A) Transients 3-4

The basic theory and practical applications of transient phenomena are treated in detail. Emphasis is on electric circuits and electromechanical system transients. Topics covered are: DC and AC transients in series, parallel, series-parallel, coupled and multiloop circuits; transients in motors, generators, and elementary servo systems; transfer functions, elementary non-linear transients; the analogue computer and its use. The Laplace transform method is used.

Texts: Gardner and Barnes: Transients in Linear Systems; Kurtz and Corcoran: Introduction to Electric Transients.

Prerequisite: EE-251(C) or EE-272(C).

EE-672(A) Servomechanisms 3-3

The mathematical theory of linear feedback-control systems is discussed in detail. Topics are: Basic system equations, time domain and frequency domain relationships, methods for improving performance, damping, differentiation and integration and their relationship to phase concepts, polar and logarithmic plots, design calculations, introduction to the root locus method. Problems and laboratory work illustrate the theory.

Text: Thaler and Brown: Servomechanisms Analysis.

Prerequisites: EE-671(A), EE-452(C) or EE-473(B).

EE-711(C) Electronics 3-2

The elementary theory of the control of electron motion by electric and magnetic fields in vacuum, gaseous conduction phenomena and electron tube characteristics are presented as a basis for the study of electronic circuits. The principles of the amplifier, rectifier and oscillator circuits are presented in their essentials. Some consideration is given to the special tubes encountered in electronic devices. Laboratory work serves to integrate the principles presented in the classroom with practical applications and circuits.

Text: Fink: Engineering Electronics.

Prerequisite: EE-251(C).

EE-731(C) Power Electronics 3-2

The theory and application of various types of electron tubes is covered with particular emphasis on the thyratron. The principles of electronics circuitry as applied to the control of power in motors, generators and selsyn instruments constitute the general theme of the course. Application in naval devices is stressed. The laboratory work consists of experiments to demonstrate the theory.

Text: Ryder: Electronic Engineering Principles.

Prerequisite: EE-231(C).

EE-745(A) Electronic Control and Measurement 3-3

This course presents the principles and practice of electronic control and measurement as found in research laboratories and in industry. It includes the theory of such basic circuits as vacuum tube voltmeters, direct coupled amplifiers, oscillators, timing circuite and frequency sensitive circuits with particular attention to their application in the measurement and control of current, voltage, frequency, speed, pressure, temperature and illumination. Some time is devoted to the study of data transmission methods by modulation and detection in carrier systems. Applications are studied in the laboratory.

Text: MIT Staff: Applied Electronics.

Prerequisite: EE-751(C).

EE-751(C) Electronics 3-4

A general introduction to the art and science of electronics. Topics treated are: electron ballistics, characteristics of vacuum tubes, gas discharge phenomena, gas tube characteristics, rectifier and amplifier circuits, equivalent circuits, special tubes, and applications. Problems and laboratory work supplement the lectures.

Text: Ryder: Electronic Engineering Principles.

Prerequisite: EE-451(C).

EE-753(C) Electronics 1-2

A continuation of EE-751, with emphasis on applications and electronic controls. The use of vacuum and gas-filled tubes in the control of motors, generators, and mechanical devices is treated in detail. Laboratory work supplements the theory.

Text: None.

Prerequisites: EE-451(C), EE-751(C).

EE-755(A) Electronic Control and Measurement 3-4

The principles and practice of electronic control and measurement as found in research laboratories and in industry. Includes the theory of such basic circuits as vacuum tube voltmeters, direct coupled amplifiers, oscillators, timing circuits and frequency sensitive circuits with particular attention to their application in the measurement and control of current, voltage, frequency, speed, pressure, temperature and illumination. Some time is devoted to the study of data transmission methods by modulation and detection in carrier systems. Applications are studied in the laboratory.

Text: MIT Staff: Applied Electronics.

Prerequisite: EE-751(C).

EE-771(B) Electronics 3-2

The theory of electron tubes and circuits for those curricula requiring a more advanced treatment. The theory of electron motion in electric and magnetic fields, vacuum and gas tube characteristics and the principles of such tubes as the ignitron, glow tube, cathode-ray tube and phototube. Circuit theory of rectifiers, detectors, amplifiers and oscillators is covered, with particular attention to industrial and naval power and control applications. Laboratory experiments and problems supplement the basic theory.

Text: MIT Staff: Applied Electronics.

Prerequisite: EE-272(C).

EE-772(B) Electronics 3-2

A continuation of EE-771(B). The more complicated electronic circuits encountered in practice with particular attention to the integration of various components in accordance with the basic theory of feedback and stabilization.

Text: MIT Staff: Applied Electronics.

Prerequisite: EE-771(B).

EE-871(A) Electrical Machine Design 4-0

A quantitative analysis of machine characteristics using the design approach. Serves to develop an appreciation for the limitations and possibilities in electrical machine construction especially for naval applications, and the ability to evaluate properly the merits of present designs. In particular, this course consists of the quantitative study and design of a transformer to meet certain specifications. Later, the analysis of the DC machine is begun.

Text: Slichter: Principles Underlying the Design of Electrical Machinery.

Prerequisite: EE-472(C).

EE-872(A) Electrical Machine Design 4-0

A continuation of EE-871(A). The completion of the quantitative analysis and design of a DC machine and the beginning of a similar analysis of the synchronous machine.

Text: Slichter: Principles Underlying the Design of Electrical Machinery.

Prerequisite: EE-871(A).

EE-873(A) Electrical Machine Design 4-0

A continuation of EE-872(A). The completion of the quantitative analysis and design of a synchronous machine and a similar analysis and design of the induction machine.

Text: Slichter: Principles Underlying the Design of Electrical Machinery.

Prerequisite: EE-872(A).

EE-874(A) Electrical Machine Design 4-0

A continuation of EE-873(A). The design of the induction machine is analyzed quantitatively and its operating characteristics, both as a motor and as an induction generator, are determined.

Text: Slichter: Principles Underlying the Design of Electrical Machinery.

Prerequisite: EE873(A).

EE-971(A) Seminar 1-0

In the seminar sessions, papers on research and developments in the field of electrical science are presented to the more advanced group of students. Some appreciation for research methods is developed. In these sessions papers treating of student research in progress and matters of major importance in electrical engineering are delivered by the faculty and by the students pursuing an advanced engineering curriculum.

Text: None.

Prerequisite: A background of advanced work in electrical engineering.

EE-972(A) Thesis 0-0

This work provides an opportunity for research and study necessary for the preparation of the thesis as required for the master's degree in electrical engineering. Individual laboratory and library work is performed under the general supervision of the members of the Electrical Engineering Staff.

Text: None.

Prerequisite: The first two years of the advanced electrical engineering curriculum.

ENGINEERING ELECTRONICS

Es Courses

Electronics Administration	Es-036(C)
DC and AC Electric Circuits	Es-111(C)
AC Electricity	Es-112(C)
Circuit Analysis and Measurements	Es-113(C)
Circuit Analysis and Measurements	Es-114(C)
Advanced Circuit Theory	Es-121(A)
Advanced Circuit Theory	Es-122(A)
Advanced Circuit Theory	Es-123(A)
Radio-Frequency Measurements	Es-126(C)
Advanced Circuit Theory	Es-134(A)
DC Electricity and Static Fields	Es-141(C)
AC Electricity	Es-142(C)
Communications Fundamentals	Es-186(C)
Electron Tubes and Circuits	Es-212(C)
Electron Tubes and Circuits	Es-213(C)
Electron Tubes and Circuits	Es-214(C)
Electron Tubes	Es-225(A)
Ultra-High Frequency Techniques	Es-226(A)
Ultra-High Frequency Techniques	Es-227(C)
Electron Tubes and Circuits	Es-261(C)
Electron Tubes and Circuits	Es-262(C)
Electronics I	Es-271(C)
Electronics II	Es-272(C)
Electronic Fundamentals	Es-281(C)
Vacuum Tube Circuits	Es-282(C)
Vacuum Tube Circuits	Es-283(C)
Pulsing and High-Frequency Circuits	Es-286(C)
Radio Systems	Es-321(B)
Radio Systems	Es-322(B)
Radio Systems	Es-326(B)
Radio Systems	Es-327(B)
Radio Systems	Es-328(B)
Radio Systems	Es-333(B)
Transmitters and Receivers	Es-386(C)
Pulse Techniques	Es-421(B)
Radar System Engineering	Es-422(B)
Radar System Engineering	Es-423(B)
Radar System Engineering	Es-431(B)
Radar System Engineering	Es-432(B)
Introduction to Radar	Es-446(C)
Electronics Pulse Techniques	Es-447(C)
Introduction to Radar (Airborne)	Es-456(C)
Radar Propagation and Displays	Es-466(C)
Special Systems	Es-521(B)
Special Systems	Es-522(B)
Special Systems	Es-531(B)
Special Systems	Es-532(B)
Counter Measures	Es-536(B)
Special Systems	Es-586(C)
Electric and Magnetic Fields	Es-616(C)
Electromagnetics	Es-621(A)
Electromagnetics	Es-622(A)
Electromagnetics	Es-623(A)
Electromagnetics	Es-624(A)
Antennas and Wave Propagation	Es-721(B)
Antennas and Wave Propagation	Es-722(B)
Antennas, Transmission Lines	Es-736(B)
R-F Energy Transmission	Es-786(C)
Project Seminar	Es-836(A)
Introduction to Electronics	Es-991(C)
Introduction to Electronics	Es-992(C)

Es-036(C) Electronics Administration 2-0

A problem and lecture series designed to acquaint the student with the administration and organization of electronics activities and applications, ashore and afloat. The principal topics are: Army, Navy and Air Force organization; shipyard electronics organization; radio station administration; electronics supply matters.

Text: None.

Prerequisite: None.

Es-111(C) DC and AC Electric Circuits 4-5

An introduction to DC and AC circuits. The principal topics are: circuit fundamentals, batteries, non-linear elements, elementary AC concepts, complex quantities, series and parallel circuits, real and apparent power, network theorems, coupled circuits. The laboratory work familiarizes the student with electronic components and basic measuring equipment.

Texts: Tang: Alternating Current Circuits; second edition.

Prerequisite: Mathematics through calculus.

Es-112(C) AC Electricity 2-0

A continuation of Es-111(C). The principal topics are: a brief introduction to polyphase circuits, non-sinusoidal voltages and currents, DC and AC transients in RLC circuits, voltage and current relations, and impedance on transmission lines.

Texts: Tang: Alternating Current Circuits; Everitt: Communication Engineering.

Prerequisite: Es-111(C).

Es-113(C) Circuit Analysis and Measurements 3-3

This course covers ordinary measurements techniques and continues into AC circuit theory. The principal topics are: coupled circuits, network theorems, the infinite line, radio frequency bridges, measurements at high frequencies, measurements involving complex wave forms.

Texts: Everitt: Communication Engineering; Terman: Radio Engineering; Terman: Measurements in Radio Engineering.

Prerequisite. Es-112(C).

Es-114(C) Circuit Analysis and Measurements 3-3

A continuation of Es-113(C). The principal topics are: reflections in lines, solution of the general line, stubs, derivation and use of circle diagrams, constant-K and M-derived filters, impedance measurements with slotted lines.

Text: Everitt: Communication Engineering.

Prerequisite: Es-113(C).

Es-121(A) Advanced Circuit Theory 3-2

An introduction to transient phenomena in electrical networks and their solutions on the loop and nodal basis; modes. Solutions are by classical methods, Fourier Integral, Laplace transforms.

Texts: Guillemin: Communication Networks, Vol. I; Goldman; Frequency Analysis, Modulation, and Noise; Gardner and Barnes: Transients in Linear Systems.

Prerequisite: Es-114(C).

Es-122(A) Advanced Circuit Theory 3-2

A continuation of Es-121(A). The Laplace transform is employed for solution of transients in typical circuits used in radio and radar.

Text: Gardner and Barnes: Transients in Linear Systems.

Prerequisite: Es-121(A).

Es-123(A) Advanced Circuit Theory 3-0

A continuation of Es-122(A). The transmission line as a communication facility leading to filter theory is treated. The principal topics are: four terminal networks; Foster's reactance theorem with Cauer's extension; Lagrange's equations; driving point impedance; principle of duality; lumped loaded lines; lattice structures.

Text: Guillemin: Communication Networks, Vol. II.

Prerequisite: Es-122(A).

Es-126(C) Radio-Frequency Measurements 2-6

Impedance and frequency bridges and the techniques of the measurement of voltage, current, power, and impedance in the various frequency ranges. The topics include a detailed study of radio-frequency resonant methods, precision slotted lines, microwave measurements, standards of E, R, L, C and F.

Text: Hartshorn: Radio-Frequency Measurements.

Prerequisites: Es-114(C), Es-225(A).

Es-134(A) Advanced Circuit Theory 3-0

A continuation of Es-123(A). The theory and basic design of ladder and lattice structure filters are studied together with their transient behavior.

Texts: Guillemin: Communication Networks, Vol. II; Bode: Network Analysis and Feedback Amplifiers.

Prerequisite: Es-123(A).

Es-141(C) DC Electricity and Static Fields 4-4

Develops circuit analysis techniques applicable to direct current circuits and presents fundamental electric and magnetic concepts. Principal topics covered are: Ohm's Law; Kirchhoff's Laws; network theorems; mesh and nodal analysis; electric fields; capacitance; magnetic fields; inductance; mutual inductance. The laboratory work familiarizes the student with electrical components and common configurations thereof, and with basic measuring instruments.

Text: Hessler and Carey: Fundamentals of Electrical Engineering.

Prerequisite: Mathematics through the calculus.

Es-142(C) AC Electricity 4-3

A continuation of Es-141(C). Circuit analysis techniques are extended to include alternating currents and reactive circuits. Principal topics covered are: Definition of alternating voltage and current; non-sinusoidal waves, elementary reactive circuits, resonance, network theorems, analysis of multi-mesh networks, mutual inductance, inductively coupled circuits, equivalent tee and pi sections, impedance transformation, polyphase circuits (brief).

The factual content of Es-141(C) and Es-142(C) is presented rapidly and largely constitutes a review for most students. Emphasis is placed particularly on developing effective analysis techniques.

Text: Tang: Alternating Current Circuits.

Prerequisite: Es-141(C).

Es-186(C) Communications Fundamentals 4-4

The fundamental principles of radio communications and basic circuits. The principal topics are: fundamentals of energy transmission by means of radio waves, basic alternating-current theory, frequency selectivity circuits, coupled circuits.

Texts: Sheingold: Fundamentals of Radio Communications.

Prerequisite: None.

Es-212(C) Electron Tubes and Circuits 4-6

The principal topics are: physical principles of vacuum and gas tubes, i.e., emission, space charge; tube characteristics and coefficients; R-C and transformer coupled voltage amplifiers; audio power amplifiers; rectifiers and filters.

Texts: Geppert: Basic Electron Tubes; Terman: Radio Engineering.

Prerequisites: Es-111(C), Es-616(C).

Es-213(C) Electron Tubes and Circuits 4-3

A continuation of Es-212(C). Course topics include: voltage regulator; applications of the tube as a switch, i.e., saw-tooth and square-wave generators, clipping clamping, differentiating, and integrating; inverse feedback; video amplifier; tuned amplifiers, i.e., narrow-band voltage and power amplifiers, wideband voltage amplifier.

Texts: Seely: Electron Tube Circuits; Cruft: Electronic Circuits and Tubes.

Prerequisite: Es-212(C).

Es-214(C) Electron Tubes and Circuits 4-3

A continuation of Es-213(C). The principal topics are: Sine-wave oscillators; methods of modulation; methods of detection; avc; discriminators; receiver principles.

Texts: Cruft Electronics Staff: Electronic Circuits and Tubes; Seely: Electron-tube Circuits; Terman: Radio Engineering.

Prerequisite: Es-213(C)

Es-225(A) Electron Tubes 3-6

A continuation of Es-214(C). The principal topics are: noise, electron ballistics, electron optics, cathode-ray tubes, photo-multiplier tubes, television tubes, polyphase and controlled rectifiers, transistors. Laboratory work includes individual student projects.

Text: Spangenberg: Vacuum Tubes.

Prerequisite: Es-214(C).

Es-226(A) Ultra-High Frequency Techniques 4-3

The principal topics are: ultra-high frequency effects in conventional tubes, cavity resonators, klystron and magnetron tubes and circuits, traveling-wave tubes, pulsing circuits, and related laboratory work.

Texts: Spangenberg: Vacuum Tubes; Ridenour: Radar System Engineering; Massachusetts Institute of Technology Staff: Principles of Radar, Second Ed.: Bell Lab Journals.

Prerequisites. Es-225(A), Es-623(A).

Es-227(C) Ultra-High Frequency Techniques 3-2

The principles and underlying problems of high-frequency techniques. The principal topics are: limitations of conventional tubes at ultra-high frequencies, transit-time effects, noise problems, electron ballistics, wave guides, cavity resonators, klystrons, magnetrons and travelling-wave tubes. The course emphasizes a descriptive presentation rather than a mathematical one.

Texts: Spangenberg: Vacuum Tubes; Massachusette Institute of Technology Radar School Staff: Principles of Radar, Third Ed.

Prerequisite: Es-214(C).

Es-261(C) Electron Tubes and Circuits 3-2

The first term of a two-term course in the fundamentals and general applications of electron tubes and circuits, primarily for non-communication students. The principal topics are: emission, characteristics of vacuum and gas tubes, rectifiers and filters, grid-controlled rectifiers, class A amplifiers.

Text: Massachusetts Institute of Technology Staff: Applied Electronics.

Prerequisites: Es-111(C), Es-112(C).

Es-262(C) Electron Tubes and Circuits 3-2

A continuation of Es-261(C). The principal topics are: feedback amplifiers, class B and C amplifiers, oscillators, modulation, detection.

Text: Massachusetts Institute of Technology Staff: Applied Electronics.

Prerequisite: Es-261(C).

Es-271(C) Electronics I 3-3

An introduction to DC and AC circuit theory. The principal topics are: series and parallel circuit analysis; an introduction to thermionic vacuum tubes.

Text: Cruft Electronics Staff: Electronic Circuits and Tubes.

Prerequisite: None.

Es-272(C) Electronics II 3-2

The study of thermionic vacuum tube circuits, simple rectifiers, voltage and power amplifiers, counting circuits, timing circuits, simple R, L and C transients.

Text: Cruft Electronics Staff: Electronic Circuits and Tubes.

Prerequisite: Es-271(C) or equivalent.

Es-281(C) Electronic Fundamentals 2-2

The basic principles of electronics. The principal topics are: a review of basic mathematical concepts; the underlying physical principles of electron-tube operation.

Texts: Robeson: Physics; Eastman: Fundamentals of Vacuum Tubes; Cook: Mathematics for Electricians and Radiomen; Sheingold: Fundamentals of Radio Communications.

Prerequisite: None.

Es-282(C) Vacuum Tube Circuits 4-4

A continuation of Es-281(C). The course covers the operational characteristics of electron tubes and some of their applications. The principal topics are: general operational features of diodes, triodes, multigrid tubes and gas tubes; amplification of small alternating voltages; power amplifiers.

Text: Sheingold: Fundamentals of Radio Communications.

Prerequisite: Es-281(C).

Es-283(C) Vacuum Tube Circuits 4-3

A continuation of Es-282(C). The course covers further applications of electron tubes, in continuation of the material presented in Es-282(C). The principal topics are: sine-wave oscillators, amplitude modulation and the A-M transmitter, demodulation and the TRF receiver, frequency conversion and the superheterodyne A-M receiver, power supplies, frequency modulation.

Text: Sheingold: Fundamentals of Radio Communications.

Prerequisite: Es-282(C).

Es-286(C) Pulsing and High Frequency 3-2

The principles and underlying problems of pulsing and high-frequency circuit operation. The principal topics are: Characteristics of non-sinusoidal waves; pulse-shaping techniques; the sawtooth generator, multivibrator, and blocking oscillator; problems and techniques of high-frequency circuit operation; the magnetron and velocity-modulated tubes; guided waves.

Texts: Navships 900.016: Radar Electronic Fundamentals; Massachusetts Institute of Technology Staff: Principles of Radar, Second Ed.; Sheingold: Fundamentals of Radio Communications.

Prerequisite: Es-282(C).

Es-321(B) Radio Systems 3-3

The first of a sequence of five courses on the engineering applications of theoretical electronics to the specific problems of radio communications and electronic systems aimed to give the student experience in design and to integrate his previous theoretical training as applied in radio systems engineering. Included is a general survey of the basic problems of a communications system with emphasis on the design of transmitters for medium and high frequencies.

Texts: Terman: Radio Engineer's Handbook; War Department Technical Manual, TM11-486 (Electrical Communication System Engineering); Navy equipment instruction books.

Prerequisites: Es-225(A), Ma-104(A).

Es-322(B) Radio Systems 3-3

A continuation of the series begun in Es-321(B). Emphasis is placed upon the design of receivers for the reception of amplitude-modulated signals in the medium and high frequency bands. The design problem is extended to include the VHF region and the changes introduced by the use of frequency and phase modulation.

Text: Sturley: Radio Receiver Design; Terman: Radio Engineer's Handbook; Massachusetts Institute of Technology Radiation Laboratory Series: Microwave Receivers; other selected references.

Prerequisite: Es-321(B).

Es-326(B) Radio Systems 3-3

The first of a sequence of five courses on the engineering applications of theoretical electronics to the specific problems of radio communications and electronics systems, aimed to give the student an appreciation of the problems encountered in such systems design and to integrate his previous theoretical training as applied in radio systems engineering. Included is a general survey of the basic problems of a communications system with emphasis on typical designs employed in transmitters for medium and high frequencies.

Texts: Terman: Radio Engineer's Handbook; War Department Technical Manual, TM11-486 (Electrical Communication System Engineering); Navy equipment instruction books.

Prerequisites: Es-114(C), Es-214(C).

Es-327(B) Radio Systems 4-3

A continuation of the series begun in Es-326(B). Emphasis is placed upon typical circuit designs of receivers for the reception of amplitude-modulated signals in the medium and high frequency band. Circuit modifications to include the VHF region and the changes introduced by the use of frequency and phase modulation are also covered.

Texts: Sturley: Radio Receiver Design; Terman: Radio Engineer's Handbook; Massachusetts Institute of Technology Radiation Laboratory Series: Microwave Receivers; other selected references.

Prerequisite: Es-326(B).

Es-328(B) Radio Systems 2-3

Continues the systems series. The principal topics are: the application of teletype and frequency-shift keying to radio transmission; tone multiplex, applications of multiplexing to remote control, single side-band transmission theory and basic single side-band multiplex transmitter and receiver design.

Texts: Naval instruction books; instructor's notes.

Prerequisite: Es-327(B).

Es-333(B) Radio Systems 2-3

Continues the systems series. The principal topics are: the application of teletype and frequency-shift keying to radio transmission, tone multiplex, applications of multiplexing to remote control, single side-band multiplex transmitter and receiver design.

Texts: Naval instruction books; instructor's notes.

Prerequisite: Es-322(B).

Es-386(C) Transmitter and Receivers 3-3

The operational characteristics of typical Navy-type transmitters and receivers. Included topics are frequency standards and meters, Navy transmitters, Navy receivers.

Texts: Lecture notes; equipment instruction books.

Prerequisites: Es-283(C), Es-786(C).

Es-421(B) Pulse Techniques 2-3

The principles and underlying problems of pulse techniques. Principal topics are: pulse-shaping, switching, clipping differentiating and integrating circuits; sweep-circuit generators; pulse transformers; delay lines; transistors.

Text: Massachusetts Institute of Technology Radar School Staff: Principles of Radar, Third Ed.

Prerequisite: Es-114(C).

Es-422(B) Radar System Engineering 3-3

A study of the fundamental principles of radar. The principal topics are: the theory of operation of radar timing circuits, indicators, modulators, transmitters, r-f systems and receivers, the radar range equation.

Texts: Ridenour: Radar System Engineering; Massachusetts Institute of Technology Radar School Staff: Principles of Radar, Second Ed.

Prerequisite: Es-421(B).

Es-423(B) Radar System Engineering 3-6

A continuation of Es-422(B). The course contents include a study of representative search, fire-control and IFF systems, including airborne, with particular attention to design features; a study of current radar developments; related laboratory work on current Navy radar equipment.

Text: Ridenour: Radar System Engineering.

Prerequisite: Es-422(B).

Es-431(B) Radar System Engineering 3-3

A treatment of the fundamental principles of radar. The principal topics are: the theory of operation and design features of radar timing circuits, indicators, modulators, transmitters, r-f systems and receivers.

Texts: Ridenour: Radar System Engineering; Massachusetts Institute of Technology Radar School Staff: Principles of Radar, Second Ed.

Prerequisite: Es-226(A).

Es-432(B) Radar System Engineering 3-6

A continuation of Es-431(B). The course contents include a study of representative search, fire-control and IFF systems, including airborne, with particular attention to design features; a study of current radar developments; related laboratory work on current Navy radar equipment.

Text: Ridenour: Radar System Engineering.

Prerequisite: Es-431(B).

Es-446(C) Introduction to Radar 2-2

A study of the radar range equation, i.e., effect of pulse duration, pulse repetition frequency, types of targets, etc.; block diagram studies of current fire-control systems, with emphasis on operational limitations, propagation phenomena, types of presentation, and anti-jam techniques; and laboratory work that emphasizes operational techniques of current fire-control systems.

Text: Massachusetts Institute of Technology Radar School Staff: Principles of Radar, Second Ed.

Prerequisite: Es-262(C) or equivalent.

Es-447(C) Electronics Pulse Techniques 3-0

The basic principles of pulse-shaping circuits, clippers, peakers, gaters, etc., pulse-forming networks and artificial lines. Also, r-f, i-f and video amplifiers are treated from the view point of pulse amplification, distortion tolerances and requirements. The course is directed toward preparing the students for more advanced courses in radar.

Texts: Ridenour: Radar System Engineering; Massachusetts Institute of Technology Radar School Staff: Principles of Radar, Second Ed.

Prerequisite: Es-262(C) or equivalent.

Es-456(C) Introduction to Radar (Airborne) 2-2

A study of the radar range equation, i.e., effect of pulse duration, pulse repetition frequency, types of targets, etc., block diagram studies of current airborne systems with emphasis on operational limitations, propagation phenomena, types of presentation, and anti-jam techniques and laboratory work on current airborne radar equipment.

Text: Massachusetts Institute of Technology Radar School Staff: Principles of Radar, Second Ed.

Prerequisite: Es-262 or equivalent.

Es-466(C) Radar Propagation and Displays

The principal topics are: the operational char acteristics of search radar; a complete study of the radar equation; types of indicators and the influence of phosphor types on data interpretation.

Texts: Ridenour: Radar System Engineering; Massachusetts Institute of Technology Staff: Principles of Radar, Third Ed.

Prerequisite: None

Es-521(B) Special Systems 3-3

A continuation of the series starting with Es-321 (B). The principal topics are: pulse-modulation principles, pulse-time-modulation multiplex; principles of television, television receiver and transmitter design practice, facsimile, and basic telemetering systems.

Texts: Naval instruction books; instructor's notes.

Prerequisite: Es-327(B).

Es-522(B) Special Systems 3-3

A continuation of the special systems series. The principal topics are: principles of radio direction finding and navigation, and radio and radar countermeasures.

Texts: Massachusetts Institute of Technology Radiation Laboratory Series: Loran; Radio Research Laboratory Staff: Very High Frequency Techniques, Vol. I; other selected references.

Prerequisite: Es-521(B).

Es-531(B) Special Systems 3-3

A continuation of the series starting with Es-321 (B). The principal topics are: pulse-modulation principles, pulse-time-modulation multiplex, principles of television, television receiver and transmitter design, facsimile and basic telemetering systems.

Texts: Naval instruction books; instructor's notes.

Prerequisite: Es-333(B).

Es-532(B) Special Systems 3-3

A continuation of the special systems series. The principal topics are: principles of radio direction finding and navigation, and radio and radar countermeasures.

Texts: Massachusetts Institute of Technology Radiation Laboratory Series: Loran; Radio Research Laboratory Staff: Very High Frequency Techniques, Vol. I; other selected references.

Prerequisite: Es-531(B).

Es-536(B) Counter Measures 2-3

Principles of radio direction finding; special electronic circuits with particular application to the field of electronic counter-measures; basic principles of electronic counter-measures tactics and operational procedures; passive and active electronic countermeasures equipment.

Texts: Radio Research Laboratory Staff: Very High Frequency Techniques, Vols. 1 and II; Navy equipment manuals; instructor's notes.

Prerequisite: None.

Es-586(C) Special Systems 3-3

Navy electronic systems other than communications transmitters and receivers. The principal topics are: loran systems; radar systems; image transmission systems; frequency-shift keying techniques; multiplex systems.

Texts: Lecture notes; equipment instruction books; Sheingold: Fundamentals of Radio Communications.

Prerequisites: Es-283(C), Es-786(C).

Es-616(C) Basic Electric and Magnetic Fields 2-2

Electric field concepts (potential, intensity, flux, mapping, energy, capacitance, RC transients); magnetic field concepts (MMF, potential, intensity, flux, energy, inductance, RL transients); magnetic circuits (B-H curves, calculation of MMF and flux, hysteresis and eddy currents); electromagnetic induction and forces, cathode ray deflection.

Text: Corcoran: Basic Electrical Engineering.

Prerequisite: None.

Es-621(A) Electromagnetics 3-0

An introduction to the fundamental definitions and circuit parameters later to be used in resonant cavities, wave guides, wave propagation, etc., as exemplified through the differential equations solution of lumped circuits and transmission lines. An application of vector analysis to electrostatics and magnetostatics in rectangular and in generalized coordinates, including the gradient, divergence and curl of electromagnetic fields; scalar and vector potentials; energy stored in electric and in magnetic fields. Text material is considerably amplified in class lectures.

Text: Chaney: Electromagnetics in Engineering Electronics.

References: Ramo and Winnery: Fields and Waves in Modern Radio; Schelkunoff: Electromagnetic Waves.

Prerequisites: Ma-104(A), Ph-311(B).

Es-622(A) Electromagnetics 4-0

A continuation of Es-621(A). An application of complex variables to potential theory; derivation of capacitance and inductance per unit length for open wire and coaxial transmission lines; application of Bessel equations to potential theory; Maxwell's equations; relations between units; Poisson's equations; retarded vector potentials; radiation from current dipole, halfwave antennas, radiation resistance of halfwave antennas in terms of Ci and Si functions; antenna arrays; field patterns and gain of yagi arrays; input impedance of yagi arrays.

Text: Chaney: Electromagnetics in Engineering Electronics.

References: Ramo and Whinnery: Fields and Waves in Modern Radio; Schelkunoff: Electromagnetic Waves.

Prerequisite: Es-621(A).

Es-623(A) Electromagnetics 4-0

A continuation of Es-622(A). The principal topics are: skin effect and internal impedance; solutions involving Bessel and Hankel functions; calculations of inductance; propagation and reflection of plane electromagnetic waves; attenuation; power factor; waves guided by lossy planes; solutions of Maxwell's equations for rectangular and cylinderical wave guides.

Text: Chaney: Electromagnetics in Engineering Electronics.

References: Ramo and Whinnery: Fields and Waves in Modern Radio; Schelkunoff: Electromagnetic Waves.

Prerequisite: Es-622(A).

Es-624(A) Electromagnetics 3-0

A continuation of Es-623(A). The principal topics are: radial disk transmission lines; resonant cavaties; generalized Maxwell's equations; generalized method of deriving radiation field patterns; radiation resistance; long straight wire antenna; Vee antenna; radiation from end of wave guide; rhombic antenna; non-uniform transmission line; input impedance of antennas.

Text: Chaney: Electromagnetics in Engineering Electronics.

References: Ramo and Whinnery: Fields and Waves in Modern Radio; Schelkunoff: Electromagnetic Waves.

Prerequisite: Es-623(A).

Es-721(B) Antennas and Wave Propagation 3-3

Designed to give the student the best possible understanding of the problems involved in the radiation and propagation of electromagnetic energy without the use of the classic Maxwell equation type of approach. The emphasis is on practical problems encountered in communications engineering, including selection of proper antennas for various services as well as proper frequencies for optimum transmission.

Texts: Instructor's notes; Kraus: Antennas; King, Mimno, and Wing: Antennas, Transmission Lines, and Wave Guides.

Prerequisites: Es-327(B), Es-114(C).

Es-722(B) Antennas and Wave Propagation 3-3

A continuation of Es-721(B).

Texts: Instructor's notes; Kraus; Antennas; King, Mimno, and Wing: Antennas, Transmission Lines, and Wave Guides.

Prerequisite: Es-721(B).

Es-736(B) Antennas, Transmission Lines 3-3

The engineering problems associated with the practical design of antennas, antenna systems, and transmission lines. A technique of rapid approximation of antenna field patterns is presented. All common receiving and transmitting antennas are presented and analyzed. The problems inherent in the various frequency ranges are discussed, including the microwave region. The problem of efficient transmission of r-f energy, matching, phasing and achieving proper current distributions are studied. The classwork is accompanied by considerable problem drill and measurements on typical systems.

Text: Kraus: Antennas.

Prerequisite: Es-624(A).

Es-786(C) R-F Energy Transmission 3-2

The principles and techniques of energy transmission by means of radio-frequency waves. The principal topics are: conditions for maximum energy transfer between circuits; r-f transmission lines for energy transfer; lines as circuit elements; principles of energy radiation; directional radiation techniques; propagation characteristics. The laboratory periods are occasionally used for lecture-demonstrations.

Texts: Terman: Radio Engineering; NavShips 900,016: Radar Electronic Fundamentals; Sheingold: Fundamentals of Radio Communications.

Prerequisite: Es-186(C).

Es-836(A) Project Seminar 1-0

Provides the student with the opportunity to prepare a report on the project in which he was engaged during his experience at an industrial laboratory. The student is required to give an oral seminar report.

Text: None.

Prerequisite: None.

Es-991(C) and 992(C) Introduction to Electronics 2-0

This course will continue through two consecutive terms and is intended to acquaint the student officer with the general principles, capabilities and limitations of radio, sonar and radar and to give him a limited familiarity with equipment. The following topics will be studied in an elementary manner: resonant circuits; principles of vacuum tubes; their actions as oscillators, amplifiers, detectors, modulators; general principles of transmitters and receivers, both AM and FM; antennas, wave propagation; basic principles of radar and sonar.

Text: None.

Prerequisite: None.

GEOLOGY

Ge Courses

Ge-101(C) Physical Geology 3-0

The study of the various geological phenomena. Topics discussed are: rock-forming minerals; igneous, sedimentary, and metamorphic rocks; weathering and erosion; stream sculpture; glaciation; surface and sub-surface waters; volcanism, dynamic processes; structural geology; and interpretation of topographic maps. Frequent reference is made to other than the prescribed textbook. The course stresses those topics of particular interest to the petroleum engineer.

Text: Longwell, Flint, Knopf: Physical Geology.

Prerequisite: None.

Ge-201(C) Physical Geology 4-0

Course content similar to Ge-101, but directed towards the specific needs of the Nuclear Engineering Groups.

Prerequisite: None.

Ge-241(C) Geology of Petroleum 2-2

Seminars and discussions on the origin, accumulation, and structure which aid in the accumulation of petroleum, its general occurrence and distribution. The following regions are studied: Eastern United States, Mid-Continent, Gulf Coast, Rocky Mountains, Pacific Coast, North America (except U. S.), West Indies, South America, Europe, Russia, Oceanica and Asia. This course is supplemented by reading assignments in the current petroleum and petroleum geology journals.

Text: Lalicker: Principles of Petroleum Geology.

Prerequisite: Ge-101(C).

Ge-302(C) Determinative Mineralogy 1-4

The lectures are designed to familiarize the student with the principles and techniques involved in determining minerals in the laboratory. The laboratory periods are spent in the determination of some fifty of the more common minerals by blowpipe, chemical, x-ray diffraction and crystallographic methods. The student is also made familiar with the methods employed in the use of chemical microscopy for the determination of certain elements.

Text: Lewis, Hawkins: Determinative Mineralogy; Dana, Ford: Textbook of Mineralogy.

Prerequisite: Cr-301(B) or Cr-311(B).

Ge-401(C) Petrology and Petrography 2-3

A series of lectures on the differentiation of magmas into the various igneous rock series on the basis of physical chemical theories; the characteristics, structures and textures of igneous rocks; the metamorphic rocks, mineral alteration, metamorphism and the resultant rock types. The laboratory work consists of the study of the various rocks in hand specimens, and in thin sections under the petrographic microscope. When practicable, the course is supplemented by trips to nearby localities to study rocks and minerals in the field.

Text: Pirsson, Knopf: Rocks and Rock Minerals.

Prerequisite: Ge-101(C) (may be taken concurrently), or Cr-301(B), or Cr-311.

INDUSTRIAL ENGINEERING

IE Lecture Courses

IE-101(C) Principles of Industrial Organization 0-1

Ten lectures covering the rise and growth of industrial enterprises; standard types of ownership and organization structures; coordination and executive control; standardization; labor compensation; problems of management; effects of science in industry, and related topics. An integrated series given by authorities in the field of industrial and management engineering.

Text: None.

Reference: Kimball and Kimball: Principles of Industrial Organization. Other texts on industrial and management engineering.

Prerequisite: None.

IE-103(C) Applied Industrial Organization. 0-1

The application of organization and management principles to the structure of actual industrial and government enterprises; further consideration of problems facing management. In some lectures, representatives of typical industrial or government activities discuss the structure and management of their own activities; in other speeches, educators and authorities in various fields discuss particular aspects of industrial engineering.

Text: None.

Prerequisite: IE-101.

IE-104(C) Technical Lectures 0-1

A series of ten lectures covering various technical subjects pertaining to engineering in the Navy, delivered by naval officer specialists or qualified civilians. In addition to strictly engineering subjects, lectures are scheduled in such fields as human engineering, psychophysical systems research, and use of human factors in equipment design.

Text: None.

Prerequisite: None.

MARINE ENGINEERING

NE Courses

NE-101(C) Main Propulsion Plants--------------3-0

A practical study of naval geared-turbine main propulsion plants, boilers and main propulsion plant auxiliaries. This course deals primarily with the Bureau of Ships with regard to the operation, main-Ships Journals and letters, and by descriptive texts as necessary. The purpose of the course is to give the technical engineer a sound basic knowledge of, and familiarity with, the procedures set forth by the bureau of Ships with regard to the operation, maintenance and repair of main propulsion machinery.

Texts: Bureau of Ships Manual; Bureau of Ships Journals; Naval Turbines—1949; Naval Boilers—1949.

Prerequisite: None.

NE-102(C) Auxiliary Machinery 3-0

A practical study of naval machinery other than main propulsion machinery, boilers and main propulsion plant auxiliaries. This course deals primarily with the Bureau of Ships Manual supplemented by Bureau of Ships Journals and letters and by descriptive texts as necessary. The purpose is to give the technical engineer a sound basic knowledge of, and familiarity with, the procedures set forth by the Bureau of Ships with regard to the operation, maintenance and repair of subject machinery.

Texts: Bureau of Ships Manual; Bureau of Ships Journals; Naval Auxiliary Machinery—1949.

Prerequisite: None.

NE-103(C) Engineering Department Administration 2-0

A study of the administrative duties of the Engineer Officer afloat. Subjects treated include: engineering department organization, routine tests and inspections, machinery index, machinery history, current ship's maintenance project, ship's force overhauls, tender overhauls, shipyard overhauls, supplies, spare parts, requisitions, engineering casualty control, safety precautions, engineering competition and economical operation of engineering plants.

Texts: Bureau of Ships Manual; Bureau of Ships Journals; fleet training publications; prepared pamphlets on above subjects.

Prerequisite: None.

MATHEMATICS

Ma Courses

Ma-100(C) Vector Algebra and Geometry 2-1

Review of plane analytic geometry. Vectors and their algebra. Analytic geometry of space; points, lines and planes in scalar and vector notation. Determinants and linear systems. Special surfaces.

Texts: Smith, Gale and Neelley: New Analytic Geometry; mimeographed notes.

Prerequisite: A former course in plane analytic geometry.

Ma-101(C) Introduction to Engineering Mathematics 3-0

Introduction to infinite series, differential equations, hyperbolic functions. Partial derivatives, multiple integration.

Texts: Sokolnikoff and Sokolnikoff: Higher Mathematics; Granville, Smith and Longley: Elements of the Differential and Integral Calculus.

Prerequisites: A former course in differential and integral calculus, and Ma-100(C) to be taken concurrently.

Ma-102(C) Differential Equations and Series 5-0

A continuation of Ma-100(C) and Ma-101(C). Elementary operations with complex quantities. Solution of algebraic equations, Graeffe's method. Further study of ordinary differential equations and their applications, stability criteria, systems of linear differential equations with constant coefficients. Operations on series, power series. Introduction to elliptic integrals, Fourier series, numerical harmonic analysis.

Texts: Cohen: Differential Equations; Sokolnikoff and Sokolnikoff: Higher Mathematics.

Prerequisites: Ma-100(C), Ma-101(C).

Ma-103(B) Functions of Several Variables and Vector Analysis 5-0

A continuation of Ma-102(C). Elementary matrix theory and applications. Analytic geometry of space curves and surfaces. Applications of partial derivatives. Differentiation of vectors. Differential operators. Line, surface, and space integrals with applications. Divergence theorem and the theorems of Green and Stokes. Curvilinear coordinates. Introduction to analytic functions of a complex variable.

Texts: Sokolnikoff and Sokolnikoff: Higher mathematics; Weatherburn: Elementary and Advanced Vector Analysis; Smith, Gale and Neelley: New Analytic Geometry.

Prerequisite: Ma-102(C) or Ma-132(C).

Ma-104(A) Partial Differential Equations and Related Topics 5-0

A continuation of Ma-103(B). Total differential equations and systems of ordinary differential equations. Linear and other first order partial differential equations. Special cases of higher order partial differential equations with emphasis on those with constant coefficients. Solution of ordinary differential equations by series. Gamma, Beta, Bessel and Legendre functions. Introduction to boundary value problems and orthogonal functions with applications to heat flow, vibrations of strings and membranes, and flow of electricity in cables. Interpolation formulas of Newton, Stirling and Lagrange. Quadrature formulas and numerical integration of ordinary differential equations and systems of such equations.

Texts: Sokolnikoff and Sokolnikoff: Higher Mathematics; Cohen: Differential Equations; Scarborough: Numerical Mathematical Analysis.

Prerequisite: Ma-103(B).

Ma-105(A) Fourier Series and Boundary Value Problems 4-0

Derivation of the basic partial differential equations of theoretical physics. Study of the trigonometric, Bessel and Legendre fúnctions, and other systems of orthogonal functions. The Sturm-Liouville theory. Solution of boundary value problems by orthogonal series. Method of relaxation. Uniqueness of the solution.

Texts: Churchill: Fourier Series and Boundary Value Problems; H. W. Emmons: Numerical Solution of Partial Differential Equations (Quart. Appl. Math., 2, 1944, 173-195).

Prerequisite: Ma-104(A) or Ma-114(A).

Ma-106(A) Complex Variables and Laplace Transforms 4-0

Analytic functions; Cauchy's theorem and formula, Taylor and Laurent series, residues, contour integration, conformal mapping. The Laplace transform and its use in solving ordinary differential equations; special theorems and manipulations for the Laplace transform; application to partial differential equations and difference equations.

Texts: Churchill: Introduction to Complex Variables and Applications; Churchill: Modern Operational Mathematics in Engineering; Gardner and Barnes: Transients in Linear Systems.

Prerequisite: Ma-104(A).

Ma-109(A) Topics in Advanced Calculus 3-0

Extension of natural numbers to the real number system; basic theorems on limits; continuity and differentiation properties of functions; the definite integral and improper definite integrals; infinite series.

Text: Courant: Differential and Integral Calculus, Volume I.

Prerequisite: Ma-104(A) or Ma-184(A) or one of these to be taken concurrently.

Ma-111(C) Introduction to Engineering Mathematics 3-1

Partial differentiation; multiple integrals; solution of algebraic equations; algêbra of complex numbers; introduction to infinite series and ordinary differential equations.

Texts: Sokolnikoff and Sokolnikoff: Higher Mathematics; Golomb and Shanks: Ordinary Differential Equations; Granville, Smith and Longley: Elements of the Differential and Integral Calculus.

Prerequisites: A former course in differential and integral calculus, and Ma-100(C) to be taken concurrently.

Ma-112(B) Differential Equations and Boundary Value Problems 4-0

A continuation of Ma-111(C). Systems of ordinary linear differential equations with constant coefficients; the Laplace transform; series solutions of differential equations; boundary value problems and orthogonal functions including Fourier series.

Texts: Hildebrand: Advanced Calculus for Engineers; Golomb and Shanks: Ordinary Differential Equations.

Prerequisite: Ma-111(C).

Ma-113(B) Vector Analysis and Introduction to Partial Differential Equations 3-0

A continuation of Ma-112(B). Calculus of vectors with geometric applications; line, surface and volume integrals involving vector fields with applications to fluid flow problems; differentiation under the integral sign and introduction to partial differential equations.

Texts: Hildebrand: Advanced Calculus for Engineers; Sokolnikoff and Sokolnikoff: Higher Mathematics.

Prerequisite: Ma-112(B).

Ma-114(A) Partial Differential Equations and Functions of a Complex Variable 3-0

A continuation of Ma-113(B). Solution of the Laplace and Poisson partial differential equations occurring in engineering; functions of a complex variable; analytic functions; line integrals; singularities; residues; evaluation of integrals; conformal mapping and applications.

Texts: Hildebrand: Advanced Calculus for Engineers; Churchill: Complex Variables.

Prerequisite: Ma-113(B).

Ma-115(A) Differential Equations for Automatic Control 3-0

Phase trajectories for linear and certain non-linear systems; stability investigations; theories of Poincare and of Kryloff and Bogoliuboff; resonance. The Laplace transform as used in ordinary initial value problems and partial differential equations; inversion integrals; Fourier transforms. Application of Laplace transforms to non-linear mechanics.

Texts: Minorsky: Introduction to Non-linear Mechanics; Churchill: Modern Operational Mathematics in Engineering; Pipes: Operational Methods in Non-linear Mechanics.

Prerequisite: Ma-114(A).

Ma-116(A) Matrices and Numerical Methods 4-0

Finite differences, interpolation, numerical differentiation and integration; numerical solution of polynomial equations; numerical methods for initial value and boundary value problems involving ordinary and partial differential equations; solution of systems of linear algebraic equations; elementary properties and types of matrices; matrix algebra; latent roots and characteristic vectors of matrices; numerical methods for inversion of matrices.

Texts: Scarborough: Numerical Mathematical Analysis; Frazer, Duncan and Collar: Elementary Matrices; Reprints of articles from scientific journals.

Prerequisite: Ma-114(A).

Ma-118(A) Mathematics of Stability Analysis 3-0

This course covers topics important in the study of aircraft flight performance. These topics include differential operator methods, Laplace transform methods, applications of matrix theory and non-linear mechanics.

Text: Pipes: Applied Mathematics for Engineers and Physicists.

Prerequisite: Ma-104(A) or Ma-114(A).

Ma-131(C) Algebraic Equations and Series 3-0

Solution of algebraic equations, Graeffe's method. Determinants and systems of linear equations. Fundamentals of series. Power series and applications. Fourier Series.

Texts: Sokolnikoff and Sokolnikoff: Higher Mathematics; Granville, Smith and Longley: Elements of the Differential and Integral Calculus (Revised Edition).

Prerequisite: A former course in differential and integral calculus.

Ma-132(C) Topics in Engineering Mathematics 5-0

Introduction to three-dimensional analytics and vectors. Partial differentiation and multiple integrals. Ordinary differential equations of first order. Linear differential equations with constant coefficients.

Texts: Smith, Gale and Neelley: New Analytic Geometry; Sokolnikoff and Sokolnikoff: Higher Mathematics; Weatherburn: Elementary Vector Analysis; Cohen: Differential Equations.

Prerequisites: A former course in differential and integral calculus and Ma-131(C) to be taken concurrently.

Ma-134(B) Vector Mechanics and Introduction to Statistics 5-0

Vector equations of motion. Streamlines and trajectories. Irrotational, solenoidal and linear vector fields. Elementary differential geometry of surfaces. Preliminary considerations in the analysis of observational data. Elementary probability; discrete and continuous probability distributions.

Texts: Weatherburn: Advanced Vector Analysis; Snyder and Sisam: Analytic Geometry of Space; Wilks: Elementary Statistical Analysis.

Prerequisite: Ma 103(B).

Ma-135(B) Partial Differential Equations and Numerical Methods 4-1

Total differential equations and systems of linear differential equations. Partial differential equations.

Introduction to orthogonal functions and boundary value problems with applications to physics. Numerical interpolation, differentiation and integration. Elementary alignment charts.

Texts: Cohen: Differential Equations (Revised); Churchill: Fourier Series and Boundary Value Problems; Scarborough: Numerical Mathematical Analysis.

Prerequisite: Ma-103(B).

Ma-140(C) Survey of Calculus 3-0

Definition of derivative; rules for differentiation; applications of derivatives; integration as inverse of differentiation; standard integration formulas; definite integrals as limit of sum; applications to area, volume, moment problem; motion problems, curvature, equation solving and other applications.

Text: Granville, Smith and Longley: Elements of the Differential and Integral Calculus (Revised Edition).

Prerequisite: Previous study of calculus.

Ma-161(C) Algebra, Trigonometry and Analytic Geometry 5-0

Review of elementary algebraic operations. Exponent laws and logarithms. Variables and functions of variables. Coordinate representation of functions; graphs. The trigonometric functions. The straight line and its slope. Simultaneous linear equations. The quadratic equation. Elementary equations of the conics.

Text: Brink: A First Year of College Mathematics.

Prerequisite: None.

Ma-162(C) Introduction to Calculus 5-0

The limit concept. The derivatives of elementary functions. Elementary applications of derivatives. Differentials, higher order derivatives and curvature. The integral as an antiderivative and as an area. Elementary applications of integration.

Text: Granville, Smith and Longley: Elements of the Differential and Integral Calculus (Revised Edition).

Prerequisite: Ma-161(C) or satisfactory evidence of competence in analytic geometry.

Ma-163(C) Calculus and Vector Analysis 5-0

Elementary vector operations. Infinite series. Partial derivatives, total derivatives and total differentials with applications. Partial and multiple integrals. Differentiation of vectors; gradient, divergence and curl. Introduction to line, surface and volume integrals.

Texts: Phillips: Vector Analysis; Granville, Smith and Longley: Elements of the Differential and Integral Calculus (Revised Edition).

Prerequisite: Ma-162(C), Ma-140(C) or a recent course in differential and integral calculus.

Ma-171(C) Special Topics in Calculus I 3-0

Algebra of complex numbers. Introduction to differential equations. Multiple integrals. Hyperbolic functions.

Texts: Granville, Smith and Longley: Elements of the Differential and Integral Calculus; Churchill: Introduction to Complex Variables and Applications; Reddick and Miller: Advanced Mathematics for Engineers.

Prerequisites: A former course in differential and integral calculus, and Ma-100(C) to be taken concurrently.

Ma-172(C) Special Topics in Calculus II 3-0

Partial derivatives and applications. Series of constants. Expansion of functions. Series of functions.

Texts: Granville, Smith and Longley: Elements of the Differential and Integral Calculus (Revised Edition); Reddick and Miller: Advanced Mathematics for Engineers.

Prerequisite: Ma-171(C).

Ma-173(B) Special Topics in Calculus III 3-0

Fourier series. Linear differential equations of higher order and systems of such equations. Introduction to functions of a complex variable.

Texts: Reddick and Miller: Advanced Mathematics for Engineers; Churchill: Introduction to Complex Variables and Applications.

Prerequisite: Ma-172(C).

Ma-174(B) Special Topics in Calculus IV 3-0

Introduction to Laplace transforms. Vector differential calculus.

Texts: Churchill: Modern Operational Mathematics in Engineering; Reddick and Miller: Advanced Mathematics for Engineers.

Prerequisite: Ma-173(B).

Ma-181(C) Directional Derivatives and Locus Integrals 3-1

Review of elementary calculus. Partial derivatives and their physical interpretations. Total derivatives and gradients. Line integrals, surface integrals, volume integrals, and their physical interpretations.

Texts: Granville, Smith and Longley: Differential and integral Calculus; Burington and Torrance: Higher Mathematics.

Prerequisites: A former course in differential and integral calculus, and Ma-100(C) to be taken concurrently.

Ma-182(C) Differential Equations and Vector Analysis 5-0

Ordinary first order differential equations. Higher order linear differential equations. Series, and series solution of differential equations. Systems of differential equations. Vector differential operators. Vector integral relations. Physical applications.

Texts: Cohen: Differential Equations (Revised); Phillips: Vector Analysis; Weatherburn: Elementary and Advanced Vector Analysis.

Prerequisites: Ma-100(C) and Ma-181(C).

Ma-183(B) Complex Variables and Partial Differential Equations 5-0

Analytic functions of a complex variable. Cauchy's theorem and its applications. Solution of partial differential equations by Fourier series. Sturm-Liouville theory and orthogonal series. The functions of theoretical physics.

Texts: Churchill: Complex Variables; Churchill: Fourier Series and Boundary Value Problems; Margenau and Murphy: Mathematics of Physics and Chemistry.

Prerequisite: Ma-182(C).

Ma-184(A) Laplace Transforms and Matrices 3-0

Definition and properties of Laplace transforms. Solution of ordinary and partial differential equations by Laplace transforms. Algebra of matrices. Characteristic values of matrices.

Texts: Churchill: Modern Operational Mathematics; Margenau and Murphy: Mathematics of Physics and Chemistry.

Prerequisite: Ma-183(B).

Ma-191(C) Basic Concepts and Interpretations of Mathematical Analysis 5-2

Theory of limits, particularly the interchange of repeated limits. Review of elementary calculus. Partial derivatives and their physical interpretations. Total derivatives and gradients. Indefinite line integrals. Introduction to ordinary differential equations. Definite line integrals and their physical interpretations. Surface and volume integrals. Introduction to complex variables. Derivatives and integrals in vector and complex notation.

Texts: Granville, Smith and Longley: Differential and Integral Calculus; Burington and Torrance: Higher Mathematics; Weatherburn: Elementary and Advanced Vector Analysis; Churchill: Complex Variables.

Prerequisites: A former course in differential and integral calculus, and Ma-100(C) to be taken concurrently.

Ma-192(C) Ordinary Differential Equations and Vector Analysis 5-0

Ordinary first order differential equations. Higher order linear differential equations. Differential equations associated with vector fields. Vector differential operators. Vector integral relations. Physical applications.

Texts: Cohen: Differential Equations (Revised); Phillips: Vector Analysis; Weatherburn: Elementary and Advanced Vector Analysis.

Prerequisites: Ma-100(C) and Ma-191(C).

Ma-193(B) Partial Differential Equations 5-0

Series. Series solution of ordinary differential equations. Fourier series. Boundary value problems. Sturm-Liouville theory and orthogonal series. Laplace transforms. Analytic functions of a complex variable. Cauchy's theorem and residues.

Texts: Granville, Smith and Longley: Differential and Integral Calculus; Cohen: Differential Equations (Revised); Churchill: Fourier Series and Boundary Value Problems; Churchill: Modern Operational Mathematics; Churchill: Complex Variables.

Prerequisite: Ma-192(C).

Ma-194(A) Laplace Transforms, Matrices and Variations 5-0

Definition and properties of Laplace transforms. Solution of ordinary and partial differential equations by Laplace transforms. Algebra of matrices. Characteristic values of matrices and differential operators. Introduction to calculus of variations.

Texts: Churchill: Modern Operational Mathematics; Margenau and Murphy: Mathematics of Physics and Chemistry; Burington and Torrance: Higher Mathematics.

Prerequisite: Ma-183(B).

Ma-195(A) Matrix Theory and Integration Theory 5-0

Algebra of matrices; characteristic values of matrices; Hamilton-Cayley and Sylvester's theorems;

matrix methods in the solution of systems of differential equations. Basic concepts in the theories of Riemann, Lebesgue, and Stieltjes integrals with emphasis on the applications of these theories.

Texts: Frazer, Duncan and Collar: Elementary Matrices; McKinsey: Introduction to the Theory of Games.

Prerequisite: Ma-193(B).

Ma-201(C) Graphical and Mechanical Computation 0-2

Construction of scales. Use of coordinate papers. Construction of nomograms, including alignment charts, by geometric methods and use of determinants. Conversion of empirical data into alignment charts. Improvements of charts by projection (accomplished by determinants). Theory and use of the planimeter and integrator.

Texts: Lipka: Graphical and Mechanical Computation; Rybner: Nomograms (G. E. Review, 33, 1950, 164 ff); Baude: Simplified Nomogram Construction (Machine Design, May 1952, 155 ff); USNPGS Multiliths.

Prerequisite: Ma-100(C). (May be taken concurrently).

Ma-301(B) Statistics 3-2

Fundamental principles of probability. Probability distributions with special emphasis on the binomial, Poisson and normal distributions. Simple and multiple regressions and correlation. Distribution of mean, chi-square, variance, t and F. Analysis of variance. Tests of statistical hypotheses.

Texts: Wilks: Elementary Statistical Analysis; Hoel: Introduction to Mathematical Statistics.

Prerequisite: Ma-103(B). (May be taken concurrently).

Ma-331(A) Statistics 4-2

A continuation of Ma-134(B). Gamma and Beta functions. Mathematical expectation, moments and moment generating functions. Theoretical distribution functions of one variable. Distribution functions of two or more variables. Large and small sampling theory. Testing statistical hypotheses; sampling and the design of experiments. Applications to problems in aerology.

Text: Hoel: Introduction to Mathematical Statistics.

Prerequisite: Ma-134(B).

Ma-381(C) Elementary Probability and Statistics 4-2

Frequency distributions. Elements of the theory of probability. The binomial, Poisson and normal probability distributions. Elements of sampling theory and statistical inference with applications. Confidence intervals. Bivariate distributions. Regression lines and simple correlation.

Text: Wilks: Elementary Statistical Analysis.

Prerequisite: Ma-163(C) or Ma-181(C).

Ma-382(A) Probability 3-0

Further consideration of problems in discrete probability. Probabilities of hypotheses and Bayes theorem. Use of difference equations in solving problems in probability. Mathematical expectation. Law of large numbers. Probabilities in continuum. Fundamental limit theorems. Multivariate distributions. Moments and moment generating functions. Bivariate and multivariate normal distributions.

Texts: Munroe: Theory of Probability; Uspensky: Introduction to Mathematical Probability.

Prerequisite: Ma-381(C).

Ma-383(A) Statistics 3-2

Point and interval estimation. Tests of hypotheses. Analysis of variance. Design of experiments. Further topics in regression and correlation.

Texts: Mood: Introduction to the Theory of Statistics; Hald: Statistical Theory with Engineering Applications.

Prerequisite: Ma-382(A).

Ma-385(A) Statistical Decision Functions 3-0

Basic concepts; relation of statistical decision functions to the theory of games; applications in the planning of operational evaluation trials.

Texts: Wald: Statistical Decision Functions; classified official publications.

Prerequisites: Ma-383(A), Ma-501(A).

Ma-401(A) Mathematical Computation by Physical Means 2-2

Elementary physical devices which may be used to perform addition, multiplication, function generation, integration, etc. Combinations of such devices for solution of differential equations, systems of linear equations, algebraic equations, harmonic analysis, etc. Some of the material is presented to the class by the students as informal reports.

Texts: Murray: Theory of Mathematical Machines; reprints of articles from scientific periodicals.

Prerequisite: Ma-103(B) or Ma-113(B).

Ma-496(A) High Speed Computing Machines 3-2

The logical design of punch card machines, automatic digital computers and simulators. Programming and coding. Laboratory operation of computing machines. Numerical analysis. Applications to problems in operations analysis.

Texts: Engineering Research Associates: High Speed Computing Devices; Hartree: Calculating Instruments and Machines.

Prerequisite: Ma-195(A), or Ma-116(A), or Ma-184(A).

Ma-501(A) Theory of Games 3-2

The basic concepts and foundations for the theory of games, such as game, play, strategy, complete and incomplete information, zero-sum games, etc. The structures of various games, particularly two-person zero-sum games with finite and infinite strategies. Games of timing. The related algebra of matrices and bilinear forms to yield methods for evaluating games. The minimax theorem and properties of minimax strategies. Games involving three or more persons and the effects of coalitions.

Texts: Von Neumann and Morgenstern: Theory of Games and Economic Behavior; Rand Reports; McKinsey: Introduction to the Theory of Games; USNPGS Multiliths.

Prerequisites: Ma-195(A), Ma-382(A).

MECHANICS

Mc Courses

Mc-101(C) Engineering Mechanics I 2-2

Review of statics; free-body diagrams; distributed forces; centroids; moments and products of inertia of areas; hydrostatics; friction; plane trusses; funicular polygon; general principles of dynamics; dimensional analysis; kinematics of a particle; relative and absolute time rate of change of a vector; Coriolis acceleration.

Text: Housner and Hudson: Applied Mechanics.

Prerequisite: A previous course in mechanics is desirable.

Mc-102(C) Engineering Mechanics II 2-2

Dynamics of a particle; impulse and momentum; work and energy; potential; conservation of energy; vibrating systems, free and forced, with and without damping; impact; dynamics of rigid bodies; moments and products of inertia; principal axes of inertia; the gyroscope.

Text: Housner and Hudson: Applied Mechanics.

Prerequisite: Mc-101(C).

Mc-201(A) Methods in Dynamics 2-2

The principles of (a) linear momentum, (b) angular momentum, (c) work and energy, (d) power and energy, (e) conservation of energy, (f) virtual work, and (g) d'Alembert are developed and discussed in detail. This work is followed by a development and interpretation of Lagrange's equations of motion. Application of these various principles to obtain the differential equations of motion of dynamical systems is given particular attention. Numerous exercises in the writing of differential equations of motion are assigned; some of these are designed to furnish practice in the formulation of the differential equations for systems of variable mass.

Texts: Synge and Griffith: Principles of Mechanics; Timoshenko and Young: Advanced Dynamics.

Prerequisites: Mc-102(C) and Ma-103(B). (The latter may be taken concurrently.)

Mc-311(A) Vibrations 3-2

Kinematics of vibrations; free and forced vibrations of systems with one degree of freedom; theory of vibration measuring instruments and of vibration insulation; systems with many degrees of freedom; normal modes of vibration; computation of fastest and slowest modes by matrix methods; vibrations of strings, beams, shafts and membranes; Rayleigh's method; Stodola's method; critical speeds; self-excited vibrations; effect of impact on elastic structures.

Texts: Den Hartog: Mechanical Vibrations (3rd edition); Frankland: Effects of Impact on Simple Elastic Structures (TMB Report 481).

Prerequisite: Ma-104(A), Mc-102(C) and ME-500(C).

Mc-401(A) Exterior Ballistics 3-0

Topics presented include the vacuum trajectory; density and temperature structure of the atmosphere; application of dimensional analysis to the problem of air resistance; theory of longitudinal elastic waves in the air; numerical integration of differential equations of motion under standard conditions; differential corrections for abnormal conditions; weighting factors; integration of the adjoint system; exact and approximate construction of firing tables for aircraft machine guns. The projectile is treated as a mass particle, aerodynamic and rocket considerations being deferred to a later course, Mc-402(A).

Texts: McShane, Kelley and Reno: Exterior Ballistics; Scarborough: Numerical Mathematical Analysis (First Edition).

Prerequisite Mc-102(C).

Mc-402(A) Dynamics of Missiles and Gyros 3-0

Review of the dynamics of rigid bodies; gyroscopes; the general aerodynamic system of forces acting on a spinning projectile; necessary and sufficient conditions for the stability and trailing of a spinning projectile; computation of drift; dispersion of fin-stabilized and spin-stabilized rockets; effect of wind on rockets.

Texts: Synge and Griffith: Principles of Mechanics (Second Edition); McShane, Kelley and Reno: Exterior Ballistics.

Prerequisite: Mc-401(A).

Mc-421(A) Interior Ballistics 2-0

Basic thermodynamics of interior ballistics including methods of determining the adiabatic flame temperature, specific heat and number of moles of powder gas. These basic topics are followed by a detailed study (including computational exercises) of the linear system of interior ballistics of Hirschfelder developed under NDRC auspices. The contribution of modern interior ballistic theory to the problem of gun design is emphasized.

Texts: Hirschfelder and Sherman: Simple Calculation of Thermochemical Properties for Use in Ballistics (OSRD Report 935); Curtiss and Wrench: Interior Ballistics (OSRD Report 6468).

Prerequisites: Ma-111(C), Mc-102(C), Ch-631(A).

Mc-431(A) Theory of Plasticity of Metals and Strength of Guns 3-0

Types of gun construction; theory of the tensile test; geometry of stress; Mohr's representation of stress; octahedral stresses; the Lode parameter; geometry of strain; theories of mechanical strength; the three rules of plastic deformation; theory of plastic deformation of thick-walled spheres and cylinders; autofrettage process used in the radial expansion of guns.

Text: Nadai: Theory of Flow and Fracture of Solids (Second Edition).

Prerequisites: Ma-112(B), Mc-102(C).

MECHANICAL ENGINEERING

ME Courses

Engineering Thermodynamics	ME-111(C)
Engineering Thermodynamics	ME-112(B)
Engineering Thermodynamics	ME-122(C)
Engineering Thermodynamics	ME-131(C)
Engineering Thermodynamics	ME-132(C)
Engineering Thermodynamics	ME-141(C)
Engineering Thermodynamics	ME-142(A)
Engineering Thermodynamics	ME-143(A)
Thermodynamics	ME-150(C)
Marine Power Plant Equipment	ME-211(C)
Marine Power Plant Equipment	ME-212(C)
Marine Power Plant Analysis and Design	ME-215(A)
Marine Power Plant Design	ME-216(A)
Internal Combustion Engines (Diesel)	ME-217(C)
Marine Power Plant Equipment	ME-221(C)
Marine Power Plant Equipment	ME-222(C)
Marine Power Plant Analysis	ME-223(B)
Heat Transfer	ME-310(B)
Heat Transfer	ME-350(C)
Hydromechanics	ME-411(C)
Hydromechanics	ME-412(A)
Hydromechanics	ME-421(C)
Hydromechanics	ME-422(B)
Hydromechanics	ME-441(B)
Compressible-fluid Flow	ME-442(B)
Strength of Materials	ME-500(C)
Strength of Materials	ME-511(C)
Strength of Materials	ME-512(A)
Theory of Elasticity	ME-513(A)
Strength of Materials	ME-522(B)
Strength of Materials	ME-541(C)
Strength of Materials	ME-542(B)
Elastic Body Mechanics	ME-550(B)
Materials Testing Laboratory	ME-601(C)
Materials Testing Laboratory	ME-611(C)
Experimental Stress Analysis	ME-612(A)
Experimental Stress Analysis	ME-622(B)
Kinematics of Machinery	ME-700(C)
Mechanics of Machinery	ME-711(B)
Dynamics of Machinery	ME-712(A)
Dynamics of Machinery	ME-730(B)
Kinematics and Machine Design	ME-740(C)
Machine Design	ME-811(C)
Machine Design	ME-812(B)
Machine Design	ME-820(C)
Machine Design	ME-830(C)
Manufacturing Engineering	ME-840(C)

ME-111(C) Engineering Thermodynamics 4-2

Stored and transitional energies, their accounting by energy equations in dynamic and chemical processes. Aspects of reversibility, thermodynamic scale of temperature, entropy of energy and the entropy function. Second and Third Laws of thermodynamics, Maxwell relations. Phase rule, thermodynamic properties of liquids and vapors in equilibrial and metastable states, property tables and diagrams, representative reversible and irreversible processes in vapor and liquid phases. Property relations, tables and diagrams for ideal or quasi-ideal gases, representative reversible and irreversible processes with these. Associated problems. This course is the first of a coordinated sequence containing ME-112 or 122, 211 or 221, et cetera.

Text: Kiefer, Kinney and Stuart: Engineering Thermodynamics.

Prerequisite: Ma-102(C).

ME-112(B) Engineering Thermodynamics 4-2

Properties of mixtures of quasi-ideal gases, low-pressure gas-vapor mixtures and related indices, representative processes with these, multi- and mono-pressure hygrometric diagrams. Combustion of fuels, material and energy balances, fuel calorimetry, equilibrium and equilibrium constant, rich-mixture and thin-mixture combustion, flame temperatures. As time permits, non-ideal gases and their p-v-T correlation by equation and by compressibility diagrams, residual enthalpy and entropy functions and their determination from compressibility and throttling data, representative processes and generation of thermodynamic diagrams. Associated problems. The course is in continuation of ME-111.

Text: Kiefer, Kinney and Stuart: Engineering Thermodynamics.

Prerequisite: ME-111(C).

ME-122(C) Engineering Thermodynamics 3-2

Studies included are as indicated for course ME-112 except for omission of considerations of the thermodynamic properties and property correlations for non-ideal gases. This course is in continuation of ME-111.

Text: Kiefer, Kinney and Stuart: Engineering Thermodynamics.

Prerequisite: ME-111(C).

ME-131(C) Engineering Thermodynamics 4-2

Stored and transitional energies, their accounting by energy equations in dynamic and chemical processes. Aspects of reversibility, thermodynamic scale of temperature, entropy of energy and the entropy property, Second and Third Laws of thermodynamics, Maxwell relations. Phase rule, thermodynamic characteristics of liquids and vapors. Property relations, tables and diagrams for ideal or quasi-ideal gases and representative reversible and irreversible processes with these. Gas mixtures, low-pressure gas-vapor mixture and their indices, representative processes with them, multi- and monopressure hygrometric charts. Elements of atmospheric thermodynamics.

Text: Kiefer, Kinney and Stuart: Engineering Thermodynamics.

Prerequisite: Ma-102(C).

ME-132(C) Engineering Thermodynamics 3-2

Materials and energy balance in combustion. Spark-ignition engine and simpler gas-turbine power installations and their performance characteristics. Subsonic and supersonic flow of compressible fluids, reversible and shockwise, in nozzle, diffuser or duct; associated wall forces and their operation in turbine or compressor blading and in jet propulsion or the rocket motor. Elements of heat transmission. Sequent to ME-131, those thermodynamic applications are considered which are of major concern in aircraft power installations.

Text and Supplements: Kiefer, Kinney and Stuart: Engineering Thermodynamics; Keenan and Kaye: Gas Tables.

Prerequisite: ME-131(C).

ME-141(C) Engineering Thermodynamics 4-2

The fundamental concepts of thermodynamics; energy and its accounting; availability and entropy of energy; the thermodynamic properties of pure substances and their changes in various processes, including chemical interaction. Emphasis is placed on those topics essential for subsequent studies of torpedo power plants, jet engines, explosives and similar applications where non-standard fluids are involved. The laboratory periods are used for student solution of practical problems chosen to illustrate the principles discussed in the classroom.

Text: Kiefer, Kinney and Stuart: Engineering Thermodynamics.

Prerequisite: Ma-103(B).

ME-142(A) Engineering Thermodynamics 2-2

Organization of the thermodynamic properties of non-ideal gases through the use of the residual functions preparation and use of thermodynamic diagrams for simple systems of ideal and non-ideal gases and for complex systems in chemical equilibrium, heat and work effects in representative processes involving complex mixtures such as the products of combustion. This course is a continuation of ME-141(C). The laboratory periods are used for students solution of practical problems to illustrate the principles discussed in the classroom.

Text: Kiefer, Kinney and Stuart: Engineering Thermodynamics.

Prerequisite: ME-141(C).

ME-143(A) Engineering Thermodynamics 4-4

Thermodynamic aspects of the flow of compressible fluids in nozzle, diffuser and duct, compressive shocks, dynamics of the jet and diverted flow. Application of thermodynamic facilities to power plants such as jet engines and torpedo motors which operate on non-standard fluids. Turbine nozzle and blading design factors and performance indices. Elements of heat transfer. Associated problems.

Text: Kiefer, Kinney and Stuart: Engineering Thermodynamics; Church: Steam Turbine.

Prerequisite: ME-142(C).

ME-150(C) Thermodynamics 4-2

Fundamental aspects of energy accounting at molecular and atomic levels, and its mechanical availability. Thermodynamic properties of actual gases, correlation with the kinetic theory, property changes and their correlation in representative processes and accompanying work effects. Reversible and shockwise flow of gases and shock propagation.

Text and Supplement: Kiefer, Kinney and Stuart: Engineering Thermodynamics; Keenan and Kaye: Gas Tables.

Prerequisite: Ma-181(C).

ME-211(C) Marine Power Plant Equipment 3-2

Steam power plant cycles, internal combustion power cycles, elementary gas turbine power plant, influences of regenerative pre-heating and of reheating, performance indices. Thermodynamic aspects of the flow of compressible fluids in nozzle, diffuser and duct, compressive shocks, dynamics of jet and of diverted flow. Marine boiler performance analysis and characteristics. Associated problems and laboratory work.

Text: Kiefer, Kinney and Stuart: Engineering Thermodynamics; miscellaneous supplementary material.

Prerequisite: ME-112(B).

ME-212(C) Marine Power Plant Equipment 3-4

Thermodynamic aspects of the turbine, impulse and reaction types of the reciprocating engine, the gas compressor and blower. Refrigeration and heat pump cycles, refrigerants, multi-level refrigeration. Air conditioning; requirements and equipment, associated laboratory work.

Text: Kiefer, Kinney and Stuart: Engineering Thermodynamics; miscellaneous supplementary material.

Prerequisite: ME-211(C).

ME-215(A) Marine Power Plant Analysis and Design 2-4

Studies of the methods and procedures employed in the over-all planning of naval ships from the viewpoint of the power plant engineer, their principal plant components and various practical and military factors which influence the design. Project work includes preliminary methods of estimating for a hypothetical naval ship: the hull, main engine and auxiliary power requirements, inter-relationship of individual equipment items, and computation of various ship and plant performance indices. The time is distributed variously between lectures, student project work, seminar and, upon occasion, lectures by visiting authorities in specialized fields of naval marine engineering.

Text: Seward: Marine Engineering; Bureau of Ships publications and data; Kiefer, Kinney and Stuart: Engineering Thermodynamics.

Prerequisite: ME-212(C); ME-310(B) and ME-411(C).

ME-216(A) Marine Power Plant Analysis and Design. 2-4

This course, in continuation of ME-215(A), carries to completion the project work of the latter, as required, with additional project work in preliminary design investigation of main propulsion turbines and other major equipment items. The time is distributed variously between lectures, student project work, seminar and, upon occasion, lectures by visiting authorities in specialized fields of naval marine engineering.

Text: Seward: Marine Engineering; Labberton: Marine Engineering; Church: Steam Turbines; Bureau of Ships publications and data; Kiefer, Kinney and Stuart: Engineering Thermodynamics.

Prerequisite: ME-215(A).

ME-217(C) Internal Combustion Engines (Diesel) 3-2

The studies include the thermodynamic analysis of the fundamental cycle, ideal and actual combustion processes, cyclic processes, injection phenomena and methods of injection system analysis, and the variables that affect the efficiency and performance of the engine. The laboratory work includes a series of tests on various engines to determine volumetric and mechanical efficiency, speed-torque characteristics, fuel consumption rates, effect of injection system variables upon engine performance, analysis of high speed engine indicator card, etc.

Text: Lichty: Internal Combustion Engine; Taylor and Taylor: Internal Combustion Engine; Heldt: High Speed Diesel Engines.

Prerequisite: ME-112(B) or 122 (C).

ME-221(C) Marine Power Plant Equipment 3-2

Steam power plant cycles, influences of regenerative feed heating and of reheating, performance indices. Internal combustion power cycles, elementary gas turbine power plant, influence of regenerative preheating and of reheating, performance indices. Thermodynamic aspects of flow of compressible fluids in nozzle, diffuser and duct, dynamics of jet and of diverted flow. Elements of heat transmission. Marine boiler performance analysis and characteristics. Associated problems and laboratory work.

Text: Kiefer, Kinney and Stuart: Engineering Thermodynamics; miscellaneous supplementary material.

Prerequisite: ME-122(C).

ME-222(C) Marine Power Plant Equipment 3-4

Thermodynamic aspects of the turbine, impulse and reaction types, of the reciprocating engine, the gas compressor and blower. Refrigeration and heat pump cycles, refrigerants, multi-level refrigeration, air conditioning requirements and equipment. Asociated laboratory work.

Text: Kiefer, Kinney and Stuart: Engineering Thermodynamics; miscellaneous supplementary material.

Prerequisite: ME-221(C).

ME-223(B) Marine Power Plant Analysis 2-4

Preliminary methods of estimating for a hypothetical naval ship the hull, main engine and auxiliary power requirements, inter-relationship of individual equipment items, and computation of various plant and ship performance indices. Preliminary design investigation of main propulsion turbines and other power plant equipment. Heat balance and flow diagrams.

Text: Seward: Marine Engineering; Labberton: Marine Engineering; Church: Steam Turbines; Bureau of Ships publications and data.

Prerequisite: ME-222(C) and ME-421(C).

ME-310(B) Heat Transfer 3-2

General manners of energy transition by temperature potential, characteristic thermal circuits, concepts and correlation of individual and overall heat transfer coefficients. Fourier's general law of conduction, applications to representative steady-state situations and unsteady-state condition, Schmidt and relaxation methods of approximation. Convection phases of thermal circuits, free and forced, and ones involving vaporization and condensation. Heat radiation. Associated problems and laboratory work.

Text: Jakob and Hawkins: Elements of Installation and Heat Transfer, Vol. I; McAdams: Heat Transmission.

Prerequisite: Ma-104 or 183 or equivalent, ME-112(B), ME-411(C).

ME-350(C) Heat Transfer 2-2

General survey of the manners of energy transition by temperature potential, with major emphasis on its transfer by radiation and conduction under steady and unsteady-state conditions.

Text: Jakob and Hawkins: Elements of Insulation and Heat Transfer, Vol. I; McAdams: Heat Transmission.

Prerequisite: Ma-182(C) or equivalent.

ME-411(C) Hydromechanics 3-2

The mechanical properties of liquids, hydrostatic pressures and forces on submerged surfaces and associated matters of buoyancy and ship stability. Energy aspects of liquid flow, the resistance to such flow through pipes, liquid flow metering and control, hydraulic force-transmission and arrester systems. Dynamic forces associated with flow through confining channels, the centrifugal pump and hydrodynamic coupling, etc. The principle of dynamic similarity and dimensional analysis are developed and employed extensively. The laboratory periods are used for student's solution of related practical problems and for related laboratory tests. The course is the first of a sequence of ME-411 and 412.

Text: Departmental notes (Kiefer and Drucker), Mechanics of Hydraulic Equipment.

Prerequisite: Ma-103(B).

ME-412(A) Hydromechanics 4-2

Basic concepts and characteristics of flow, primarily with ideal and incompressible fluids. The flow net and primary flow patterns, their synthesis initially by graphical technics but subsequently utilizing the mathematic facilities of vector calculus and the complex variables. Theory and applications of conformal tranformation. Lamina flow, particularly in hydromechanic lubrication.

Text: Departmental notes (Kiefer and Drucker), Mechanics of Hydraulic Equipment; Streeter: Fluid Dynamics.

Prerequisite: ME-411(C), Ma-104(A) or equivalent.

ME-421(C) Hydromechanics 3-2

The course is the first of a sequence of ME-421 and 422. The content parallels that of ME-411, but proceeds at lower rate.

Text: Departmental notes (Kiefer and Drucker), Mechanics of Hydraulic Equipment.

Prerequisite: Ma-102 or equivalent.

ME-422(B) Hydromechanics 2-2

Dynamic forces in fluid flow, centrifugal pumps, couplings and torque converters, jet propulsion. Introduction to the kinematics of ideal-fluid flow, primary flow patterns and their synthesis by graphical technics. Elements of hydrodynamic lubrication.

Text: Departmental notes (Kiefer and Drucker), Mechanics of Hydraulic Equipment.

Prerequisite: ME-421, Ma-103 or equivalent.

ME-441(B) Hydromechanics 4-2

A one-term coverage of materials as follows: Mechanical properties of fluids. Hydrostatic pressures and force distribution, submerged surfaces. Energy aspects of flow; resisitance to laminar and turbulent flow in ducts, with introduction to the correlation of relevant variables through the principle of dynamic similarity and use of dimensional analysis. Flow metering and control elements of hydraulic arrester. Dynamics of flow in representative devices, and performance correlations by dynamic similarity principle. Introduction to the concepts of the stream function, velocity potential, source, sink and free vortex and their synthesis to form simpler irrotational flow patterns. Brief survey of the utilization of vector calculus and the complex variable in analysis of more complex patterns.

Text: Kiefer and Drucker: departmental notes.

Prerequisite: Ma-153(B) and Ma-154(A).

ME-442(B) Compressible-fluid Flow 2-2

Review of general thermodynamic principles, and of the thermodynamic properties and property relation for gaseous fluids. Thermodynamics of the subsonic and supersonic flow of compressible fluids, reversible and shockwise, in nozzle or diffuser and about simpler obstructions. Associated wall forces, and their operation in jet propulsion or the rocket motor.

Text and Supplements: Kiefer, Kinney and Stuart: Engineering Thermodynamics; Keenan and Kaye: Gas Tables.

Prerequisite: Ch-401(A) and Ch-631(A).

ME-500(C) Strength of Materials 3-0

Elements of the mechanics of elastic bodies; tensile and compressive stresses, shearing stress, Hooke's law, thin-walled cylinders, combined stresses, torsion of circular-sectioned members, elementary beam theory, combined loadings and columns.

Text: Timoshenko and MacCullough: Elements of Strength of Materials.

Prerequisite: Ma-101(C) and Mc-101(C) or equivalent.

ME-511(C) Strength of Materials 5-0

Topics in elastic-body mechanics, including tensile and compressive stress, shearing stress, Hooke's law, thin-walled cylinders, combined stresses, torsion of circular-sectioned members, elementary beam theory, statically indeterminate problems in bending, beams on elastic foundations.

Text: Timoshenko: Strength of Materials, Vols. I and II.

Prerequisite: Ma-101(C) and Mc-101(C) or equivalent.

ME-512(A) Strength of Materials 5-0

Beam columns, problems having radial symmetry, combined loading, columns, strain energy, thin plates, thick-walled cylinders, fundamental concepts in the theory of elasticity.

Text: Timoshenko: Strength of Materials, Vols. I and II.

Prerequisite: ME-511(C).

ME-513(A) Theory of Elasticity 3-0

Plane-stress considerations, differential equations of equilibrium and compatibility, the Airy stress function, curvilinear coordinates, problems in plane stress and plane strain, three-dimensional stress considerations, St. Venant theory of torsion, energy considerations.

Text: Timoshenko and Goodier: Theory of Elasticity.

Prerequisite: ME-512(A) or the equivalent.

ME-522(B) Strength of Materials 4-0

Beam columns, problems having radial symmetry, strain energy, fundamental concepts in the theory of elasticity.

Text: Timoshenko: Strength of Materials, Vols. I and II; Lee: An Introduction to Experimental Stress Analysis.

Prerequisite: ME-511(C).

ME-541(C) Strength of Materials 3-0

Stress, strain, Hooke's law, thin-walled cylinders, combined stresses, torsion of solid and hollow shafts, elementary beam theory, combined bending and torsion, combined bending and axial load, behavior of columns.

Text: Timoshenko and MacCullough: Elements of Strength of Materials.

Prerequisite: Ma-101(C) and Mc-101(C) or equivalent.

ME-542(B) Strength of Materials 3-0

Statically indeterminate problems in bending, bending beyond the yield point, curved beams, strain energy, mechanical properties of materials.

Text: Timoshenko and MacCullough: Elements of Strength of Materials.

Prerequisite: ME-541(C).

ME-550(B) Elastic Body Mechanics 5-0

Stress, strain, Hooke's law, torsion, elementary beam theory, reinforced concrete beams, columns, simple structures under static and impact loads.

Text: Timoshenko: Strength of Materials, Vol. I.

Prerequisite: Mc-311(A).

ME-601(C) Materials Testing Laboratory 0-2

Performance and analysis of standard tests used in determining the mechanical properties of engineering materials, including tests in tension, compression, torsion, shear, transverse bending, impact and hardness.

Text: Muhlenbruch: Testing of Engineering Materials; A.S.T.M. Student Standards.

Prerequisite: Subsequent to or concurrent with ME-500(C) or ME-541(C).

ME-611(C) Materials Testing Laboratory 2-2

Study of the theories of failure, the evaluation of experimental error and experiments in the determination of the mechanical properties of engineering materials. These tests include: tension, compression, torsion, shear, transverse bending, impact, hardness, fatigue and columns.

Text: Timoshenko: Strength of materials, Vol. II; Davis, et al: Testing and Inspection of Engineering Materials.

Prerequisite: ME-511(C).

ME-612(A) Experimental Stress Analysis 3-2

The course includes: dimensional analysis, strain gage techniques, photoelasticity, brittle lacquer method, membrane analogy, miscellaneous methods in experimental stress analysis. Diversified laboratory projects will be assigned, offering an opportunity to apply the methods of experimental stress analysis to the solution of both static and dynamic problems.

Text: Lee: An Introduction to Experimental Stress Analysis.

Prerequisite: ME-513(A) and ME-611(C). ME-612(A) may be taken concurrently with ME-513(A).

ME-622(B) Experimental Stress Analysis 2-2

Introduction to the theory of elasticity, dimensional analysis, strain gage techniques, photoelasticity, brittle lacquer method, membrane analogy, miscellaneous methods in experimental stress analysis. Laboratory projects will be assigned to demonstrate the several methods presented.

Text: Lee: An Introduction to Experimental Stress Analysis.

Prerequisite: ME-522(B) and ME-611(C) or equivalent.

ME-700(C) Kinematics of Machinery 2-3

This is a general service course. The following topics are studied: link-work, cams, toothed gearing, trains of mechanisms, velocities, accelerations, static forces and inertia forces in machine members. The practical work periods are devoted to the solution on the drawing board of selected problems.

Text: Ham and Crane: Mechanics of Machinery.

Prerequisite: MC-102(C).

ME-711(B) Mechanics of Machinery 3-2

Topics considered briefly include link-works, cams and gears. Major emphasis is on the velocities and accelerations of moving parts, static and inertia forces and their balancing, critical speeds in shafts. This course is the first of a co-ordinated sequence of ME-711 and 712.

Text: Ham and Crane: Mechanics of Machinery.

Prerequisite: MC-102(C).

ME-712(A) Dynamics of Machinery 3-2

Studies are made of the following topics: balancing of solid rotors, torsional vibrations by the Holzer method, single and two degrees of freedom linear vibrating systems with and without damping, tuned pendulum absorbers, harmonic analysis of the reciprocating engine. Laboratory work includes the following experiments: balancing a solid rotor on a mechanical as well as an electrical balancing machine, vibrating linear damped vibration absorbers on the Westinghouse equipment, and operating a torsional vibration inducer unit.

Text: Den Hartog: Mechanical Vibrations; Notes by E. K. Gatcombe.

Prerequisite: Ma-103(B), Mc-201(A), ME-711(C) and ME-511(C).

ME-730(B) Dynamics of Machinery 3-2

Studies are made of the following topics: balancing of solid rotors, torsional vibration analysis by the Holzer method, single and two degrees of freedom linear vibrating systems with and without damping, tuned pendulum absorbers, harmonic analysis of the radial aircraft engine. The laboratory work includes the following experiments: balancing of solid rotors on the mechanical as well as the electrical balancing machine, vibrating linear damped vibration absorbers on the Westinghouse equipment and operating a torsional vibration inducer unit.

Text: Den Hartog: Mechanical Vibrations; Notes by E. K. Gatcombe.

Prerequisite: Ma-103(B), Mc-201(A), Ae-202(C).

ME-740(C) Kinematics and Machine Design 3-2

Studies are made of the following topics: displacements, velocities, and accelerations of the various kinematic linkages, such as the four bar mechanism, the drag link, cams, gears, intermittent motions, cyclic gears and gyros. Several design topics will be considered: the design of shafting (considering strength, deflection, bearing loads, critical speeds etc.); couplings; springs; bearings, fits and tolerances.

Text: Ham and Crane: Mechanics of Machinery; machine design notes by E. K. Gatcombe.

Prerequisite: Mc-102(C), ME-542(B)

ME-811(C) Machine Design 3-2

Review of strength of materials, selections of materials, stress-concentration, bearings, fits and tolerances. Several short design projects as follows: tabulation of tolerances for shafts and holes for the various classes of fits, accumulation of tolerances in machines, design of an armature shaft, spring design, screw fastening design, design of a power screw and the design of a set of gears. Studies of belt and chain drives, brakes, clutches, cams and thin and thick cylinders.

Text: Vallance: Design of Machine Elements; notes by E. K. Gatcombe.

Prerequisite: ME-511(C) or equivalent, ME-711(B).

ME-812(B) Machine Design 3-4

Several practical design projects will be completed on the drawing board. The projects will give the students an opportunity to combine theory with practice. The drawings involved in the projects will be completely dimensioned; proper materials selected; correct base references, surfaces for machining and inspecting will be chosen; proper fits and tolerances will be chosen for interchangeable manufacture. The objective is to create designs which may actually be fabricated.

Text: Notes by E. K. Gatcombe.

Prerequisite: ME-811(C).

ME-820(C) Machine Design 2-4

Short review of strength of materials. Stress-concentration, factors of safety. Fits and tolerances. Several short design projects which illustrate the application of the principles of stress, strain deflection, fits and tolerances, vibrations, etc. General design information on bearings, springs shafting, screw fastenings, gears, clutches, brakes, cams and thick and thin cylinders.

Text: Notes by E. K. Gatcombe.

Prerequisite: ME-700(C).

Reference: Vallance: Design of Machine Members.

ME-830(C) Machine Design 4-2

Review of strength of materials, selections of materials for different designs. Stress-concentration, bearing design, fits and tolerances. Several short design projects as follows: tabulation of tolerances for shafts and holes for various classes of fits, accumulation of tolerances in machines, design of an armature shaft, spring design, screw fastening design, design of a power screw and the design of a set of gears. Studies of belt and chain drives, brakes, clutches, cams and thin and thick cylinder design.

Text: Vallance: Design of Machine Members; Notes by E. K. Gatcombe.

Prerequisite: ME-700(C), Ae-202(C).

ME-840(C) Manufacturing Engineering 3-2

The following topics are studied: the principles of interchangeable manufacture, the selection of and use of the proper machine tools to fulfill a specific requirement, the details of gage design and inspection methods with reference to proper fits and tolerances. Several industrial plants will be visited, where lectures on the use of machines will be provided.

Text: Buckingham: Interchangeable Manufacturing.

Prerequisite: ME-811(C).

METALLURGY

Mt Courses

Mt-101(C) Production Metallurgy 2-0

An introduction to the study of metallurgy and is essentially descriptive in nature. Subjects treated include the occurrence and classification of metal-bearing raw materials; the fundamentals processes of extractive metallurgy; refractories, fuels, fluxes, slags and equipment; a brief summary of steel-making and the production of copper and zinc.

Text: Stoughton, Butt: Engineering Metallurgy (1938).

Prerequisite: Ch-101(C), Ch-121(B), or concurrently with either.

Mt-102(C) Production of Steel 3-0

The subject matter includes such topics as the occurrence and composition of various iron ores, blast furnace products. The various methods of steel production and the production of grey, white and malleable cast iron.

Text: Bray: Ferrous Production Metallurgy.

Prerequisite: Ch-101(C) or Ch-121(B).

Mt-103(C) Production of Non-Ferrous Metals 3-0

A discussion of the sources, the strategic importance of, and the methods of production of the following metals: copper, zinc, lead, tin, aluminum, magnesium, and other metals of technical interest.

Text: Bray: Non-Ferrous Production Metallurgy.

Prerequisite: Ch-101(C) or Ch-121(B).

Mt-201(C) Introductory Physical Metallurgy 3-2

An introduction to physical metallurgy. Subjects treated include: (a) the nature, characteristics and properties of metals; (b) the application of the phase rule to binary and ternary alloy systems and characterisitc phase diagrams; (c) the correlation of microstructure, mechanical properties and corrosion resistance of alloys, with phase diagrams; (d) mechanical deformation and heat treatment of alloys; (e) descriptions of representative non-ferrous alloys of commercial importance. The subject matter is illustrated by reference to technically important alloy systems in which the phenomena are commonly observed.

The laboratory experiments are designed to introduce to the student the methods available to the metallurgist for the study of metals and alloys. These include the construction of equilibrium diagrams and metallographic studies of fundamental structures, brass, bronze, bearings, etc.

Text: Coonan: Principles of Physical Metallurgy; Heyer: Engineering Physical Metallurgy.

Prerequisite: None.

Mt-202(C) Ferrous Physical Metallurgy 3-2

Continues the presentation of subject matter introduced in Metals, Mt-201, with emphasis on the alloys of iron. Subjects treated include (a) the iron-carbon alloys, (b) effects of various heat treatments and cooling rates on the structure and properties of steel, (c) isothermal reaction rates and the hardenability of steel, (d) surface hardening methods, (e) characteristics and properties of plain carbon and alloy cast irons, (f) the effect of other alloying elements on steel, (g) tool steels, (h) corrosion and corrosion-resisting steels.

The laboratory work includes experiments in the heat treatment of steel, mechanical testing and metallographic examination of common ferrous alloys.

Text: Coonan: Principles of Physical Metallurgy; Heyer: Engineering Physical Metallurgy.

Prerequisite: Mt-201(C).

Mt-203(B) Physical Metallurgy (Special Topics) 2-2

A continuation of material presented in Mt-201 and Mt-202. The subject of matter includes a discussion of the theories of corrosion, corrosion prevention, factors in corrosion, developments in powder metallurgy, metallurgical aspects of welding, casting, fatigue and fatigue failures. The alloys of aluminum and magnesium and certain alloys having characteristics suitable for special applications.

Text: Heyer: Engineering Physical Metallurgy; Coonan: Principles of Physical Metallurgy; Woldman: Metal Process Engineering.

Prerequisite: Mt-202(C).

Mt-204(A) Advanced Physical Metallurgy 3-4

An enlargement of material covered in Mt-201 and Mt-202 to prepare students for advanced study in theoretical physical metallurgy. Subjects covered include the nature and source of structures occurring in steels and other ferrous materials, the interdependence of structures and mechanical properties, phase transformations in steels under isothermal and continuous cooling conditions, response to quenching and hardenability of steels, practical heat treating of steels, effects of welding and the nature and properties of engineering cast irons and cast steels.

Text: Bullens-Battelle: Steel and Its Heat Treatment, Vol. I, II, and III.

Prerequisite: Mt-201(C), Mt-202(C).

Mt-205(A) Advanced Physical Metallurgy 3-4

The subject matter includes a discussion of equilibrium in alloys systems, structure of metals and alloys, phase transformations and diffusion.

Text: Barrett: Structure of Metals.

Prerequisite: Mt-202(C).

Mt-206(A) Advanced Physical Metallurgy 3-4

The subject matter is an extension of that offered in Mt-205(A) and includes such topics as plastic deformation, theories of slip, recrystallization, preferred orientation, age hardening, etc.

Text: Barrett: Structure of Metals; Chalmers: Progress in Metal Physics.

Prerequisite: Mt-205(A).

Mt-207(A) The Physics of Solids

A course for engineers intended as an introduction to the current concepts of the nature of solids. Topics discussed include the wave and particle aspects of electrons, the band structure of metals, insulators and semi-conductors, perfect crystal and imperfect crystals and the interpretation of bulk properties, in terms of electronic, atomic and crystal structures.

Text: Instructor's notes.

Prerequisites: Mt-201, Ph-631, Ph-540.

Mt-301(A) High Temperature Materials 3-0

A study of the methods used in evaluating the probable behavior of materials at elevated temperatures, a consideration of the properties of particular importance in such service; evaluation of present heat-resisting alloys; a study of the effect of high temperature on the behavior of alloys; metals used in gas turbines, jets, and rockets; the use of ceramics for elevated temperatures.

Text: None.

Prerequisite: Mt-202(C).

Mt-302(A) Alloy Steels 3-3

The subject matter covered includes a thorough study of the effects of the alloying elements, including carbon, commonly used in steel making on the characteristics of steels in the annealed, the hardened and the hardened and tempered conditions. The principles elucidated are subsequently applied to studies of the classes of steels used for structural purposes, machinery (S.A.E. and A.I.S.I. grades), electrical purposes, tools, and corrosion resisting purposes.

Text: E. C. Bain: The Alloying Elements in Steel; references and reading assignments in other books and current literature.

Prerequisite: Mt-202(C), Mt-204(A).

Mt-303(A) Metallurgy Seminar
Hours to be arranged

Papers from current technical journals will be reported on and discussed by students.

Text: None.

Prerequisite: Mt-203(B), 204(A), or 205(A).

Mt-304(C) Radiography 2-2

Principles of x-ray and gamma ray radiography, including a discussion of high voltage equipment, film characteristics and a comparison of radiography with other non-destructive methods of inspection.

Text: None.

Prerequisite: Mt-202(C).

Mt-401(A) Physics of Metals 3-0

A discussion of crystal chemistry and modern theories of the solid state. Topics considered are the wave nature of electrons, the electron theory of metals, reaction kinetics, free energy of alloy phases, order-disorder transformations, etc.

Text: Cottrell: Theoretical Structure Metallurgy.

Prerequisite: Mt-205(A), Ph-610(B), or 640(B).

Mt-402(B) Nuclear Reactor Materials-Effects of Radiation 3-0

A course designed for students in nuclear engineering. Includes a study of materials of reactor construction; factors in materials selection; commercially available materials; liquid metal coolants; nature of radiation damage on materials.

Prerequisite: Mt-202.

NEW WEAPONS DEVELOPMENT

SL Lecture Courses

SL-101 New Weapons Development I 0-1

Consists of the first ten lectures of a twenty-lecture series to be delivered by authorities in the field of new weapons development, the latter term being used in its broadest sense and including such developments as atomic energy, guided missiles, pilotless aircraft, radar, special communication equipment, countermeasures, special fuzes and jet propulsion.

Text: None.

Prerequisite: None.

SL-102 New Weapons Development II 0-1

A continuation of Course SL-101 and consists of the second ten lectures of the twenty-lecture series described under SL-101.

Text: None.

Prerequisite: None.

OCEANOGRAPHY

Oc Courses

Oc-101(C) Introduction to Oceanography 2-1

A survey of the physical and chemical properties of sea water, marine biology, and submarine geology; ocean currents, heat budget, water masses, tides, oceanographic observations and instruments.

Texts: Sverdrup: Oceanography for Meteorologists; NavAer 50-1R-242: The Application of Oceanography to Subsurface Warfare.

Prerequisites: Ma-161(C) or Ma-100(C); Ph-190(C) or Ph-196(C) or equivalent.

Oc-111(B) General Oceanography 3-1

Physical, chemical, and biological properties of the oceans; exchange of heat, moisture, and momentum between sea and atmosphere; equations of relative mean motion, special forms; oceanographic instruments and observations.

Texts: Sverdrup, Johnson and Fleming: The Oceans; NavAer 50-1R-242: The Applications of Oceanography to Submarine Warfare; Holmboe, Forsythe, Gustin: Dynamic Meteorology.

Prerequisites: Ma-163(C), Mr-216(B) or equivalent.

Oc-201(C) Physical Oceanography 2-0

Processes which tend to modify the distribution of physical properties in the oceans: turbulence, diffusion, wind stress, internal waves, evaporation, the geostrophic current, upwelling and sinking, stability.

Texts: Sverdrup: Oceanography for Meteorologists; NavAer 50-1R-242: The Applications of Oceanography to Subsurface Warfare; Berry, Bollay, Beers: Handbook of Meteorology.

Prerequisites: Ph-191(C) or Ph-196(C) or equivalent; Ma-163(C) or Ma-100 and Ma-140; Oc-101(C).

Oc-203(C) Amphibious Oceanography 3-1

The characteristics of breaking waves, littoral currents and beach processes, and their effects upon amphibious operations; estuarine circulation, bottom sediments, and naval applications; shallow-water observations and equipment.

Text: Mimeographed notes.

Prerequisite: Mr-610(C) or Mr-620(B).

Oc-213(C) Littoral Oceanography 2-2

Similar to Course Oc-203(C), but emphasizing recent developments in the field.

Texts: Mimeographed notes.

Prerequisites: Oc-111(B), Mr-620(B), Mr-323(A).

Oc-301(C) Military Oceanography 2-1

The oceanographic factors involved in sound ranging: thermal gradients, ambient noise, volume and surface scattering and their time variation; forecasting sonar ranges and changes in ranging conditions as related to meteorological factors.

Texts: NavAer 50-1R-242: The Application of Oceanography to Subsurface Warfare; NDRC Technical Summary: The Principles of Underwater Sound.

Prerequisite: Oc-201(C).

Oc-311(C) Oceanographic Factors in Underwater Sound 2-1

Refraction, absorption, scattering, and diffraction of underwater sound as a function of the oceanic environment. Similar to Course Oc-301(C), but emphasizing recent developments.

Texts: NDRC Technical Summary: The Principles of Underwater Sound; NavAer 50-1R-242: Applications of Oceanography to Submarine Warfare; mimeographed notes.

Prerequisites: Oc-111(B), Ph-196(C) or equivalent.

Oc-401(C) Naval Applications of Oceanography 3-0

Waves, currents, tides, thermal structure and biological phenomena in the oceans, and submarine geology; their applications to problems in landing operations, navigation, mine, and submarine warfare.

Text: NavAer 50-1R-242: The Application of Oceanography to Submarine Warfare.

Prerequisite: Oc-101(C).

OPERATIONS ANALYSIS

Oa Courses

Oa-151(B) Survey of Weapons Evaluation 3-0

Sources of firing errors and their relative contributions to the over-all errors. Determination of aim point for an evading target. Concept and evaluation of lethal area as a function of both the target and the weapon system. Damage probabilities. Patterns of projectiles, bombs, torpedoes, and mines.

Texts: Operations Evaluation Group: Report No. 54, Methods of Operations Research; Classified official publications.

Prerequisites: Ma-100(C), Ma-101(C), Ma-301(B).

Oa-152(C) Measures of Effectiveness of Mines 3-0

Introduction to Operations Analysis. Actuation probability and actuation radius. Lethal volume. Probability of damage. Comparative evaluation of mine types. Errors in mine laying. Theory of mine field operation.

Texts: Classified official publications.

Prerequisites: Ma-381(C), Ma-382(A).

Oa-153(B) Game Theory and Its Applications to Mine Fields 3-0

A continuation of Oa-152(C). Introduction to Game Theory. Operation of a mine field according to Game Theory. Design of mine fields. Detection of mines.

Texts: Classified official publications.

Prerequisite: Oa-152(C).

Oa-191(C) Introduction to Operations Analysis 3-0

Development of fundamental concepts and methods of operations analysis as illustrated in the fields of submarine and anti-submarine warfare. Overall measures of effectiveness of a submarine as a weapon system. Determination of effectiveness as a product of measures of detection, attack, and kill capabilities.

Texts: Operations Evaluation Group: Report No. 54, Methods of Operations Research; Classified official publications.

Prerequisites: Ma-192(C), Ma-381(C).

Oa-192(B) Theory of Search 3-0

Theory of radar detection. Methods of evaluating the operational performance of search radars. Blip-scan ratios and their determination by tracking runs and by computational methods. Search patterns. Barrier patrols.

Texts: Classified official publications.

Prerequisites: Oa-191(C), Ma-382(A).

Oa-193(B) Effectiveness of Weapons 4-0

Probability of a hit by one or more projectiles, torpedoes or other weapons. Correlation between shots. Sources of errors. Lethal area and lethal volume. Damage and kill probabilities. Theory of prediction. Comparison of weapons.

Text: Classified official publications.

Prerequisites: Ma-192(C), Ma-382(A) and Oa-192(B).

Oa-194(A) Optimal Weapon Systems I 4-0

Selection of optimum airplane-weapon system for anti-submarine patrol. Optimal formations of ships and airplanes. Optimal design of minefields.

Text: Classified official publications.

Prerequisites: Ma-591(A), Oa-193(B).

Oa-195(A) Optimal Weapon Systems II 3-0

A continuation of Oa-194(A). Air defense. Atomic weapons. Biological warfare. Applications of game theory.

Texts: Classified official publications.

Prerequisite: Oa-194(A).

Oa-201(A) Logistics Analysis 3-2

Mathematical methods in logistics, with major emphasis on applications of linear programming to problems of transportation and scheduling of interdependent activities. Theory of inventory control. Laboratory work on computation of optimal solutions of linear programs.

Text: Koopmans: Activity Analysis of production and Allocation.

Prerequisites: Ma-501(A), Ma-195(A).

Oa-202(A) Econometrics 3-0

A continuation of Oa-201(A). Inter-industry analysis; mathematical economic theory; review of current theoretical investigations of relationships between military programs and the national economy.

Texts: Tintner: Econometrics; Koopmans: Activity Analysis of Production and Allocation.

Prerequisites: Oa-201(A), Ma-195(A).

Oa-401(A) Theory of Information Communication 3-0

Measurement of information; noise; entropy of information; maximum capacity of a channel. Automatic control. Stochastic functions, stationary processes, correlation, spectral resolution; prediction; filtration.

Texts: Shannon and Weaver: The Mathematical Theory of Communication; Wiener: Cybernetics; Wiener: Extrapolation, Interpolation and Smoothing of Stationary Time Series.

Prerequisites: Ma-195(A), Ma-383(A).

ORDNANCE

Or Courses

Or-101(C) Ordnance I 2-1

The first of four courses in a series designed to provide a survey of the organization, principles, and theories used in the various ordnance fields with limited examples to demonstrate application. Bureau of Ordnance organization and activities; logistics; safety precautions; explosives; ammunition selection and capabilities; ordnance literature.

Text: Classified official publications.

Prerequisite: None.

Or-102(C) Ordnance II 3-2

Continuation of Or-101(C) series. Basic mechanisms (mechanical, electrical, and electronic); aviation ordnance; guided missiles; underwater ordnance.

Text: Classified official publications.

Prerequisite: None.

Or-103(C) Ordnance III 2-2

Continuation of Or-101(C) series. Fire control radar; surface fire control; AA fire control, fire control fundamentals, representative naval systems.

Text: Classified official publications.

Prerequisite: None.

Or-104(C) Ordnance IV 2-1

Continuation of Or-101(C) series. Chemical warfare, agents, effects, methods; biological warfare, agents, methods; atomic warfare, nuclear reactions, effects, damage criteria and weapons size.

Text: Classified official publications.

Prerequisite: None.

Or-191(C) Mines and Mine Mechanisms 2-0

Present U. S. mines, mine handling, mine storage, explosives, surveillance. Foreign types. Mine firing mechanisms, representative types. Preparation and test.

Text: Classified official publications.

Prerequisite: None.

Or-192(C) Mining Operations 2-0

Mine layers. Tactical and strategic mining. Mine fields. Minelaying plans. Procedures. Requirements. Operation plans.

Text: Classified official publications.

Prerequisite: Or-191(C).

Or-231(B) Advanced Fire Control 2-0

A study of fire control theory and fundamentals. Comparison of fundamentals of AA fire control systems. Dynamics of fire control systems. Theory of lead computing gunsights.

Text: Classified official publications.

Prerequisite: None.

Or-241(C) Guided Missiles I 2-0

General concepts and theoretical problems involved in guidance, launching, propulsion, warhead design, stabilization, and simulation of guided missiles. Tactical problems and limitations of guidance systems. Organization of guided missile program. Test ranges and instrumentation. Practical application as exemplified by the BAT.

Text: Classified official publications.

Prerequisite: None.

Or-242(B) Guided Missiles II 2-0

Continuation of Or-241(C). Concepts of FM-CW and doppler radar; types of servos; the ballistic trajectory as applied to guided missiles. Application of guided missiles principles and uses as exemplified by V-2, Loon, Terrier, Talos, Zeus, and Regulus. The Kingfisher-Petrel program.

Text: Classified official publications.

Prerequisite: Or-241(C).

Or-291(C) Mine Countermeasures I 3-0

Sweeper characteristics. Sweeping techniques. Countermeasures for specific influence mine types. Practical sweeping of influence mines. Passive countermeasures.

Text: Classified official publications.

Prerequisite: None.

Or-292(C) Mine Countermeasures II 3-2

Continuation of Or-291(C). Theory of various countermeasures techniques. Lab demonstrations. Mine detection by various means. Scope of detection devices. Mine destruction. Operation plans, and procedures.

Text: Classified official publications.

Prerequisite: Or-291(C).

Or-294(A) Mine Warfare Seminar 2-0

Investigation and reports by students on assigned mine warfare topics. Occasional presentations and discussions by field representatives of mine warfare activities.

Text: None.

Prerequisite: Or-292(C).

Or-295(A) Thesis I 2-9

Thesis preparation and research in a designated mine warfare subject guided by appropriate staff and faculty members.

Text: None.

Prerequisite: None.

Or-296(A) Thesis II 2-6

Continuation of Or-295(A). Completion of research and thesis.

Text: None.

Prerequisite: Or-295(A).

PHYSICS

Ph Courses

Ph-113(B) Dynamics 3-0

Kinematical and dynamical motions of a particle and of rigid bodies, energy concepts in dynamics, constrained motion, equations of Lagrange and of Hamilton, oscillations of a dynamical system. Both analytical and vector methods are used.

Text: Lindsay: Physical Mechanics.

Prerequisites: Ph-212(B); Ma-103(B). (May be taken concurrently.)

Ph-141(B) Analytical Mechanics 4-0

Fundamental dynamical concepts, oscillator theory, curvilinear motion in a plane, energy concepts, statics and dynamics of a rigid body. Both analytical and vector methods are used.

Texts: Lindsay: Physical Mechanics; Page: Introduction to Theoretical Physics.

Prerequisite: Ma-182(C). (May be taken concurrently.)

Ph-142(B) Analytical Mechanics 4-0

Wave motion, fluid mechanics, constrained motion, Hamilton's principle, Lagrange's equations.

Texts: Lindsay: Physical Mechanics; Page: Introduction to Theoretical Physics.

Prerequisite: Ph-141(B); Ma-183(B). (May be taken concurrently.)

Ph-143(A) Analytical Mechanics 3-0

Lagrange's and Hamilton's equations. Central force fields. Kinematic of rigid bodies. Canonical transformations.

Texts: Goldstein: Classical Mechanics; Slater and Frank: Mechanics.

Prerequisite: Mc-102(C).

Ph-190(C) Survey of Physics I 3-0

Elementary concepts and laws of statics and dynamics. Introduction to the statics and dynamics of fluids. Temperature, heat, radiation, kinetic theory and the gas laws. Fundamentals of vector representation and notation.

Text: Sears and Zemansky: College Physics.

Prerequisite: None.

Ph-191(C) Survey of Physics II 3-0

A continuation of Ph-190(C). A survey of wave propagation, sound, electricity and magnetism, atomic structure, the properties of light, and other electromagnetic wave phenomena.

Text: Sears and Zemansky: College Physics.
Prerequisite: Ph-190(C) or equivalent.

Ph-196(C) Review of General Physics 5-0

A short review of statics and dynamics. A survey of temperature, heat, kinetic theory, electricity and magnetism, wave motion and sound, and selected topics in light as time permits.

Text: Sears and Zemansky: University Physics.

Prerequisite: Ph-191(C) or equivalent.

Ph-211(C) Optics 3-0

The principal topics are: reflection and refraction of light; lenses and lens aberrations; stops; optical systems; and dispersion.

Text: Jenkins and White: Fundamentals of Optics.

Prerequisite: Ma-101(C). (May be taken concurrently.)

Ph-212(B) Physical Optics and Introductory Dynamics 3-3

A continuation of Ph-211(C). An analytical presentation of interference, diffraction, polarization, origin of spectra, optical behavior of radio waves, introductory dynamics.

Texts: Jenkins and White: Fundamentals of Optics; Lindsay: Physical Mechanics.

Prerequisites: Ph-211(C); Ma-102(C). (May be taken concurrently.)

Ph-240(C) Geometrical and Physical Optics 3-3

Reflection and refraction of light, lenses, optical systems, dispersion, interference, diffraction, polarization.

Text: Jenkins and White: Fundamentals of Optics.

Prerequisite: Ma-101(C) or 181(B). (May be taken concurrently.)

Ph-241(B) Polarized Light 1-3

Primarily a laboratory course in polarized light. The following experiments are included: polarization phenomena caused by transmission of light through crystals, polarization by reflection from dielectrics, reflection from metals and optical constants of metals, analysis of elliptically polarized light, wave plates, and optical activity.

Text: Lecture notes.

Prerequisite: Ph-240(C) or Ph-250(C).

Ph-250(C) Geometrical and Physical Optics 3-2

Reflection and refraction of light, lenses, lens systems, dispersion, interference, diffraction.

Text: Jenkins and White: Fundamentals of Optics.

Prerequisite: Ma-101(C) or 181(B) (May be taken concurrently.)

Ph-311(B) Electrostatics and Magnetostatics 3-0

Coulomb's law, Gauss' law, dipoles, dielectric theory, polarization, harmonic solutions of Laplace's equation, electrical images, magnetic dipoles and shells, Ampere's law, magnetic field of current, magnetic theory. Both analytical and vector methods are used.

Text: Harnwell: Principles of Electricity and Electromagnetism.

Prerequisites: Ma-103(B); Es-112(C).

Ph-341(C) Electricity and Magnetism 4-2

DC and AC circuits, elementary electrostatics, vacuum tubes, coupled circuits, filters, lines, vacuum tube circuits. The treatment emphasizes the physical aspects of these phenomena.

Texts: Harnwell: Principles of Electricity and Magnetism; NavShips 900,016; lecture notes.

Prerequisite: Ma-182(B). (May be taken concurrently.)

Ph-351(A) Electricity and Magnetism 5-0

Electrostatics, electromagnetic fields and potentials, dielectrics, Maxwell's equations, electromagnetic waves.

Text: Slater and Frank: Electromagnetism.

Prerequisites: Ph-143(A); Es-272(C).

Ph-361(A) Electromagnetism 3-0

Electromagnetic field theory; electrostatics, dielectrics, magnetic fields of currents; vector potential; magnetic materials; magnetomotive force; electromagnetic induction; Maxwell's equations; electromagnetic waves.

Text: Slater and Frank: Electromagnetism.

Prerequisites: Ma-104(A); EE-272(C), or equivalent.

Ph-362(A) Electromagnetic Waves 3-0

A continuation of Ph-361(A). Reflection and refraction of electromagnetic waves; wave guides; cavity resonators; electromagnetic radiation.

Text: Slater and Frank: Electromagnetism.

Prerequisite: Ph-361(A).

Ph-410(B) Sound 3-0

A brief survey of vibrating systems, and of the problems arising in connection with the radiation, transmission and reception of sound in air and in water.

Text: Kinsler, Frey: Fundamentals of Acoustics.

Prerequisite: Ma-102(C).

Ph-421(A) Fundamental Acoustics 3-0

An analytical study of the dynamics of vibrating systems including free, forced, damped, and coupled simple harmonic motion, vibrations of strings, bars, membranes, and diaphragms. A development of the acoustic wave equation. Propagation of plane waves through pipes and between different media. Propagation of spherical waves, including radiation from pulsating sphere and circular piston.

Text: Kinsler, Frey: Fundamentals of Acoustics.

Prerequisite: Ma-104(A).

Ph-422(A) Applied Acoustics 3-0

A continuation of Ph-421(A). An analytical treatment of acoustic resonators; acoustic impedance; effects of branches, orifices, and viscosity on propagation of plane waves through pipes; horn, loud speaker, and microphone theory and practice. Fundamentals of acoustical measurements including rating and calibration methods of microphones and loud speakers. Architectural acoustics. Fundamentals of hearing.

Text: Kinsler, Frey: Fundamentals of Acoustics.

Prerequisite: Ph-421(A).

Ph-423(A) Underwater Acoustics 2-3

A continuation of Ph-422(A). An analytical treatment of the piezoelectric effect and the magnetostriction effect with applications to sonar transducers and to crystal oscillators; transmission of sound in sea water, including problems of refraction, attenuation and reverberation. Physical principles and electronic circuits used in design and operation of modern sonar equipment. Experiments in acoustical measurements, sound beam and sonar equipment measurements, operation of sonar equipment.

Text: NDRC Technical Summary: Principles of Underwater Sound.

Prerequisite: Ph-422(A).

Ph-424(A) Sonar Systems and Developments 3-3

Various types of sonar equipment and new developments are studied in the laboratory and in the classroom. Shock waves.

Text: Cole: Underwater Explosions.

Prerequisite: Ph-423(A) or Ph-450(B).

Ph-425(A) Underwater Acoustics 3-2

A continuation of Ph-421(A). An analytic treatment of the propagation of underwater acoustic waves as influenced by boundary conditions, refraction, reverberation, and attenuation. Physical characteristics of sonar transducers. Psychoacoustics, acoustic impedance, shock waves, sonar systems and developments, experimental measurements in underwater acoustics. Laboratory includes experiments in underwater acoustic measurements, sonar beam pattern, and operational characteristics of sonar equipment.

Texts: Kinsler, Frey: Fundamentals of Acoustics; NDRC Technical Summary: Principles of Underwater Sound; NDRC Technical Summary: Physics of Sound in the Sea.

Prerequisite: Ph-421(A).

Ph-426(B) Acoustics Laboratory 0-3

A laboratory course to accompany Ph-421(A). An experimental study of vibrating systems and acoustic radiations.

Text: None.

Prerequisite: Ph-421(A) concurrently.

Ph-427(B) Fundamental and Applied Acoustics 4-0

A study of the dynamics of vibrating systems and of the propagation of acoustic waves. Applications of basic acoustic theory to design of resonators, filters, loudspeakers, microphones, etc.

Text: Kinsler, Frey: Fundamentals of Acoustics.

Prerequisite: Ma-103(A).

Ph-428(B) Underwater Acoustics 2-3

A continuation of Ph-427(B). A study of the transmission of sound in sea water including problems arising from refraction, absorption, reverberation, background noise, etc. Physical principles, electronic circuits, and transducers used in modern sonar equipment. Experiments in acoustical measurements, sound beam and sonar equipment measurements, operational characteristics of sonar equipment.

Text: NDRC Technical Summary: Principles of Underwater Sound.

Prerequisite: Ph-427(B).

Ph-441(A) Longitudinal Waves in Fluids 4-0

Simple oscillator. Hydrodynamics. Longitudinal wave equation. Wave propagation in fluids. Propagation of shock waves in fluids.

Texts: Kinsler, Frey: Fundamentals of Acoustics; Cole: Underwater Explosions.

Prerequisites: Ma-183(B); Ph-143(A).

Ph-450(B) Underwater Acoustics 3-2

An analytic treatment of the fundamentals of acoustics, with particular emphasis on sound radiation and transmission problems encountered in underwater acoustics.

Texts: Kinsler, Frey: Fundamentals of Acoustics; NDRC Technical Summary: Principles of Underwater Sound; NDRC Technical Summary; Physics of Sound in the Sea.

Prerequisite: Ma-102(C).

Ph-530(B) Thermodynamics 3-0

Fundamental theory of thermodynamics and application to physical problems. First and second laws of thermodynamics, entropy, free energy, the phase rule, gaseous reactions, thermodynamics of dilute solutions, specific heats of gases, the Nernst heat theorem.

Text: Sears: Thermodynamics.

Prerequisites: Ph-113(B) or Ph-142(B); Ma-103(B) or Ma-183(B).

Ph-540(B) Kinetic Theory and Statistical Mechanics 3-0

Properties of an ideal gas, Maxwell-Boltzman distribution, mean free path, collision cross-section, non-ideal gases, viscosity, heat conductivity, diffusion; introduction to classical and quantum statistics, including Fermi-Dirac and Bose-Einstein statistics.

Texts: Kennard: Kinetic Theory of Gases; Sears: Thermodynamics; Lecture notes.

Prerequisites: Ph-113(B) or Ph-142(B); Ma-103(B) or Ma-183(B).

Ph-541(B) Kinetic Theory and Statistical Mechanics 4-0

Maxwell-Boltzman distribution, collision cross-sections, introduction to classical and quantum statistics, with application to radiant energy.

Texts: Kennard: Kinetic Theory; Sears: Thermodynamics.

Prerequisites: Ma-183(B); Ph-143(A).

Ph-542(A) Thermodynamics and Statistical Mechanics 4-0

The principal topics are: equations of state, first and second laws of thermodynamics; introduction to classical and quantum statistics, including Fermi-Dirac and Bose-Einstein statistics; theory of fluctuations.

Text: Allis and Herlin: Thermodynamics and Statistical Mechanics; lecture notes.

Prerequisites: Ph-113(B) or Ph-142(B); Ma-103(B) or Ma-183(B).

Ph-610(B) Atomic Physics 3-0

Elementary charged particles, photoelectricity, X-rays, radioactivity, atomic structure, nuclear reactions.

Text: Semat: Atomic Physics.

Prerequisite: None.

Ph-631(B) Atomic Physics 4-0

Dynamics of elementary charged particles, Rutherford's model of the atom and the scattering of alpha particles, special theory of relativity, black-body radiation, Bohr model of the atom, Schroedinger wave equation, dipole radiation, optical spectra, Zeeman effect, magnetic moments, Pauli's principle, x-rays, photoelectric effect, natural radioactivity, the nucleus, artificial radioactivity.

Texts: Semat: Atomic Physics; Richtmeyer and Kennard: Introduction to Modern Physics.

Prerequisite: Ph-361(B) or equivalent.

Ph-640(B) Atomic Physics 3-3

Same as Ph-631(B) above, together with laboratory work.

Texts: Semat: Atomic Physics; Richtmeyer and Kennard: Introduction to Modern Physics.

Prerequisite: Ph-361(B) or equivalent.

Ph-641(B) Atomic Physics 3-3

Elementary charged particles, atomic structure, Bohr model of the atom, special theory of relativity, photoelectricity, X-rays and optical spectra.

Text: Richtmeyer and Kennard: Modern Physics.

Prerequisites: Ph-143(A); Ph-250(C).

Ph-642(A) Nuclear Physics 3-0

Nuclear structure, radioactivity, nuclear reactions and nuclear fission.

Text: Bitter: Nuclear Physics.

Prerequisite: Ph-740(A).

Ph-643(A) Nuclear Physics Laboratory 0-3

An experimental study of the phenomena, observational methods, and instruments used in nuclear physics.

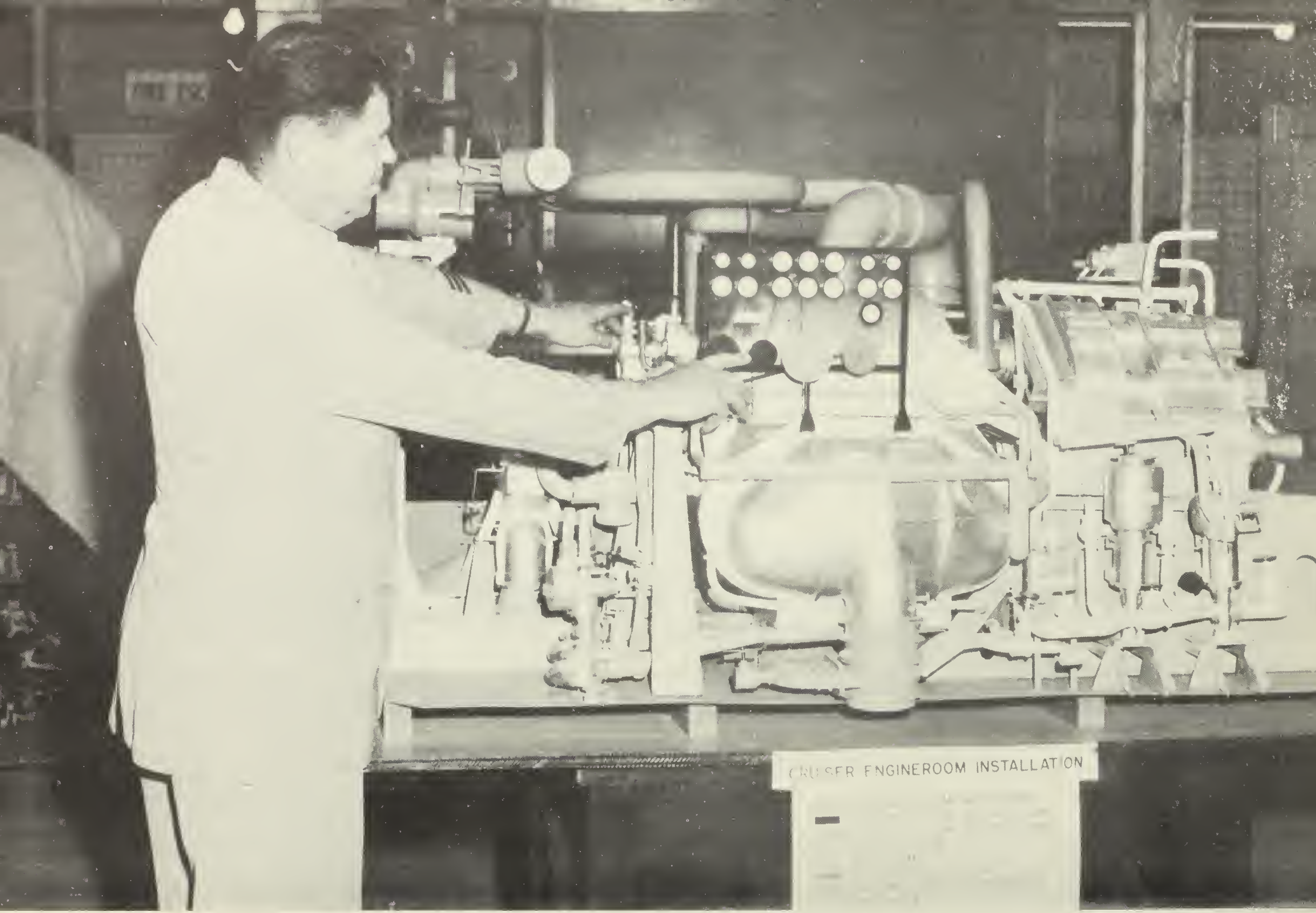
Text: None.

Prerequisite: Ph-642(A). (May be taken concurrently.)

A General Line School class in Engineering. Practical operating courses such as these play an important part in supplementing an officer's former education and experience, and preparing officers for a variety of future duties.

A General Line School class in Navigation.

Typical General Line School training equipment, currently in temporary location in buildings of the Naval Auxiliary Air Station.



Model used in engineering classes at the General Line School.

Ph-721(A) Introduction to Quantum Mechanics 4-0

This course is designed to familiarize the student with the postulates and methods of Schroedinger's quantum mechanics, with application to such problems as the free particle, particle in a potential well, potential barriers, cold cathode emission, natural radioactivity, harmonic oscillator, free rotator, hydrogen atom and the one-dimensional potential lattice for the solid state.

Text: Lecture notes.

Prerequisites: Ph-142(B); Ph-640(B) or equivalent.

Ph-722(A) Physics of the Solid State 3-0

Properties of ionic crystals such as lattice energies, electrical conductivity, absorption, phosphorescence and flourescence. The transitor. Properties of metals such as specific heats, electrical conductivity and magnetic susceptibility.

Text: Seitz: Modern Theory of Solids.

Prerequisite: Ph-721(A) or equivalent.

Ph-731(A) Theoretical Physics 3-0

Topics in theoretical physics selected to meet the needs of the student.

Text: None.

Prerequisite: Consent of instructor.

Ph-732(A) Theoretical Physics 3-0

Topics in theoretical physics selected to meet the needs of the student.

Text: None.

Prerequisite: Ph-731(A).

Ph-740(A) Introductory Quantum Mechanics 3-0

Schroedinger's wave mechanics, with application to such problems as the free particle, particle in a potential well, harmonic oscillator and the hydrogen atom.

Text: None.

Prerequisite: Ph-641(B) or equivalent.

SECTION III

THE GENERAL LINE SCHOOL

Director
George Kittrell **FRASER**, Captain, U. S. Navy
B.S., USNA, 1927; Graduate Aviation Ordnance; Engineering, USNPGS, 1938.

Assistant to the Director
Charles Coleman **TIDWELL, Jr.**, Lieutenant Commander, U. S. Navy

Training Aids Officer
Gordon Leonard **KALLENBERG**, Lieutenant, U. S. Navy

NAVAL STAFF

COMMAND AND STAFF DEPARTMENT

Charles Edward **ROBERTSON**
Captain, U. S. Navy
Head of Department
B.S., USNA, 1933.

Preston Randolph **BELCHER**
Commander, U. S. Navy
Senior Administration and Leadership Instructor

Charles Dean **DAVOL, Jr.**
Lieutenant Commander, U. S. Navy
Administration and Leadership Instructor

Lloyd Webb **BERTOGLIO**
Lieutenant Commander, U. S. Navy
Senior Aviation Instructor

Robert John **GERHARDT**
Lieutenant Commander, U. S. Navy
Logistics Instructor
B.S., Northwestern Univ., 1942; M.A., 1949

Thomas Richard **FONICK**
Commander, U. S. Navy
Senior Military Law Instructor
B.S., Univ. of Washington, 1934.

Fred Yancy **BOYER**
Commander, U. S. Navy
Military Law Instructor
LL.B., Univ. of Texas, 1942; LL.M., George Washington Univ., 1948.

Saul Myer **WEINGARTEN**
Lieutenant, U. S. Navy
Military Law Instructor
A.A., Antelope Valley College, 1940; A.B., Univ. of California at Los Angeles, 1942; LL.B., Univ. of Southern California School of Law, 1949; Coro Fellow, Coro Foundation, 1950.

OPERATIONAL COMMAND DEPARTMENT

Edwin Byron **PARKER, Jr.**
Commander, U. S. Navy
Head of Department
B.S., USNA, 1935.

John Joseph **REIDY, Jr.**
Commander, U. S. Navy
Senior Tactics Instructor
A.B., Harvard Univ., 1938; LL.B., George Washington, 1948.

Robert Arnold **NEWCOMB**
Lieutenant Commander, U. S. Navy
Tactics Instructor
B.S., USNA, 1940.

Norman Allan **SMITH**
Lieutenant Commander, U. S. Navy
Tactics Instructor

William Michael **ROBINSON**
Lieutenant Commander, U. S. Navy
Tactics Instructor
B.S., USNA, 1942.

Orin Nicholas **FORD**
Lieutenant Commander, U. S. Navy
Tactics Instructor
A.A., Hartnell College, 1941.

William Park **BAKER**
Lieutenant Commander, U. S. Navy
Tactics Instructor
B.S., USNA, 1943.

Joseph Delos **FULLER**
Lieutenant Commander, U. S. Navy
Senior Communications Instructor

Earl Henry **LEACH**
Lieutenant Commander, U. S. Navy
Communication Instructor
B.S., Springfield College, 1936.

Paul Henry BARKLEY
Lieutenant, U. S. Navy
Communication Instructor

Francis Vincent KENNEY
Commander, U. S. Navy
Senior CIC-ASW Instructor

William Ramsay TROTTER
Lieutenant, U. S. Navy
CIC-ASW Instructor

Derrill Plummer CROSBY
Lieutenant, U. S. Navy
CIC-ASW Instructor

John Newell CUMMINGS
Lieutenant, U. S. Navy
CIC-ASW Instructor

Carl William BURROWS, Jr.
Lieutenant, U. S. Navy
CIC-ASW Instructor
B.S., USNA, 1944.

SEAMANSHIP AND NAVIGATION DEPARTMENT

Edward Frank STEFFANIDES, Jr.
Commander, U. S. Navy
Head of Department
B.S., USNA, 1931.

Philip Thompson GLENNON
Commander, U. S. Navy
Senior Navigation and Submarine Instructor
B.S., USNA, 1940.

William Gwynette SHORES
Lieutenant, U. S. Navy
Navigation Instructor

Alden Seymour RIKER
Lieutenant, U. S. Navy
Navigation Instructor

Frank Gordon REESE
Lieutenant, U. S. Navy
Navigation and Submarine Instructor
B.S., Univ. of Washington, 1944.

Burton Floyd John ALBRECHT
Lieutenant Commander, U. S. Navy
Meteorology Instructor
B.S., Arizona State College, 1941.

Harry Victor HARTSELL, Jr.
Lieutenant Commander, U. S. Navy
Seamanship Instructor

Frank Clyde DUNHAM, Jr.
Lieutenant, U. S. Navy
Seamanship Instructor
B.A., Harvard Univ., 1943.

Kenneth J. CHAPMAN
Lieutenant, U. S. Navy
Seamanship Instructor

ORDNANCE AND GUNNERY DEPARTMENT

Roger Farrington MILLER
Commander, U. S. Navy
Head of Department
B.S., Univ. of California, 1931.

James Frederick Bennett JOHNSTON
Commander, U. S. Navy
Senior Ordnance and Gunnery Instructor
B.S., USNA, 1939.

Robert Wilson MILLER
Lieutenant, U. S. Navy
Ordnance and Gunnery Instructor
B.S., Pennsylvania State Teachers College, 1943.

Teddy Roosevelt FIELDING
Lieutenant, U. S. Navy
Ordnance and Gunnery Instructor

Thomas James MURRAY
Lieutenant, U. S. Navy
Ordnance and Gunnery Instructor

David Dean DITZLER
Lieutenant, U. S. Navy
Ordnance and Gunnery Instructor

ENGINEERING AND DAMAGE CONTROL DEPARTMENT

John Albert LEONARD
Commander, U. S. Navy
Head of Department
B.S., USNA, 1938.

William Wade GENTRY
Commander, U. S. Navy
Senior Naval Engineering Instructor
B.S., USNA, 1939; B.S., in M.E., USNPGS, 1948.

Arthur Ralph WAGGENER
Lieutenant Commander, U. S. Navy
Naval Engineering Instructor

Ross PETERS
Lieutenant, U. S. Navy
Naval Engineering Instructor

Preston Raymond RITTER,
Lieutenant Commander, U. S. Navy
Senior Damage Control Instructor
B.S., in M.E., Polytechnic Engineering College, Oakland, 1941.

Edmund Eugene LE BER
Lieutenant, U. S. Navy
Damage Control Instructor
B.S., Naval Architecture, Webb Institute.

Charles Golden TYLER
Lieutenant, U. S. Navy
Damage Control Instructor

CIVILIAN FACULTY

Roy Stanley GLASGOW, Academic Dean
B.S., Washington Univ., 1918; M.S., Harvard Univ., 1922; E.E., 1925.

ELECTRICAL ENGINEERING AND MATHEMATICS DEPARTMENT

Frank Emilio LACAUZA
Professor of Electrical Engineering, Head of Department (1929)* B.S., in E.E., Harvard Univ., 1923; M.S., in E.E., Harvard Univ., 1924; A.M., Harvard Univ., 1929.

Edward Markham GARDNER
Associate Professor of Electrical Engineering 1948) B.S. in Engineering, Univ. of London, 1923; M.S. in EE., California Institute of Technology, 1938.

John Dewitt RIGGIN
Associate Professor of Electrical Engineering (1946) B.S. in E.E., Univ. of Mississippi, 1934; M.S. in E.E., Univ. of Mississippi, 1936.

Raymond Kenneth HOUSTON
Associate Professor of Electrical Engineering (1946) B.S., Worchester Polytechnic Institute, 1938; M.S., 1939.

David Boysen HOISINGTON
Associate Professor of Electrical Engineering (1947) B.S. in E.E., Massachusetts Institute of Technology, 1940; M.S. in E.E., University of Pennsylvania, 1941.

Raymond Patrick MURRAY
Assistant Professor of Electrical Engineering (1947) B.E. in E.E., Kansas State College, 1937.

John Pershing PADDOCK
Assistant Professor of Electrical Engineering (1949) B.S. in E.E., Stanford Univ., 1947; M.S. in E.E., Stanford Univ., 1948.

Darrel James MONSON
Assistant Professor of Electrical Engineering (1951) B.S. in E.E., Univ. of Utah, 1943; M.S. in E.E., Univ. of California, 1951.

William Everett NORRIS
Assistant Professor of Electrical Engineering (1951) B.S. in E.E., Univ. of California, 1941; M.S. in E.E., Univ. of California, 1950

Herbert LeRoy MYERS
Assistant Professor of Electrical Engineering (1951) B.S. in E.E., Univ. of Southern California, 1951.

* The year of joining the General Line School faculty is indicated in parentheses.

THE GENERAL LINE SCHOOL

OBJECTIVE

To supplement and broaden the professional knowledge of unrestricted line officers of the Regular Navy in order to increase their capabilities and to prepare them for duties afloat and ashore commensurate with their rank.

CURRENT AND FUTURE PROGRAMS

Current. The current six months curriculum is designed to supplement the educational background and professional knowledge of former Reserve and Temporary officers who have transferred to the Regular Navy and who have gaps in their naval experience resulting from limited or specialized assignments.

Future. It is anticipated that the future program, to be inaugurated in 1955, will provide a year's study for each unrestricted line officer after he has attained approximately six years of commissioned service. In addition to providing necessary supplementary knowledge as in the current program, this program will be designed to broaden his knowledge and mental outlook, and to foster his individual growth, initiative and problem-solving ability.

ADMINISTRATION

Responsibility for administration of the General Line School rests in the Director. Under the Director are the Naval Staff and the Civilian Faculty.

The Naval Staff consists of five officers who are heads of departments, and such additional officers as may be assigned to those departments as instructors. The Civilian Faculty consists of one Civilian Head of Department and the civilians assigned him in that department. The Civilian Faculty members are under the over-all supervision and administration of the Academic Dean, insofar as their academic work and performance are concerned. The Dean represents the Superintendent and the Director, with many of the functions usually resting in the Dean of a civilian college. The faculty members are civil service personnel, with special status.

The officer students of the General Line School are divided into sections for the purpose of administration and classroom assignments. The Senior Officer of each section is designated Section Leader with responsibility for exercising administrative control of the officers in his section. Each student section has an Officer Instructor assigned to it as Section Advisor. The Section Advisor provides a connecting link between the school administration and the students.

FACILITIES AND EQUIPMENT

The administrative offices of the General Line School are located in the West Wing of the former Del Monte Hotel. Here are the offices of the Director, heads of departments and instructors. These offices were formerly guest rooms of the hotel and have been converted to serve their present use. In the companion East Wing, similar rooms have been converted into classrooms; the Line School utilizes some of these rooms independently, and some are shared with the Engineering School. Most of the classrooms for the General Line School are located in Fleming Hall, a temporary building located to the east of the former hotel.

Laboratory and practical exercises are provided for at the Naval Auxiliary Air Station located approximately two miles from the main school grounds, bus transportation being provided for the students. One building houses the electrical and electronics laboratories and several rooms which have been equipped to simulate combat information centers of ships. In another building there are facilities for the practical navigation exercises in which the student utilizes the equipment normally used by a navigator at sea. A third building contains models and cutaways of engineering equipment and installations used aboard ship. Still another building provides facilities and equipment for the conduct of anti-submarine and seamanship training; these consist of simulated ships' bridges and devices in which two or more ships may be made to maneuver on a screen by means of projectors, their movements being controlled by the students.

Ordnance and associated equipment is on display in a building on the main school grounds shared with the Engineering School.

Plans have been submitted for the construction of new buildings for the General Line School on the main grounds which will meet the need of a new Line School program to be inaugurated in 1955, at which time the West Wing will revert to its former use to house bachelor officers.

CURRICULUM AND INSTRUCTION

General. In view of the wide disparity in rank, background and experience of the officer students, the current curriculum is broad enough to meet the needs of officers deficient in any of the principal, vital areas of the naval profession. In view of the limited time available, each course is necessarily quite intense; the relative amount of time devoted to each course is a reflection of the analysis of student deficiencies and its relative importance to the average officer. Each student pursues the same curriculum regardless of past experience, except that non-aviators get some additional courses during the periods allotted to aviators for flying. Extra instruction is afforded for student deficiencies in the basic sciences.

Practice Cruise. The formal curriculum is augmented by a practice cruise at sea, normally of one week's duration. The students embark in combatant type ships and are given the opportunity to observe the organization and technical details of the ship, and, where practicable, to take over the functions of the ship's personnel at various stations under supervision, while the ship performs routine evolutions.

CURRICULUM

	Hours
Command and Staff Department	
Administration and Leadership	32
Military Law	40
Logistics	24
Aviation (for non-aviators)	24
Seamanship and Navigation Department	
Seamanship	40
Navigation	80
Meteorology	16
Submarine	8
Operational Command Department	
Naval Tactics	96
Combat Information Center/Anti-Submarine Warfare	56
Communications	40
Electrical Engineering and Mathematics Department	
Mathematics Review	19
Mechanics Review	8
Electrical Engineering	45
Electronics Survey	9
Engineering and Damage Control Department	
Naval Engineering (Basic)	48
Naval Engineering (Augmented)	12
Damage Control (Basic)	48
Damage Control (Augmented)	12
Ordnance and Gunnery Department	
Ordnance and Gunnery (Basic)	56
Ordnance and Gunnery (Augmented)	24

ADMINISTRATION AND LEADERSHIP

OBJECTIVE

To provide a course of wide scope designed to stimulate interest and increase knowledge and capability in general administrative matters and in leadership, and thus to increase the effectiveness of students in their future assignments.

COURSE DESCRIPTION

The course concerns matters affecting the naval officer and his career, philosophy and techniques of leadership, personnel administration and general administration. Within these four general areas as many pertinent topics as practicable are presented in the limited time allotted. No attempt is made to give complete treatment to any topic; the idea is to highlight salient factors, alert students to the importance of matters of chief concern and provide them with information and means for more intensive and effective effort on an individual basis.

SYLLABUS

	Hours
Philosophy of Military Life	1
Customs and Traditions	2
Career Planning	1
Personal Finances	2
Performance, Promotion, Retirement	4
Leadership	5
Enlisted Training Programs	1
Enlisted Rating Structure	1
Classification	1
Personnel Accounting and Records	2
Personnel Policies; Manpower Utilization	2
Shipboard Organization	1
Foreign Relations; Protocol	1
Public Relations and Information	1
Welfare and Recreation Programs	1
Mess Administration	1
Correspondence and Directives	5
	32

MILITARY LAW

OBJECTIVE

To teach the fundamentals of military law based upon the Uniform Code of Military Justice and the Manual for Courts-Martial, 1951 (including the Naval Supplement thereto), to the end that the administration of justice in the U. S. naval service will be sustained and strengthened.

COURSE DESCRIPTION

The student is instructed in rules and procedures of naval law, and in matters relating to the jurisdiction of naval courts-martial. The student is given practical experience by participation in moot summary and special courts-martial. The student is shown the advantages of a good knowledge of military law during his naval career, as well as the importance of military law in the proper administration of discipline and naval justice.

SYLLABUS

	Hours
Introduction and Jurisdiction	2
Charges and Specifications	2
Legal Research Problem	1
Punitive Articles of Uniform Code of Military Justice	8
Rules of Evidence	8
Non-judicial Punishment and Preliminary Inquiries	3
Court Martial Procedure	13
Action on Court Martial Proceedings by Reviewing Authorities	2
Courts of Inquiry and Investigations	1
	40

LOGISTICS

OBJECTIVE

To provide basic instruction in logistics, calculated to instill in the officer student a full appreciation of naval logistics in its present-day concepts.

The course is presented by lecture method and is developed as follows:

COURSE DESCRIPTION

A concept of logistics is derived by developing its meaning today and its importance in modern warfare.

The student is made aware of the important organization and commands involved and how they function.

The components of logistics are expanded subject by subject to give the student an understanding of logistic processes.

The operational or combat phases of logistics are discussed with emphasis placed upon logistics planning and execution as practiced in World War II and in Korea.

SYLLABUS

	Hours
Organization	3
Determination of Requirements and Budgetary Aspects	3
Procurement and Distribution	7
Manpower and Petroleum	2
Transportation	3
Theater Logistics	3
Logistics Computations	3
	24

AVIATION

OBJECTIVES

To give the non-aviation officer a broad concept of the mission, organization and objective of naval aviation; to create an appreciation of the significance and uses of naval aviation; to indicate the capabilities and limitations of naval aircraft.

COURSE DESCRIPTION

This course is presented primarily by lecture method augmented by moving pictures and includes discussion of all phases of naval aviation, its aircraft and their tactical employment in the science of naval warfare.

In keeping with the scope of the course no attempt is made to explore the more technical aspect of naval aviation but rather to present each topic to the student in the light of present employment, high-lighting the capabilities and limitations so as to bring about a more concrete understanding of the role of naval aviation.

In addition to classroom presentation one hour of the syllabus is devoted to practice work in the Link trainer. Each student is placed at the actual controls of this synthetic flight simulator with the purpose of acquainting him with the technique and problems of piloting an aircraft.

SYLLABUS	Hours
History of Naval Aviation	1
Principles of Flight	1
Classes and Development of Aircraft Carrier and their Operations	4
Patrol Aircraft and Their Operations	2
Lighter-than-Air and Utility Aircraft	1
Fundamentals of Helicopters and Their Employment	1
Aerial Mining	1
New Developments	2
Flights through the Weather	3
Aircraft in Amphibious Warfare	2
Aircraft in Anti-Submarine Warfare	3
Jet Propulsion and Flights	2
Problem of High Altitude and High Speed Flights	1
	24

SEAMANSHIP

OBJECTIVE

To present a theoretical and background knowledge of seamanship and the rules of the nautical road.

COURSE DESCRIPTION

The seamanship course is divided into three parts: deck seamanship, rules of the road, and duties of the officer of the deck. Deck seamanship covers duties of the first lieutenant, marlinspike seamanship, weight handling, boat stowage and handling, replenishment at sea, towing and ground tackle. Rules of the road include fog signals, meeting signals, lights, and emergency ship handling. Duties of the officer of the deck covers maneuvering in confined waters, rudder and screw effects, standard orders, mooring lines, formation steaming, and heavy weather steaming.

The above topics are covered in thirty-eight lecture hours. Two additional hours are spent in the shiphandling trainer. Additional practical application is obtained during the cruise.

SYLLABUS	Hours
Deck Seamanship Evolutions	11
Duties of the Officer of the Deck	2
Shiphandling	9
Rules of the Nautical Road	16
Shiphandling Trainer	2
Total exclusive of cruise at sea	40

NAVIGATION

OBJECTIVE

To provide a practical and theoretical knowledge of marine navigation.

COURSE DESCRIPTION

The navigation course is divided into three phases: piloting, astronomy and celestial navigation. Piloting covers preliminary definitions, chart projections, use of HO and other publications, the magnetic compass, Loran and radar navigation. Astronomy covers the basic motions of the celestial bodies, terms, and definitions. Celestial navigation covers the use of the Nautical Almanac, HO 214, HO 249 and Rude star finder.

The course consists of 48 hours of classroom work, lectures, training films, and problems and 32 hours of practical works including solving problems and plotting.

SYLLABUS	Hours
Mechanics: Definitions, Chart Projections, Publications	4
Tide and Current Tables, Light Lists, Nautical Almanac	7
Magnetic Compass, Exact Azimuths	3
Piloting, Loran, Use of Radar	5
Nautical Astronomy, Star Identification; Time	14
Complete Solution and Latitude Sights	8
Duties of Navigator, Voyage Planning	3
Practical Works	36
	80

METEOROLOGY

OBJECTIVE

To present suffcient theoretical and background knowledge concerning the subject of meteorology for interpretation of a weather map and weather conditions and to provide practical utilization of information so gained in application to ship and air operations.

COURSE DESCRIPTION

The first portion of this course is devoted to a study of the elements of the weather and the method of presentation of the weather elements on a weather map. This phase deals with the structure of the atmosphere, atmospheric heat processes, the evaporation-condensation cycle, and atmospheric pressure in relation to wind with the resulting primary, secondary, and local wind circulations. The second phase consists of a discussion of the air mass concept, the theory of fronts, the technique of weather map analysis, the phenomena of the tropical storm, and the inter-tropical front. The final phase covers selected basic principles of weather forecasting, weather application at sea, sources of weather information, and climatology. Practical-works utilized in the course are:

Plotting the station model

Interpreting a weather map

Drawing a weather map (embodies frontal and isobaric analysis)

Constructing a tropical storm danger sector diagram

Weather forcasting

Encoding a weather report.

Time allocated to various items of subject matter contained in course is as follows:

SYLLABUS	Hours
Structure of the Atmosphere; the Weather Elements; the Station Model; Atmospheric Heat Processes	2
The Evaporation Condensation Cycle; Weather Map Construction; Clouds; Atmospheric Pressure and Winds; Primary Winds, Secondary Winds, Local Winds	3
Air Masses and Fronts; Cyclone Structure and Movement; Weather Map Analysis; The Inter-tropical Front; Tropical Storms	5
Principles of Forecasting; Sources of Weather Information; Weather Application at Sea; Climatology	6
Total	16

SUBMARINES

OBJECTIVE

To provide a basic knowledge of the capabilities and limitations of submarines.

COURSE DESCRIPTION

The course covers the submarine force organization, construction and operation of submarines, new developments, and tactics, both offensive and defensive.

The above topics are covered in eight hours of class-room lecture. The students are given a three-hour trip on a submarine during which time they observe the activity at various stations in the boat.

SYLLABUS

	Hours
Submarine Construction	3
Submarine Tactics and New Developments	5
	8

NAVAL TACTICS

OBJECTIVE

To familiarize the student with basic tactical doctrines for surface ship formations and dispositions, for certain special purpose operations, and to develop student proficiency in the use of the maneuvering board.

COURSE DESCRIPTION

This course is presented by classroom lectures and practical works augmented by movies and other training aids. The student is advised at the outset of the course that insufficient time will be provided to insure complete proficiency in tactical operations on its completion, but that an adequate foundation is offered to the student upon which to build his proficiency through his own application and detailed study at a later time. The course commences with a treatment of maneuvering board fundamentals, on completion of which the student should have gained an adequate knowledge upon which to study more advanced types of maneuvering board problems which will be presented later. The second phase of the course consists of a detailed treatment of general tactical instructions as developed in ATP 1 with any necessary reference to USF 2 by which time the student should have a knowledge of the tactical rules applied in naval maneuvers. He will then proceed to study advanced maneuvering board problems and will follow this with detailed consideration of destroyer-type tactics, fast carrier force operations, surface action, and amphibious operations.

SYLLABUS

	Hours
Introduction to Course and Principles of War	1
Maneuvering Board	32
General Tactical Instructions	13
Screens	9
Scouting	9
Cruising Instructions	3
Destroyer Tactics	2
Carrier Task Force Instructions	10
Surface Action and Tactics	4
Amphibious Warfare	10
Mine Warfare	2
Naval Control of Shipping	1
	96

COMBAT INFORMATION CENTER and ANTI-SUBMARINE WARFARE

OBJECTIVE

To familiarize the student with current capabilities and limitations of shipborne Combat Information Center and anti-submarine warfare equipment; to acquaint the student with airborne Combat Information Center and anti-submarine warfare equipment, and to familiarize the student with their employment within the fleet.

COURSE DESCRIPTION

The course consists of 56 hours divided equally between anti-submarine warfare and Combat Information Center. The time is further divided between lectures and practical works with each receiving approximately the same number of hours. Throughout the course emphasis is placed on aircraft and shipboard organizations, capabilities and limitations of present day equipment, and a general understanding of fleet operational procedures and doctrine. The organization and duties of the Combat Information Center team and the anti-submarine warfare team are stressed. Procedures used in surface plotting, air plotting, air intercept control, radar navigation, shore bombardment, anti-submarine warfare attacks, and simulated task group operations are covered in both lectures and practical works. The basic theory, capabilities, and limitations of radar, surface and airborne submarine detection and attack equipments, electronic countermeasure and recognition systems are covered. Hunter-killer operations and the escort of convoy tactics are described in detail. Movies, training aids, and the equipment in mock-ups are used where applicable. The subjects are presented in the following order:

SYLLABUS

	Hours
Anti-Submaring Warfare Functions	9
Organization and Operation of ASW	5

Anti-Submarine Warfare Equipments; Practical Works	14
Combat Information Center Functions	9
Organization and Operation of CIC	5
CIC Equipment; Practical Works	14
	56

COMMUNICATIONS

OBJECTIVE

To acquaint the student with the relationship of communications to naval operation including the capabilities, limitations and functioning of naval communications and the responsibilities of command inherent thereto.

COURSE DESCRIPTION

The course is presented by classroom lectures and practical works. In all phases of the course, emphasis is placed on the importance of learning to use the reference texts or books correctly rather than memorizing the subject matter. Naval communication organization and functions including supervision of Navy post offices are described in detail. Standard communication procedure and doctrine for visual, radio telegraph and radio telephone procedure are stressed. Practical works are conducted in message drafting, visual signalling and voice-radio telephone procedure. The major aspects of security control, such as classification, custody, transmission, dissemination and security clearances are covered. The study of operational planning includes actual preparation by the students of sample operation plans, communication and frequency plans. Movies, where applicable, are used. The subjects are presented in the following order:

SYLLABUS

	Hours
Communication Organization and Procedures	20
Security of Classified Matter	6
Operational Planning Methods and Procedures	7
Basic Rapid Communication and Frequency Plans	7
	40

MATHEMATICS REVIEW

OBJECTIVE

To provide a review course in order to equip the student for studies and duties requiring knowledge and use of mathematics.

COURSE DESCRIPTION

This course covers enough of the fundamentals of mathematics up to, but not including, the calculus to provide background for all technical subjects to be studied in the line curriculum, the following topics being stressed: slide rule, roots, exponents, factoring, graphs, vectors, and trignometric functions.

SYLLABUS

	Hours
Slide Rule	1
Arithmetical Fundamentals	2
Algebraic Fundamentals	5
Equations, Graphs, Applications	6
Trigonometric Fundamentals	5
	19

MECHANICS REVIEW

OBJECTIVE

To provide a review course in order to equip the student for studies and duties requiring knowledge of and use of mechanics.

COURSE DESCRIPTION

This course covers basic units, velocity and acceleration, law of motion, power and energy, pressure and various types of forces.

SYLLABUS

	Hours
Unit and Laws of Motion	3
Power, Energy and Moment of Inertia	3
Miscellaneous Forces	2
	8

ELECTRICAL ENGINEERING

OBJECTIVE

To provide enough of the fundamentals of electrical circuits and machinery to aid the student in understanding the characteristics and operation of ship and aircraft electrical installations and equipment.

COURSE DESCRIPTION

Basic fundamentals of DC and AC circuits are studied as a preparation for the fields of electrical power, naval engineering, communications, CIC, and ordnance and gunnery; in DC and AC machinery, the students are acquainted with the operating characteristics of electrical equipment, such as shunt and compound generators, shunt, series, and compound motors, alternators, transformers, synchronous and induction motors. Laboratory exercises and problems are utilized wherever practicable.

SYLLABUS

	Hours
Resistance; Ohm's Law; Power, Energy; Voltage and Current	4
Voltmeter; Ammeter; DC Measurements	4

Magnetism; Electromagnetism; Inductance; Applications	4
Shunt Generator; Armature Reaction; Characteristics	4
Shunt, Series, and Compound Motor; Applications	4
Alternating Emf; AC Units; AC Power	4
RLC Circuits; Series Resonance	3
Parallel Circuits; AC Instruments	4
Polyphase Systems; Three Phase Power	4
Alternator; Characteristics; Applications	3
Transformers; Connections	2
Induction Motors; Synchronous Motors; Applications	5
	45

ELECTRONICS SURVEY

OBJECTIVE

To provide a survey of electronic devices in order to give the student an elementary knowledge of the fundamentals of electronics and associated equipment.

COURSE DESCRIPTION

This course, utilizing lectures and laboratory work, includes basic theory of electron emission and the operation of the principal common elements of electronic devices.

SYLLABUS

	Hours
The Atom and Electron Emission	1
Rectifiers, Amplifiers, and their uses	4
Oscillators, Transmitters, and Receivers	4
	9

NAVAL ENGINEERING

OBJECTIVES

To give the officer student a basic knowledge of the operation and maintenance of shipboard machinery installations and instruction in the proper administration of a ship's engineering department in order to prepare him for possible duties in the engineering department of a naval ship, or for duties as an executive officer or commanding officer.

COURSE DESCRIPTION

The Naval Engineering course consists of 48 hours of instruction for all officer students, and an additional 12 hours of instruction for non-aviators. The course covers the entire shipboard machinery installation with special emphasis being placed upon the main propulsion machinery, boilers, and auxiliaries associated with the boilers and propulsion machinery. In addition, distilling plants, diesel engines, refrigeration, electric power distribution and machinery outside of the regular engineering spaces are covered during the course. All instruction is of the lecture type. Extensive use is made of charts, drawings, sectionalized machinery, mock-ups and special training devices. Motion pictures, where applicable, are used throughout the course. The importance of safety precautions, check-off sheets and operating instructions is covered throughout the course. Engineering casualty control is emphasized. In so far as practicable, the instructors relate the material being taught to the experiences of the officer students.

SYLLABUS

Basic Course	Hours
Thermodynamics and the Eng. Plant	4
Boilers and Related Auxiliaries	9
Turbines and Related Auxiliaries	13
Fundamentals of Engineering Plant	8
Distilling Plants, Diesel Engines, Etc.	7
Electrical Installations	3
Administration and Operational Procedures	4
	48

Augmented Course	
Organization, Records and Reports	3
Gyro Compass and Degaussing	3
Control Instruments	2
Engineering Trends and Developments	3
Compressed Air Systems	1
	12

DAMAGE CONTROL

OBJECTIVES

To give the officer student a basic knowledge of the principles of damage and casualty control, stability of ships, radiological defense, biological warfare defense and chemical warfare defense; to instruct the officer student in the methods of operation, administration and maintenance of the Damage Control Department, and material assigned to it.

COURSE DESCRIPTION

The Damage Control basic course is divided into three parts: shipboard organization and the material preparedness for damage and casualty control; the principles of stability of ships and analysis of impaired stability with corrective measures necessary to restore stability; radiological, biological and chemical defense. The entire course of instruction of these parts of the course covers 48 hours, with all officer students receiving 4 hours of instruction per week for 12 weeks. Non-aviators are given an additional 12 hours of instruction, consisting of 1 hour of instruction per week. All instruction is of the lecture type. Extensive use is made of charts, drawings, models, and motion pictures. Administration of a damage control organization and its proper functioning is emphasized. Required shipboard records and procedures such as weight and moment book, hull reports, etc., are covered throughout the course.

SYLLABUS

Basic Course	Hours
Introduction to Damage Control	1
Nomenclature	1
Stability and Buoyancy	14
Analysis of Damage and Corrective Measures	5
Practical Damage and Casualty Control	8
Gas, Biological and Radiological Warfare Defense	19
	48

Augmented Course	
Warship Construction and Design, Material Upkeep	2
Stability	4
Analysis of Stability	3
Nucleonics, Radiological Warfare, Etc.	3
	12

ORDNANCE AND GUNNERY

OBJECTIVES

To present a course in Ordnance and Gunnery, including surface, air, and underwater aspects in order to prepare the officer student for duties directly or indirectly involving armament and its utilization.

COURSE DESCRIPTION

The course is presented to the student by classroom lectures, supplemented by the use of textbooks and pamphlets, motion pictures, and classroom training aids. The basic course of 56 hours is given to all students, and covers the theory of the naval gunfire control problem and its application in certain fundamental fire control systems; the various types of naval shipboard and aircraft armament and its control; the care and handling of ammunition, safety precautions, and the organization and administration of the shipboard gunnery department. The inspection and observation in operation, of guns and fire control installations is afforded the student during a short cruise aboard ship. Atomic weapons are covered by a series of special lectures.

An augmented course of 24 hours for non-aviators is designed to offer instruction in and provide discussion time for the consideration of the duties of the gunnery officer afloat.

Problems concerning the precommissioning period, commissioning, shakedown, the training cycle and the regular navy yard overhaul are discussed. The situation is that of an average gunnery officer successfully meeting the problems in a typical combatant ship organization.

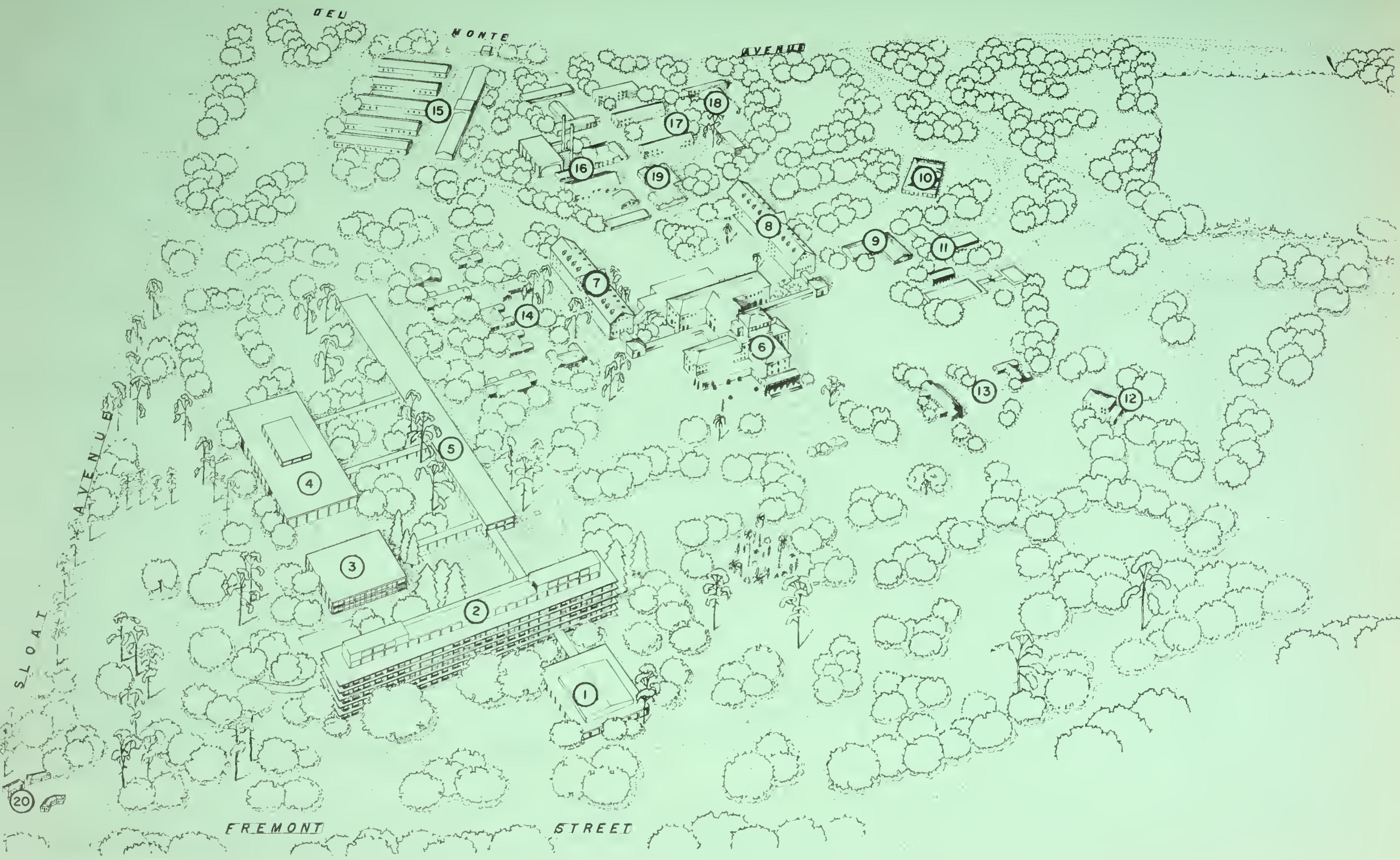
SYLLABUS

Basic Course	Hours
Introduction to Ordnance and Gunnery	1
Ammunition and Safety Precautions	6
Guns and Assemblies	9
Elements of Fire Control	7
Fire Control Systems and Equipment	4
Employment of Shipboard Fire Control Systems	5
Underwater Ordnance	5
Aviation Ordnance	5
Rockets and Guided Missiles	5
Organization, Administration and Training	3
Examinations and Practictl Work	6
	56

Augmented Course	
Precommissioning Problems of the Gunnery Officer	2
Gun Mounts and Directors	2
Planning of the Training Program	2
Safety Precaution Instructions	1
Ammunition Handling Instructions	1
Landing Party Organization	1
Battery Alignment Problems	3
Formal Shipboard Inspections	3
Spotting Procedure and Drill	1
Required Exercises and Reports	1
Computation of Initial Ballistics	2
Post Firing Analysis	2
Yard Overhaul Preparations	1
Small Arms	1
Pistol Range	1
	24

Index to Buildings at U. S. Naval Postgraduate School

1. Lecture Hall, Building No. 237
2. Electronics, Physics, Chemistry, Metallurgy, and Aerology, Building No. 232
3. Electrical Engineering, Building No. 233
4. Mechanical and Aeronautical Engineering, Building No. 234
5. Mathematics, Drafting Classrooms, Building No. 235
6. Administration, Open, Closed and General Mess, BOQ, Building No. 220
7. Administrative Offices General Line School and BOQ, Building No. 222
8. Postgraduate School Laboratories and Offices, Building No. 221
9. Powers Hall, Academic Classrooms, Building No. 300
10. Fleming Hall, Academic Classrooms, Building No. 301
11. Dressing Rooms and Solarium, Recreation, Buildings No. 209, No. 210
12. Superintendent's Quarters, Quarters A
13. Married Officers' Quarters, Quarters M, L, and K
14. Married Officers' Quarters, Quarters B through J and N
15. Interim Laboratories, Buildings No. 223 through No. 229
16. Public Works Shops and Power Plants
17. Enlisted Men's Barracks
18. Criscuolo Hall, Recreation, EM, Building No. 211
19. Aerology Classrooms, Building No. 206
20. Navy Exchange Service Station, Buildings, No. 407, No. 408 and No. 409



DEL MONTE AVENUE
SLOAT AVENUE
FREMONT STREET
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