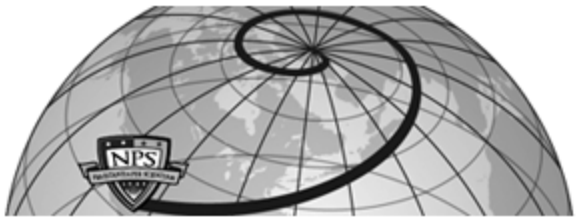

NAVPERS 15779

Catalogue of

UNITED STATES NAVAL POSTGRADUATE SCHOOL

ACADEMIC YEAR 1951-1952

POSTGRADUATE SCHOOL, ANNAPOLIS, MARYLAND

NAVPERS 15779

UNITED STATES NAVAL POSTGRADUATE SCHOOL

JUNE 1951 CATALOGUE
ACADEMIC YEAR 1951-1952

A Bulletin of Information
About the School, Its Staff, Regulations, Missions,
Regulations Governing Awarding of Degrees,
Curricula and Course Description

UNITED STATES GOVERNMENT PRINTING OFFICE, WASHINGTON, D. C., 1951

UNITED STATES NAVAL POSTGRADUATE SCHOOL CATALOGUE

1951-1952

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U. S. NAVAL POSTGRADUATE SCHOOL, 1951-1952

Rear Admiral Ernest Edward Herrmann, U. S. Navy,
Superintendent, U. S. Naval Postgraduate School.

Roy Stanley Glasgow, B.S., M.S., E.E., Academic Dean,
U. S. Naval Postgraduate School.

C A L E N D A R

ACADEMIC CALENDAR FOR 1951-1952

	1951
Registration Begins	July 5
First Term Begins	July 9
Labor Day (Holiday)	Sept 3
First Term Ends	Sept 14

Remainder of calendar will be published when the present plan to move the School to Monterey, California is completed.

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MILITARY STAFF

ERNEST EDWARD HERRMANN, Rear Admiral U. S. N.
Superintendent

HARVEY THOMAS WALSH, Capt. U. S. N.
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Administration

RICHARD DRURY HARWOOD, Cdr. U. S. N.
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FREEMAN MARVILLE JONES, LCdr. U. S. N. R.
Assistant Administrative Officer

LEWIS STANLEY HELMECI, Lt. U. S. N.
Communications Officer

BASIL THOMAS MORRISON, Lt. U. S. N.
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Aeronautical Engineering Curricula

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GEORGE ROBERT GIET, A. B., E. E.
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General Line School

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Naval Engineering Curricula

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Associate Professor of Electrical Engineering

Ordnance Engineering Curricula

RICHARD CARVEL HENSEN WHEELER, B. E., D. Eng.
Professor of Electrical Engineering

POSTGRADUATE SCHOOL PROGRAM

The general plan for officer education is set forth in the Bureau of Naval Personnel Manual, 1948, Part D, Section 3, portions of which are quoted below for information:

D-1301

(1) Functions. --The Postgraduate School, with headquarters at the Naval Academy, Annapolis, is established for maintaining courses in instruction for the advanced education and training of commissioned officers in such general or technical subjects as the Secretary of the Navy may prescribe. Postgraduate courses are conducted both at the Postgraduate School and at private institutions. Whether conducted at the Postgraduate School or elsewhere, all postgraduate courses are under the cognizance of and directed by the Superintendent of the Postgraduate School.

(3) Selection of Officers. --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 circular letters.

(6) Postgraduate School Catalogs. --Detailed information relative to the curriculum for each postgraduate course is given in the annual postgraduate school catalog. This catalog is given wide distribution and should be studied by officers interested in postgraduate training.

MISSION

The mission of the Naval Postgraduate School, as defined in the Basic Naval Establishment Plan of the U. S. Navy Department, is: to conduct and direct the advanced instruction and training of commissioned officers in practical and theoretical duties in order to meet the requirements of the Navy.

TASK

1. To provide the advanced education necessary for selected groups of officers to develop proficiency in design, inspection and installation of material, with attendant research problems, and to provide practical and theoretical instruction necessary for officers to serve in special branches of the Naval service by:

(a) Planning, conducting and maintaining suitable postgraduate courses at the U. S. Naval Postgraduate School and at selected institutions.

(b) Organizing, planning and directing General Line School Curricula at Newport, Rhode Island, and Monterey, California.

(c) Organizing, planning and directing the conduct of a naval intelligence course at Naval School (Naval Intelligence), Receiving Station, Washington, D. C.

THE REGULATIONS GOVERNING THE NAVAL POSTGRADUATE SCHOOL

The Naval Postgraduate School was established in 1909 as an activity of the U. S. Naval Academy by direction of the Navy Department. The increasing emphasis placed on the advanced technical instruction of naval officer personnel by the Navy Department, during the past several years, is reflected by the passage of three acts of Congress affecting the academic and physical stature of the Postgraduate School. These three acts authorized the School to grant advanced degrees in engineering and related fields, created the civilian position of Academic Dean and established the Naval Postgraduate School as a separate naval activity.

The first act passed by Congress, designed to emphasize the academic level of the School, was Public Law 250, 79th Congress, 1st Session. This act authorized the School to confer Master's and Doctor's degrees in engineering and related subjects. Although this authority was not exercised for two years after passage of the act, suitable courses of study were instituted as rapidly as possible. Public Law 402, 79th Congress, 2nd Session, created the civilian position of Academic Dean. This position was established to insure continuity of academic policy. Public Law 303, 80th Congress, 1st Session authorized the School to confer the Bachelor of Science degree in engineering and related subjects.

The Naval Postgraduate School was established as a separate naval activity by Public Law 303, 80th Congress, 1st Session. This act authorized the Secretary of the Navy to establish the School for the advanced instruction of commissioned officers of the Navy and Marine Corps. The military command of the School was vested in an officer of the Regular Navy, not below the rank of captain, to be appointed by the Secretary of the Navy, to serve as Superintendent. The Secretary of the Navy was also authorized to employ at the School, under the direction of the Superintendent, a civilian faculty of adequate size to meet the objective of the School. The two previous acts were amended to apply to the newly redesignated Naval Postgraduate School.

In addition to the School at Annapolis, which is primarily for engineering student officers, the Superintendent is responsible for an Intelligence School in Washington, D. C. and General Line Schools at Newport, R. I. and Monterey, Calif.

REGULATIONS GOVERNING THE AWARD OF DEGREES

1. As authorized by the provisions of Public Law 303, the Superintendent of the Naval Post-

graduate School was authorized to confer Bachelor of Science degrees in engineering and related fields "Pursuant to such regulations as the Secretary of the Navy may prescribe ---- upon due accreditation --- by the appropriate professional authority". On 19 December 1949, the Naval Postgraduate School was informed by the Engineers Council for Professional Development, Region IV Committee on Engineering Schools, that the following curricula were accredited: Aeronautical Engineering, Electrical Engineering (including option in Electronics) and Mechanical Engineering. On 26 April 1950, the Secretary of the Navy approved the regulations governing the award of the Bachelor of Science degree by the Naval Postgraduate School, and established the policy to limit the award of these degrees to those student officers enrolled on or subsequent to 31 July 1947.

2. The regulations governing awards of graduate degrees were approved by the Acting Secretary of the Navy on 18 July 1949. The Master's or Doctor's degrees in engineering or related fields may be awarded by the Superintendent of the Naval Postgraduate School upon the recommendation of the faculty based upon the satisfactory completion of a course of advanced study arranged by a Curriculum Committee, approved by the Academic Council (consisting of the Academic Dean, the Director of the School of Engineering and the Civilian Chairmen of the Academic Departments).

3. The Regulations governing the award of Bachelor of Science degrees and graduate degrees are as follows.

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 approved 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 successfully 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 chairman 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 ordinarily not given 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 Doctorate Committee will propose a further program of study. 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 dissertations. 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 examinations in his major and minor subjects. Written examinations will be conducted by the department having cognizance of the particular subjects. The occasions and scope of all examinations 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.

REQUIREMENTS FOR THE MASTER'S 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 education 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 forty-eight 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 comprise 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 to recommend the candidate to the Superintendent of the Naval Postgraduate School for the award of the Master's Degree.

REQUIREMENTS FOR THE BACHELOR'S DEGREE

(a) The bachelor's degree in engineering or other scientific fields may be awarded for the 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 deficiencies 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 to recommend the candidate to the Superintendent of the Naval Postgraduate School for the award of the Bachelor's degree.

LIBRARY FACILITIES

The Library of the Naval Postgraduate School, primarily a scientific and technical collection, includes the Reference Library at Annapolis, Maryland, and a branch at Monterey, California. The Reference Library contains 15,000 books and bound periodicals, 25,000 technical research reports, subscribes to 360 current periodicals, and is a selective depository for United States Government publications. In addition to the Reference Library, there is a Text Library containing 24,000 volumes, mainly textbooks and related materials available to students for loans of term duration. The branch library at Monterey, serving the General Line School and the Aerological Engineering Department, contains a large collection of books, periodicals, and government publications applicable to that phase of instruction.

The Library furnishes reference loan service to students, faculty, and administrative staff from 8:00 A.M. to 4:30 P.M., and is open from 8:00 to 11:00 P.M. for study, unassisted research, and loan service, Monday through Friday. Saturday hours, for the latter type of service, are 8:00 A.M. to 12:00 noon.

Interlibrary loan service is provided to all persons connected with the School to secure any publications not owned by the Reference Library. Microfilm service is also available.

SCHOLARSHIP STANDARDS

(1) Student officers enrolled in the Naval Postgraduate School will be rated academically by quality points attained, and this rating will be determined in the following manner:

Grade	Quality Points
A	3.0
B	2.0
C	1.0
D	0
X	-1.0

Quality point rating shall be calculated by dividing the sum of the products of assigned quality points and credit hours in each course by the total number of credit hours obtained. Each one-hour lecture or recitation period per week of each two-hour laboratory or practice work period will count as one credit hour.

(2) The status 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

(3) 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 semester credit-hour.

CURRICULA DESIGNATIONS

Curricula given at or commencing at the Naval Postgraduate School:

With the exception of those for the General Line Schools, all curricula given at or commencing at the Naval Postgraduate School are shown below. All are given at the Naval Postgraduate School, Annapolis, unless otherwise indicated. A group designation containing the numeral 2 indicates the second year of instruction; the numeral 3 indicates the third year.

Curriculum	Length	Group Designation
AEROLOGY (All curricula given at Postgraduate School, Monterey)		
Aerological Engineering (Last and final input to this curriculum was in August 1950)	2 yrs.	M2
Aerological Engineering (Special) (Last and final input to this curriculum was in January 1951)	18 mo.	MW2
Aerological Engineering (Initial input to this curriculum in August 1951)	18 mo.	MS, MS2
Aerology	1 yr.	MA
AERONAUTICS		
Aeronautical Engineering The third year for general aeronautical engineering is at the University of Michigan	2 yrs., 3 yrs.	A, AG, A2
Some students specialize in third year as follows:		
Compressibility. Cal. Tech.		AC3
Flight Analysis. Princeton		AF3
Seaplane Hydro. Dyn. N.Y.U. & Stevens Inst.		AH3
Jet Propulsion. Cal. Tech. & U. of Minn.		AJ3
Propulsion Systems. M.I.T.		AP3
Structures. Cal. Tech. & U. of Minn.		AS3
Gas Turbines. R.P.I.		AT3
Aeronautical Engineering (Electrical)	2 yrs., 3 yrs.	AE, AE2, AE3
Aeronautical Engineering (Armament) The third year at M.I.T.	2 yrs., 3 yrs.	AR, AR2 AR3
COMMUNICATIONS		
Communications	1 yr.	C
ELECTRONICS		
Electronic Engineering Sonar students spend third year at U.C.L.A.	3 yrs.	E, E2, E3 EW3
CHEMICAL ENGINEERING		
1951-1953 group	2 yrs.	NC, NC2
1951-1954 group Third year of the 3 year curriculum is at Lehigh University.	3 yrs.	NC, NCA2, NCA3
ELECTRICAL ENGINEERING		
Groups prior 1951	3 yrs.	NL, NL2, NL3
1951-1952 group	2 yrs.	NL, NL2
1951-1953 group	3 yrs.	NL, NLA2, NLA3

CURRICULA DESIGNATIONS —Continued

Curriculum	Length	Group Designation
GAS TURBINES		
The third year at M. I. T.	3 yrs.	NJ, NJ2, NJ3
MECHANICAL ENGINEERING		
Groups prior 1951	3 yrs.	NH, NH2, NH3
1951-1952 group	2 yrs.	NH, NH2
1951-1953 group	3 yrs.	NH, NHA2, NHA3
METALLURGICAL ENGINEERING		
1951-1953 group	2 yrs.	NM, NM2
1951-1954 group	3 yrs.	NM, NMA2, NMA3
The third year at Carnegie Inst. of Technology.		
NAVAL ENGINEERING (Applied)		
1950-1952 group only	2 yrs.	NA, NA2
PETROLEUM ENGINEERING		
1951-1953 group	2 yrs.	NP, NP2
1951-1954 group	3 yrs.	NP, NPA2, NPA3
The third year at Univ. of California		
ORDNANCE		
Ordnance Engineering (General)	2 yrs.	O, O2,
The third year at M. I. T. for selected students		O3
Ordnance Engineering (Jet Propulsion)	3 yrs.	OJ, OJ2, OJ3
The third year at Cal. Tech.		
Ordnance Engineering (Metallurgy)	3 yrs.	OM, OM2, OM3
Available Summer 1951 and alternate years thereafter.		
The third year at Carnegie Tech.		
Ordnance Engineering (Chemical)	3 yrs.	OP, OP2, OP3
Available Summer 1951 and alternate years thereafter.		
The third year at Lehigh Univ.		
Ordnance Engineering (Special Physics)	3 yrs.	OX, OX2, OX3
The second and third year at M. I. T.		
ADVANCED SCIENCE		
Advanced Science (Mathematics)	3 yrs.	RM, RM2, RM3
The second and third year at a selected university.		
Advanced Science (Chemistry)	3 yrs.	RC, RC2, RC3
The second and third year at a selected university.		
Advanced Science (Physics)	3 yrs.	RX, RX2, RX3
The second and third year at a selected university.		

CURRICULA DESIGNATIONS —Continued

Curriculum	Length	Group Designation
OPERATIONS ANALYSIS		
Operations Analysis Field work during last six months under direction of ComOpDevFor.	2 yrs.	RO, RO2
RADIOLOGICAL DEFENSE		
Radiological Defense The second and third years at the Univ. of Calif. or at Ohio State	3 yrs.	RZ, RZ2, RZ3

OFFICIALS IN CHARGE OF THE PRESENTATION OF CURRICULA OF POSTGRADUATE STUDENT OFFICER GROUPS AT UNIVERSITIES

Group	University	In Charge
A3 Aero. Eng.	Univ. of Michigan	Prof. E. W. Conlon
AF3 Aero. Eng.	Princeton	Prof. C. D. Perkins
AH3 Aero. Eng.	N.Y.U.	Prof. F. K. Teichmann
	Stevens Inst. of Tech.	Prof. B. K. Erdoss
AC3 Aero. Eng.	Cal. Tech.	Prof. E. E. Sechler
AJ3 Aero. Eng.	Cal. Tech.	Prof. E. E. Sechler
AJ3 Aero. Eng.	U. of Minn.	Prof. J. D. Akerman
AS3 Aero. Eng.	Cal. Tech.	Prof. E. E. Sechler
AS3 Aero. Eng.	U. of Minn.	Prof. J. D. Akerman
AJ3 Aero. Eng.	Univ. of Minn.	Prof. J. D. Akerman
AP3 Aero. Eng. Prop. Syst.	M.I.T.	Prof. C. F. Taylor
AR3 Aero. Eng. Arm.	M.I.T.	Prof. J. S. Newell
AT3 Aero. Eng. (Gas Turb.)	R.P.I.	Prof. N. P. Bailey
EW3 Electronic Eng.	U.C.L.A.	Prof. V. O. Knudson
NB Const. Eng.	M.I.T.	C.O., N.T.S.
NB Const. Eng.	Webb. Inst.	Capt. N. W. Gokey, U.S.N. (Ret.)
NC Chemical Eng.	Lehigh.	Dean H. A. Neville
NJ Gas Turbine	M.I.T.	C.O., N.T.S.
NM Metallurgical Eng.	Carnegie Tech.	Asso. Prof. J. W. Ludewig
NP Petroleum Eng.	Univ. of Calif.	Prof. L. C. Uren
O3 Ord. Eng. General	M.I.T.	Prof. C. S. Draper
OJ3 Ord. Jet Prop.	Cal. Inst. Tech.	Prof. E. E. Sechler
OM3 Ord. Metallurgy	Carnegie Tech.	Asso. Prof. J. W. Ludewig
OP3 Ord. Chemical	Lehigh	Dean H. A. Neville
OX2, OX3 Ord. Sp. Physics	M.I.T.	Prof. N. H. Frank
RZ2, RZ3 Radiological Defense Eng.	Univ. of Calif.	Prof. Loeb
RZ2, RZ3 Radiological Defense Eng.	Ohio State	Prof. Poole
ZCP Cinematography	Univ. of So. Calif.	P.N.S.
ZCR Photography	Roch. Inst. Tech.	P.N.S., U. of Rochester
ZG Civil Eng.	R.P.I.	P.N.S.
ZH Law	Catholic U.	Office of JAG
ZH Law	Georgetown U.	Office of JAG
ZH Law	George Washington U.	Office of JAG
ZI Naval Intelligence	Anacostia, D. C.	Director, U.S. NavScol. (NavInt.)
ZK Advanced Management	Harvard	P.N.S.
ZKP Advanced Management	Univ. of Pitts.	Prof. E. C. Stone
ZKC Business Admin.	Columbia	P.N.S.
ZKH Business Admin.	Harvard	P.N.S.
ZKS Business Admin.	Stanford	P.N.S.
ZL Petroleum Eng.	Univ. of Pitts.	Prof. Botset
ZM Textile Eng.	Georgia Tech.	P.N.S.
ZO Oceanography	Scripps Inst.	P.N.S., U.C.L.A.
ZP Personnel Admin. & Tr.	Ohio State	P.N.S.
ZP Personnel Admin. & Tr.	Stanford	P.N.S.
ZS Comptrollership	George Washington U.	Dean A. E. Burns
ZT Management & Industry	R.P.I.	P.N.S.
ZU Religion	Various	----------

PART II

CURRICULA FOR STUDENT OFFICERS COMMENCING POSTGRADUATE INSTRUCTION AT THE NAVAL POSTGRADUATE SCHOOL, ANNAPOLIS, UNLESS OTHERWISE NOTED

Descriptive name of course is followed by two numbers, separated by a hyphen. The first number is classroom hours, the second laboratory hours.

THE STATUS 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 semester credit-hour.

AEROLOGICAL ENGINEERING CURRICULA

M - groups

(Given at Monterey, Calif.)

Objective

To prepare officers:

(a) To become competent aerological officers,
(b) To improve the methods of forecasting weather,
(c) To investigate and participate in the solution of any problems involving atmospheric conditions such as (1) visibility (2) turbulence (3) aircraft icing (4) ballistic winds and densities (5) micro-meteorology, etc.

FIRST YEAR - M

First Term

Ma-101 (C)	Ord. Differential Equations	5-0
Mr-211 (C)	Weather Maps and Codes	2-6
Ph-196 (C)	General Physics	5-1
La-101 (C) 201 (C)	German or Russian	2-0
		14-7

Second Term

Ma-102 (C)	Series & Vector Algebra	5-0
Mr-212 (C)	Surface Weather Map Analysis	1-12
Mr-210 (C)	Introduction to Synoptic Meteorology	5-0
La-102 (C) 202 (C)	German or Russian	2-0
		13-12

Third Term

Ma-103 (B)	Funct. of Sev. Var. & Vect. Anal.	5-0
Mr-213 (C)	Map Analysis and Forecasting	0.9
Mr-411 (B)	Thermodynamics of Meteorology	5-2
Mr-510 (C)	Climatology	2-0
La-103 (C) 203 (C)	German or Russian	2-0
*SL-101	New Weapons Development	0-1
		14-12

Fourth Term

Ma-134 (A)	Vector Mechanics and Partial Differential Equations	4-0
Mr-214 (C)	Weather Analysis and Forecasting	2-9
Mr-321 (A)	Dynamic Meteorology I	3-0
Mr-412 (A)	Physical Meteorology	3-0
La-104 (C) 204 (C)	German or Russian	2-0
*SL-102	New Weapons Development	0-1
		14-10

*Lecture course-no academic credit.
Intercessional Field Trip

SECOND YEAR - M 2

First Term

Ma-135 (C)	Numerical Methods and Introduction to Statistics	4-0
Mr-221 (B)	Weather Analysis and Forecasting	2-9
Mr-228 (A)	Southern Hemisphere and Tropical Meteorology	2-0
Mr-322 (A)	Dynamic Meteorology II	3-0
La-105 (C) 205 (C)	German or Russian	2-0
		13-9

Second Term

Ma-331 (A)	Statistics	4-2
Mr-222 (B)	Weather Analysis & Forecasting	0-12
Mr-229 (A)	Selected Topics in Applied Meteorology	2-0
Mr-323 (A)	Dynamic Meteorology III (Turbulence & Diffusion)	3-0
La-106 (C) 026 (C)	German or Russian	2-0
		11-14

AEROLOGICAL ENGINEERING (Continued)

SECOND YEAR - M 2 (Continued)

Third Term

Mr-223 (B)	Advanced Weather analysis and Forecasting	0-9
Mr-410 (C)	Meteorological Instruments	2-2
Mr-420 (A)	Wave, Swell & Surf Forecasting	2-0
Mr-422 (A)	The Upper Atmosphere	5-0
*Mr-921 (A)	Thesis	2-0
La-107 (C) 207 (C)	German or Russian	2-0
#SL-101	New Weapons Development	0-1
		11/13-12

Fourth Term

Mr-110 (C)	Radiological Defense	2-0
Mr-224 (B)	Advanced Weather Analysis and Forecasting	0-15
Mr-225 (B)	Upper Air Analysis	0-10
!Mr-810 (C)	Seminar	2-0
*Mr-922 (A)	Thesis	4-0
La-108 (C) 208 (C)	German or Russian	2-0
#SL-102	New Weapons Development	0-1
		6/8-26

#Lecture course - no academic credit.
*Taken only by candidates for the master's degree.
! Omitted by candidates for the master's degree.

AEROLOGY CURRICULA

MA - group

(Given at Monterey, Calif.)

Objective

To prepare officers to become competent aerological officers.

ONE YEAR - MA

First Term

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

Second Term

Ma-162 (C)	Introduction to Calculus	5-0
Mr-202 (C)	Surface Weather Map Analysis and Forecasting	2-12
Mr-301 (C)	Synoptic Meteorology I	5-0
Mr-402 (C)	Meteorological Charts and Diagrams	3-0
	Total	15-12

Third Term

Mr-203 (C)	Weather Analysis and Forecasting	2-12
Mr-302 (C)	Synoptic Meteorology II	5-0
Mr-410 (C)	Meteorological Instruments	2-2
Mr-403 (C)	Physical Meteorology	4-0
*SL-101	New Weapons Development.	0-1
	Total	13-15

Fourth Term

Mr-110 (C)	Radiological Defense	2-0
Mr-204 (C)	Advanced Weather Analysis and Forecasting	0-15
Mr-205 (C)	Upper Air Analysis	0-10
Mr-404 (C)	Wave, Swell and Surf Forecasting	1-2
*SL-102	New Weapons Development	0-1
	Total	3-28

*Lecture course - no academic credit.

AEROLOGICAL ENGINEERING (Continued)

SPECIAL AEROLOGICAL ENGINEERING CURRICULA

MW - Groups

Objective

To permit specially selected aerological officers who have previously completed a short war-time curriculum:

(a) To acquire the necessary theoretical and practical training for advanced work in the field of meteorology.
(b) To acquaint these officers with the latest developments in meteorology and special weapons.
(c) To give these officers an opportunity to qualify for a Master of Science degree.

*Third Term

Ma-103 (B)	Funct. of Sev. Var. & Vect. Anal.	5-0
Mr-411 (B)	Thermodynamics of Meteorology	5-2
Mr-510 (C)	Climatology	2-0
#SL-101	New Weapons Development	0-1
		12-3

Fourth Term

Ma-134 (A)	Vector Mechanics and Partial Differential Equations	4-0
Mr-214 (C)	Weather Analysis and Forecasting	2-9
Mr-321 (A)	Dynamic Meteorology I	3-0
Mr-412 (A)	Physical Meteorology	3-0
#SL-102	New Weapons Development.	0-1
		12-10

SECOND YEAR

First Term

Ma-135 (C)	Numerical Methods & Introduction to Statistics	4-0
Mr-221 (B)	Weather Analysis & Forecasting	2-9
Mr-228 (A)	Southern Hemisphere & Tropical Meteorology	2-0
Mr-322 (A)	Dynamic Meteorology II	3-0
		11-9

Second Term

Ma-331 (A)	Statistics	4-2
Mr-222 (B(	Weather Analysis & Forecasting	0-12
Mr-229 (B)	Selected Topics in Applied Meteorology	2-0
Mr-323 (A)	Dynamic Meteorology III (Turbulence and Diffusion).	3-0
		9-14

Third Term

Mr-223 (B)	Advanced Weather Analysis & Forecasting	0-9
Mr-420 (A)	Wave, Swell and Surf Forecasting	2-0
Mr-422 (A)	The Upper Atmosphere	5-0
Mr-921 (A)	Thesis	2-0
#SL-101	New Weapons Development	0-1
		9-10

Fourth Term

Mr-110 (C)	Radiological Defense	2-0
Mr-224 (B)	Advanced Weather Analysis & Forecasting	0-15
Mr-225 (B)	Upper Air Analysis	0-10
Mr-922 (A)	Thesis	4-0
#SL-102	New Weapons Development	0-1
		6-26

*Curriculum begins in January.
#Lecture course - no academic credit.

AEROLOGICAL ENGINEERING (Continued)

AEROLOGICAL ENGINEERING CURRICULA

MS - groups

(Given at Monterey, Calif.)

Objective

To provide for selected aerological officers who have completed the aerology curriculum and have served approximately three years in aerological billets:

(a) To acquire the necessary theoretical and practical training for advanced work in the field of meteorology.
(b) To acquire a working knowledge of the latest advances in meteorology and related subjects.
(c) To qualify for a Master of Science degree.

FIRST YEAR - MS

First Term			Second Term		
Ma-131 (C)	Algebraic Eq. & Series	3-0	Ma-103 (B)	Functions of Several Var. & Vect. Anal.	5-0
Ma-132 (C)	Topics in Eng. Math.	5-0	Mr-228 (A)	Southern Hemisphere & Trop. Meteorology	2-0
Mr-520 (B)	Climatology & Oceanography	3-0	Mr-411 (B)	Thermo. of Met.	5-2
Ph-191 (C)	Review of Gen. Physics ...	4-0	Mr-412 (A)	Phys. Met.	3-0
	Total	15-0		Total	15-2

Third Term			Fourth Term		
Ma-134 (B)	Vect. Mech. & Intr. to Statistics	5-0	Ma-331 (A)	Statistics	4-2
Mr-226 (B)	Adv. Weather Anal. & Forecasting	2-9	Mr-227 (B)	Upper Air Anal. & Forecasting	2-9
Mr-229)A)	Selected Topics in Applied Meteorology	2-0	Mr-322 (A)	Dynamic Met. II	3-0
Mr-321 (A)	Dynamic Met. I	3-0	Mr-921 (A)	Thesis I	3-0
*SL-101	New Weapons Develop.	0-1	*SL-102	New Weapons Develop.	0-1
	Total	12-10		Total	12-12

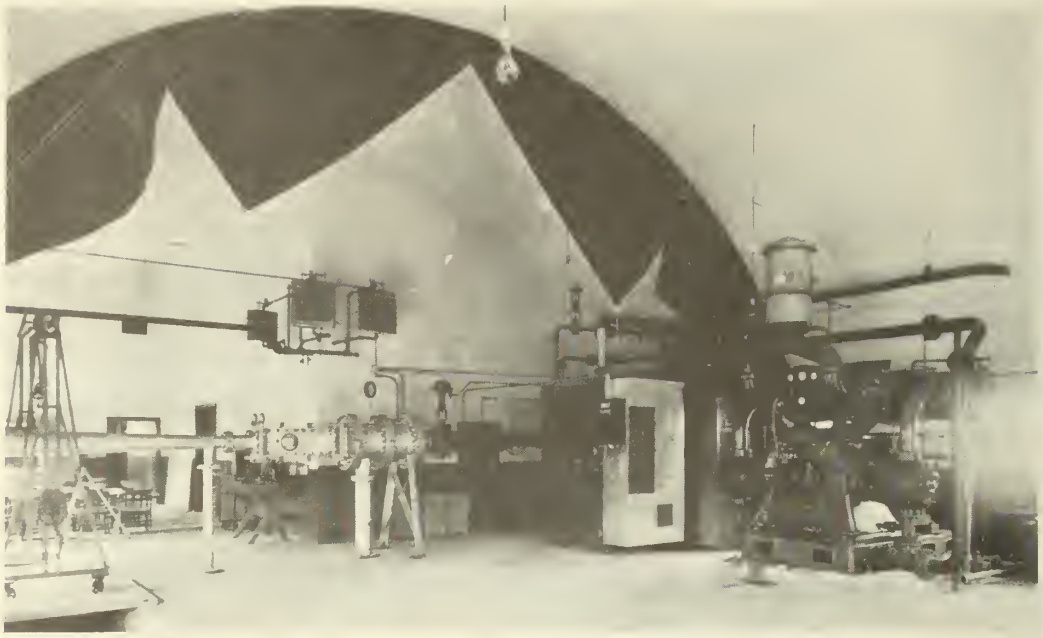
Thesis preparation during Intersessional Field Trip period. (Six Weeks)

*Lecture course - no academic credit.

SECOND YEAR - MS2

First Term			Second Term		
Ma-135 (B)	Part. Diff. Eq. & Numerical Methods	4-0	*Mr-110 (C)	Radiological Def.	2-0
Mr-323 (A)	Dynamic Met. III ..... (Turbulence & diffusion) ...	3-0	*Mr-420 (A)	Wave & Swell Forecasting.	2-1
Mr-422 (A)	The Upper Atmosphere	5-0	Mr-230 (A)	Operational Forecasting ...	0-10
Mr-922 (A)	Thesis II	3-0	Mr-810 (A)	Seminar	2-0
			Mr-923 (A)	Thesis III	3-0
	Total	15-0		Total	9-11

*Only for students who have not already completed courses in these subjects.



Supersonic Wind Tunnel with Associated Equipment,
U. S. Naval Postgraduate School, Annapolis, Maryland.

AERONAUTICAL ENGINEERING CURRICULA

Objective

The general objective of the aeronautical engineering curricula is 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, electricity, metallurgy, structural analysis, aerodynamics and dynamics as they concern the particular field of aeronautical engineering, aeronautical armament, and aeronautical electricity.

These curricula consist of two years of study at the Naval Postgraduate School, the last term of which is spent in a performance and test flight program at a Naval Air Station. 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, pilotless aircraft, aircraft performance, as well as general aeronautical engineering. Satisfactory completion of any curricula normally leads to the award of a graduate degree in aeronautical engineering.

AERONAUTICAL ENGINEERING, GENERAL

FIRST YEAR (A) GROUPS ENTERING 1951.

First Term			Second Term		
Ma 151(C)	Introd. to Eng. Math.	4-0	Ma 152(B)	Diff. Eq. and Boundary Problems	4-0
Mc 101(C)	Engeering Mechanics I	3-0	Mc 102(C)	Eng. Mechanics II	3-0
Ae 200(C)	Rigid Body Statics of Aircraft	3-2	Ae 211(C)	Stress Analysis I	4-0
Ch 121(B)	Gen. & Pet. Chemistry ...	4-2	Ae 100(C)	Basic Aerodynamics	3-4
Mt 201(C)	Intro. Physical Met.	3-2	Mt 202(C)	Ferrous Metals	3-2
			ME 601(C)	Materials Testing Lab	0-2
			Ae 001	Lecture, Aero.	- -
	Total	17-6		Total	17-8

AERONAUTICAL ENGINEERING (Continued)

FIRST YEAR (A) GROUPS ENTERING 1951 (Continued)

Third Term			Fourth Term		
Ma 153(B)	Vect. Anal. & Intro. to Part. Diff. Eq	3-0	Ma 154(A)	Par. Diff. Eq. & Functions of a Complex Variable	3-0
Ae 212(C)	Stress Analysis II	4-2	Ae 213(B)	Stress Analysis III	4-2
Ae 121(C)	Technical Aerodynamic	3-2	Ae 131(C)	Aerodynamic Performance.	4-2
Mt 203(B)	Physical Metallurgy	2-2	ME 131(C)	Eng. Thermodynamics	4-2
Ma 201(C)	Graph. & Mech. Comp	0-2	EE 351(C)	D.C. Machinery	2-2
EE 111(C)	Fundamentals of Elect. Eng	3-2	SL 102	Lecture New Weapons	- -
SL 101	Lecture New Weapons	- -			
	Total	15-10		Total	17-8

Note: Six weeks of June and July, 1952.
Intersessional Period will be spent in the field at aviation activities.

SECOND YEAR (A2) GROUPS ENTERING 1950

First Term			Second Term		
Ae 203(A)	Airc. Stress Anal. III	4-0	Ae 132(B)	Flight Analysis	3-2
Ae 311(C)	Aircraft Design I	2-4	Ae 204(A)	Stress Analysis IV	4-0
Ae 501(A)	Hydro- Aero. Mech. I	4-0	Ae 312(B)	Airplane Design II	2-4
ME 131(C)	Eng. Thermo	4-2	Ae 502(A)	Hydro. -Aero. Mech. II	4-0
EE 731(C)	Power Electronics	3-2	ME 132(C)	Eng. Thermo	3-2
			*Ae 001	Lecture-Aero	0-1
			*IE 101	Lecture-Indus. Org	0-1
	Total	17-8		Total	16-10

Third Term			Fourth Term		
Ae 503(A)	Compressibility	4-0	Ae 142(A)	Airc. Dynamics II	3-4
Ae 141(A)	Aircraft Dynamics I	3-4	Ae 421(B)	Airc. Propuls	3-2
Ae 321(A)	Adv. Aircraft Struct	4-0	Mc 311(A)	Vibrations	3-2
Ae 411(B)	Aircraft Eng	3-2	**ME 632(B)	Exper. Stress Anal	2-2
Ch 521(A)	Chemistry Plastics	3-2	Ae 431(A)	Int. Flow in Airc. Eng	4-0
*SL 101	Lecture-New Weap. Dev	0-1	*SL 102	Lecture New Weap	0-1
*IE 103	Lecture-Indust. Org	0-1			
	Total	17-10		Total	15-11

**Propulsion group takes Ch-561(A) Physical Chemistry (3-2) in place of ME 632(B) this term.

*Lecture course - no academic credit.
Summer Period spent in a civilian institution summer course in industrial engineering.

Third and last year aeronautical engineering will be conducted by a civilian institution. See third year aeronautical engineering curricula.

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AERONAUTICAL ENGINEERING (Continued)

SECOND YEAR (AG) GROUP ENTERING 1951, 2 YEAR

First Term

Ae 311(C)	Airplane Design I	2-4
Ae 132(B)	Flight Analysis	3-2
Ae 410(B)	Thermodynamics (Aero.)	3-2
Ae 501(A)	Hydro-Aeromechanics I	4-0
EE 241(C)	A.C. Circuits	3-2
	Total	15-10

Second Term

Ae 141(A)	Aircraft Dynamics I	3-4
Ae 411(B)	Aircraft Engineer	4-2
Ae 502(A)	Hydro-Aeromechanics II	4-0
EE 711(C)	Electronics	3-2
Ae 151(B)	Aero. Seminar	2-0
*Ae 001	Lecture- Aero	0-1
*IE 101	Lecture- Indust. Org	0-1
	Total	16-10

Third Term

Ae 142(A)	Aircraft Dynamics II	3-4
Ae 421(B)	Aircraft Propulsion	3-2
Ae 503(A)	Compressibility	4-0
EE 611(B)	Servomechanism	3-4
Ae 152(B)	Aero. Seminar	2-0
*SL 101	Lecture New Weapons	0-1
*IE 103	Lecture- Indust. Org	0-1
	Total	15-12

Fourth Term

Flight program emphasizing performance and test to be given at a major Naval Aviation Activity, preferably Test Pilot Training Division, NATC, Patuxent River, Md.

*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 new duty station.

SECOND YEAR (A2) GROUPS ENTERING 1951, 3 YEAR

First Term

Ae 311(C)	Airplane Design I	2-4
Ae 132(B)	Flight Analysis	3-2
Ae 410(B)	Thermodynamics (Aero.)	3-2
Ae 501(A)	Hydro-Aeromechanics I	4-0
EE 241(C)	A.C. Circuits	3-2
	Total	15-10

Second Term

Ae 141(A)	Aircraft Dynamics I	3-4
Ae 411(B)	Aircraft Engines	4-2
Ae 502(A)	Hydro-Aeromechanics II	4-0
Ae 214(A)	Stress Analysis IV	3-0
Ae 302(B)	Airplane Design II	1-4
*Ae 001	Lecture - Aero.	0-1
*IE 101	Lecture - Indust. Org.	0-1
	Total	15-12

Third Term

Ae 142(A)	Aircraft Dynamic 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 & Numerical Methods	4-0
*SL 101	Lecture- New Weapons	0-1
*IE 103	Lecture- Indust. Org.	0-1
	Total	17-10

Fourth Term

Ae 431(A)	Int. Flow in Airc. Engines	4-0
Ae 215(A)	Adv. Stress Analysis	4-0
Ae 504(A)	Compressibility II	3-2
Mc 311(A)	Vibrations	3-2
**ME 632(B)	Exper. Stress Anal	2-2
*SL 102	Lecture - New Weapons	0-1
	Total	16-7

**Propulsion group takes Ch 561(A) Physical Chemistry (3-2) in place of ME 632(B) this term.

*Lecture Course - no academic credit.

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

Third and last year aeronautical engineering will be conducted by a civilian institution.

AERONAUTICAL ENGINEERING

AERONAUTICAL ENGINEERING, ARMAMENT

These curricula consist 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 these curricula normally leads to the award of a graduate degree. These curricula are designed to cover electrical, aeronautical and mechanical engineering subjects and related mathematics, metallurgy, electronics and ordnance courses. The third year at M.I.T. majors in guided missile electronics controls and fire control systems.

FIRST YEAR (AR) GROUP ENTERING 1951

First Term			Second Term		
EE 151(C)	D.C. Circuits & Fields	3-4	EE 251(C)	A.C. Circuits	3-4
Ma 151(C)	Introd. to Eng. Math	4-0	Ma 152(B)	Diff. Eqs. & Boundary Value Probs	4-0
Mc 101(C)	Engineering Mech. I	3-0	Mc 102(C)	Eng. Mech. II	3-0
Ae 200(C)	Rigid Body Statics of Airc	3-2	Ae 211(C)	Stress Analysis I	4-0
Ch 101(C)	Chem. General Inorganic	3-2	Ae 100(C)	Basic Aerodyn	3-4
			*Ae 001	Lecture Aero	0-1
	Total	16-8		Total	17-9

Third Term			Fourth Term		
EE 451(C)	Transformers & Synchros	2-2	EE 455(C)	Asyn. Motors	2-2
Ma 153(B)	Vector Anal. & Introd. to Part. Diff. Eq	3-0	Ma 154(A)	Part. Diff. Eq. & Functions of a Comp. Variable	3-0
Mt 201(C)	Phys. Metallurgy-Intro	3-2	Mt 202(C)	Phys. Metal Ferrous	3-2
Ae 212(C)	Stress Analysis II	4-2	Ae 213(B)	Stress Analysis III	4-2
Ae 121(C)	Technical Aerodyn	3-2	Ae 136(B)	Aircraft Perform	3-2
Ma 201(C)	Graph. & Mech. Comp	0-2	*SL 102	Lecture New Weapons	0-1
*SL 101	Lecture New Weapons	0-1			
	Total	15-11		Total	15-9

Six weeks intersessional period in the field.

SECOND YEAR (AR2) GROUP ENTERING 1950

First Term			Second Term		
EE 551(B)	Transm. Lines & Filters	3-2	EE 755(A)	Electronic Control & Measurement	3-4
Ma 155(A)	Matrices and Eng. Math	3-0	Mc 401(A)	Ext. Ballistics	3-0
EE 751(C)	Electronics	3-4	Ma 401(A)	Mech. Computers	2-2
Ae 311(C)	Aircraft Design	2-4	Ma 106(A)	Comp. Var. & LaPlace Tr.	4-0
Ae 501(A)	Hydro-Aero. Mech. I	4-0	Ae 502(A)	Hydro-Aero. Mech. II	4-0
			*IE 101	Lecture-Indus. Org	0-1
			*Ae 001	Lecture-Aero	0-1
	Total	15-10		Total	16-8

*Lecture course — no academic credit.

AERONAUTICAL ENGINEERING, ARMAMENT (Continued)

SECOND YEAR (AR2) GROUP ENTERING 1950 (Continued)

Third Term			Fourth Term		
EE 671(A)	Transients	3-4	EE 753(C)	Electronics	1-2
Mc 402(A)	Dyn. of Missl. & Gyros	3-0	EE 662(A)	Servo-Mechanisms	3-3
Or 141(C)	Guid. Missl. Guidance	2-0	Es 456(C)	Introd. to Radar (Airborn)	2-2
Ae 503(A)	Compressibility	4-0	Mt 203(B)	Physical Metallurgy	2-2
Ae 146(A)	Airc, Dynamics	3-2	Mc 201(A)	Methods in Dynamics	2-2
*SL 101	Lecture-New Weap. Dev	0-1	Or 142(C)	Guid. Missl. Guidance	1-0
*IE 103	Lecture-Indus. Org	0-1	*SL 102	Lecture New Weap. Dev	0-1
	Total	15-8		Total	11-12

Summer period between 2nd and 3rd years will be spent at a naval aviation activity.

Third year at M. I. T.

SECOND YEAR (AR2) GROUP ENTERING 1951

First Term			Second Term		
Ma 105(A)	Fourier Series and Boundary Value	4-0	Ma 106(A)	Complex Variable & Laplace	4-0
Ae 501(A)	Hydro-Aero. Mech. I	4-0	Ma 401(A)	Mechanical Computers	2-2
Ae 311(C)	Aircraft Design	2-4	Mc 401(A)	Exterior Ballistics	3-0
EE 551(B)	Transmissions, Liners & Filters	3-2	Ae 502(A)	Hydro-Aero-Mech. II	4-0
EE 751(C)	Electronics	3-4	EE 755(A)	Elect. Control & Measurement	3-4
			*Ae 001	Lecture Aero	0-1
			*IE 101	Lecture Indust. Org	0-1
	Total	16-10		Total	16-8

Third Term			Fourth Term		
EE 671(A)	Transients	3-4	EE 753(C)	Electronics	1-2
Mc 402(A)	Dyn. of Missl. & Gyros	3-0	EE 662(A)	Servo-Mechanisms	3-3
Or 141(C)	Guid. Missl. Guidance	2-0	Es 456(C)	Intro. to Radar (Airborn)	2-2
Ae 503(A)	Compressibility	4-0	Mt 203(B)	Physical Metallurgy	2-2
Ae 146(A)	Airc. Dynamics	3-2	Mc 201(A)	Methods in Dynamics	2-2
*SL 101	Lecture New Weap. Dev	0-1	Or 142(C)	Guid. Missl. Guidance	1-0
*IE 103	Lecture Indus. Org	0-1	*SL 102	Lecture New Weap. Dev	0-1
	Total	15-8		Total	11-12

Summer period between 2nd and 3rd years will be spent at a naval aviation activity.

THIRD YEAR (AR3) AT M. I. T.

Fall Term	Spring Term
16.40 Space Kin. & Gyro Theory	16.44 Fire Control Instruments Adv.
16.15 Stability & Cont. of Airc.	16.46 Fire Control Instrument Lab.
16.41 Introd. to Fire Control	Thesis
16.43 Fire Cont. Instr. Lab.	
16.39 Autom. Control Equip	
Thesis	

*Lecture course — no academic credit.

AERONAUTICAL ENGINEERING, ELECTRICAL

These curricula consist 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 normally leads to the award of a graduate degree in electrical engineering. These curricula are designed to provide major emphasis on electricity and are supported by aeronautics, mathematics, metallurgy, electronics and mechanics. The objective of these curricula is to provide electrical engineers with a good understanding of aeronautical engineering.

FIRST YEAR (AE) GROUP ENTERING 1951

First Term			Second Term		
Ma 151(C)	Intro. to Eng. Math	4-0	Ma 152(B)	Diff. Eq. & Boundary Value Prob	4-0
EE 171(C)	Elect. Circts. & Flds	3-4	EE 271(C)	A.C. Circuits	3-2
Mc 100(C)	Engineering Mech. I	3-0	Mc 102(C)	Engineering Mech. II	3-0
Ae 200(C)	Rigid Body Statics of Airc.	3-2	Ae 211(C)	Stress Analysis I	4-0
Ch 101(C)	Chem. General Inorganic	3-2	Ae 100(C)	Basic Aerodyn	3-4
			*Ae 001	Lect. Aero	0-1
			*IE 101	Lect. Ind. Org.	0-1
	Total	16-8		Total	17-8

Third Term			Fourth Term		
Ma 153(B)	Vector Anal. & Intro. to Part. Diff. Eq	3-0	Ma 154(A)	Part. Diff. Eqs. & Func. of a Comp. Var.	3-0
EE 272(C)	A.C. Circuits	2-2	EE 371(C)	D.C. Mach	3-2
Mt 201(C)	Phys. Metall. Intro	3-2	Mt 202(C)	Phys. Metall. Ferrous	3-2
Ae 212(C)	Stress Anal. II	4-2	Ae 213(B)	Stress Anal. III	4-2
Ae 121(C)	Tech Aerod. I	3-2	Ae 136(B)	Airc. Perform	3-2
Ma 201(C)	Graph. & Mech. Comp.	0-2	*SL 102	Lect. New Weap. Dev.	0-1
*SL 101	Lect. New Weap. Dev	0-1			
	Total	15-11		Total	16-9

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

SECOND YEAR (AE2) GROUP ENTERING 1950

First Term			Second Term		
Ma 105(A)	Fourier Series & B.L. Prob	4-0	Ma 106(A)	Comp. Var. & LaPlace Trans	4-0
EE 471(C)	Transformers Asymchro. & Synchro. Mach.	3-4	EE 472(C)	Syn. Machines	3-4
Ae 311(C)	Aircraft Design	2-4	EE 971(A)	Elect. Seminar	1-0
Ae 203(A)	Airc. Stress Anal. III	4-0	Ch 521(A)	Chem. Plastics	3-2
Ae 501(A)	Hydro. Aero. Mech. I	4-0	Ae 502(A)	Hydro. Aero. Mech. II	4-0
			*IE 101	Lect. Ind. Org.	0-1
			*Ae 001	Lect. Aero	0-1
	Total	17-8		Total	15-8

*Lecture course - no academic credit.

AERONAUTICAL ENGINEERING, ELECTRICAL (Continued)

SECOND YEAR (AE2) GROUP ENTERING 1950 (Continued)

Third Term			Fourth Term		
EE 571(B)	Transm. Lines & Filtrs	3-4	EE 772(B)	Electronics	3-2
EE 771(B)	Electronics	3-2	EE 971(A)	Elect. Seminar	1-0
EE 971(A)	Elect. Seminar	1-0	Es 226(A)	Pulse Circuits	2-1
Es 256(C)	Introduction to Radar App. of Vac. Tubes	2-0	Mt 203(B)	Physical Metallurgy	2-2
			Mc 201(A)	Methods in Dynamics	2-2
Ae 503(A)	Compressibility	4-0	Ma 201(C)	Graph. & Mech. Comp	0-2
Ae 146(A)	Aircraft Dynam	3-2	*IE 104	Lect. Indust. Organ	0-1
*Ae 002	Lect. Aero	0-2	*SL 101	Lect. New Weap. Dev	0-1
*SL 101	Lect. New Weap. Dev	0-1			
*IE 103	Lect. Indust. Org	0-1			
	Total	16-12		Total	10-11

Intersessional period of four weeks in an electrical test activity.

THIRD YEAR (AE3) GROUPS ENTERING 1949, 1950 and 1951

First Term			Second Term		
EE 671(A)	Transients	3-4	EE 662(A)	Servomechanisms	3-3
EE 871(A)	Electrical Machine Design	4-0	EE 872(A)	Elect. Mach. Des	4-0
Es 431(B)	Radar System Eng	3-3	EE 971(A)	Elect. Seminar	1-0
	Thesis	0-6	Es 432(B)	Radar System Eng	3-6
				Thesis	0-3
	Total	10-13		Total	11-12

Third Term			Fourth Term		
Es 321(B)	Radio Systems Des	3-3	EE 971(A)	Elect. Seminar	1-0
EE 873(A)	Elect. Mach. Des	4-0	Es 536	Counter Measures	2-3
EE 971(A)	Elect. Seminar	1-0		Thesis	0-10
*Ae 002	Lecture Aero	0-2			
*IE 103	Lecture-Indust. Org	0-10			
	Total	8-16		Total	3-13

SECOND YEAR (AE2) GROUP ENTERING 1951

First Term			Second Term		
Ma 105(A)	Fourier Series & B.L. Prob	4-0	Ma 106(A)	Comp. Var. & LaPlace Trans	4-0
EE 471(C)	Transfrmrs. Asymchro. & Synchro. Mach	3-4	EE 472(C)	Syn. Machines	3-4
Ae 311(C)	Aircraft Design	2-4	EE 971(A)	Elect. Seminar	1-0
Ae 501(A)	Hydro. Aero. Mech. I	4-0	Ch 521(A)	Chem. Plastics	3-2
			Ae 502(A)	Hydro. Aero. Mech. II	4-0
			*IE 101	Lect. Ind. Org	0-1
			*Ae 001	Lect. Aero	0-1
	Total	13-8		Total	15-8

*Lecture course — no academic credit.

AERONAUTICAL ENGINEERING, ELECTRICAL (Continued)

SECOND YEAR (AE2) GROUP ENTERING 1951 (Continued)

Third Term			Fourth Term		
EE 571(B)	Transm. Lines & Filtrs	3-4	EE 772(B)	Electronics	3-2
EE 771(B)	Electronics	3-2	EE 971(A)	Elect. Seminar	1-0
EE 971(A)	Elect. Seminar	1-0	Es 226(A)	Pulse Circuits	2-1
Es 256(C)	Introd. to Radar App. of Vac. Tubes	2-0	Mt 203(B)	Phys. Metallurgy	2-2
Ae 503(A)	Compressibility	4-0	Mc 201(A)	Methods Dynamics Elective**	2-2
Ae 146(A)	Aircraft Dynam	3-2	*IE 104	Lect. Indust. Organ	0-1
*Ae 002	Lect. Aero	0-2	*SL 101	Lect. New Weap. Dev	0-1
*SL 101	Lect. New Weap. Dev	0-1			
*IE 103	Lect. Indust. Org	0-1			
	Total	16-12		Total	10-9

Intersessional period of four weeks in an electrical test activity.

THIRD YEAR (A3) AT THE UNIV. OF MICHIGAN

Fall Term	Spring Term
Ae 116 Advcd. Fluid Dynamics	*AE 102 Advanced Design
Ae 172 Instrumentation & Research	*AE 133 Advcd Airpln Structures
*Ae 118 Experim. Aerodynmcs.	*AE 160-1 Introd. to non-linear Sys.
*Ae 174 Atomic Physics	AE 160-2 Symposium-Propulsion
*Ae 105 Dynamic Stability	AE 162 Thesis
*EM 123 Theory of Strength	*AE 165 Airc. Propulsion I
*MA 152 Math. Fourier Series	*AE 171 Airc. Servo Cont. Systems
Thesis	*AE 202 Dynmcs. Compress. Fluids
	*AE 203 Dynmcs. Perfect Fluids
	*AE 204 Aircft. Propulsion II
* Elective Courses	*EM 129 Plasticity

THIRD YEAR (AC3) AT CALIF. INSTITUTE OF TECHNOLOGY

AE 260 Research in Aero.
AE 261 Hydro. of Comp. Fluids
AE 266 Theor. Aerodyn. of Fluids
AE 270 Elasticity of Aeronautics
AE 272 Precision Measurmts.
AE 290 Aeronautics Seminar
AM 150 Vibration & Flutter

AIRCRAFT FLIGHT PERFORMANCE

THIRD YEAR (AF3) AT PRINCETON UNIV.

Fall Term	Spring Term
AE 565 Airplane Dynamics	AE 566 Airplane Dynamics
AE 567 Helicopter Analysis	AE 568 Helicopter Analysis
AE 583 Advcd. Airpln. Performance	AE 570 Analytcl. Methods in Eng.
AE 563 Jet Propulsion	AE 528 Servomechanisms
AE 569 Analytical Methods in Eng.	AE 700 Spec. Probs. in Airc. Perf.
Thesis	Thesis

* Lecture course - no academic credit.
** Elective courses may be selected from advanced courses in the Aeronautical Engineering Department or the Electrical Engineering Department or other departments in the Post-graduate School, subject to the needs of the individual student.

AERONAUTICAL ENGINEERING GENERAL, (Continued)

SEAPLANE HYDRONAMICS

THIRD YEAR (AH3) AT STEVENS INST. OF TECHNOLOGY AND NEW YORK UNIVERSITY

Fall Term	Spring Term
FD 203 Mechanics of Fluid Resistance	FD 210 Exp. Math. in Hydrodynamics
FD 204 Hydrodynamic Theory	FD 211 Mechanics of Bodies in Fluids
FD 215 Seaplane Design I	FD 216 Seaplane Design II
*FD 217 Marine & Aircraft Propulsion I	*FD 218 Marine & Aircraft Propulsion II
*FD 213 Special Problems, Fluid Dyn. I	*FD 214 Spec. Probs. Fluid Dyn II
*MA 517 Ord. & Part. Diff. Equations	*MA 520 Advanced Calculus II
*MA 519 Advanced Calculus I	*AE 117 Aircraft Structural Lab.
*AE 206 Applied Elasticity	AE 210 Aircraft Stress Analysis
AE 209 Adv. Stress Analysis	Thesis
Thesis	

JET PROPULSION

THIRD YEAR (AJ3) AT CALIF. INSTITUTE OF TECHNOLOGY

AE 261 Hydrodynmc of Compr. Fluids
AE 272 Precision Measurmts.
AE 290 Aeronautics Seminar
JP 121 Rockets
JP 130 Thermal Jets
JP 170 Jet Propulsn. Lab.
JP 210 HiTemp. Design Probs.
JP 280 Research in Jets.
JP 200 Chemistry Probs. in Jets.

THIRD YEAR (AJ3) AT UNIV. OF MINNESOTA

Fall Term	Winter Term
AE 116 Advcd. Airpln. Stresses	AE 117 Advcd. Airpl. Stresses
AE 201 Aerodn. Comprs. Fluids	AE 202 Compress. Fluids
ME 252 Advcd. Reciproc. Engs.	ME 253 Advcd. Gas Turbines
Thesis	Thesis

Spring Term

AE 118 Stresses in Aircraft Structures
AE 204 Supersonic Aerodynamic Lab.
ME 255 Thermal Jets & Rockets
Thesis

AIRCRAFT PROPULSION SYSTEMS

THIRD YEAR (AP3) AT M. I. T.

Fall Term	Spring Term
2.213 Gas Turbines	2.214 Gas Turbines
2.791 Internal Comb. Engs.	2.792 Intern. Comb. Engines
10.70 Principles of Combust.	16.56 Jet Engines
16.105 Applied Aerodynamics	Thesis
Thesis	

*Elective Courses

STRUCTURES

THIRD YEAR (AS3) AT CALIF. INSTITUTE OF TECHNOLOGY

AE 254 Advcd Probs. in Airplane Design
AE 257 Engineering Mathematical Princs.
AE 260 Research in Aeronautics
AE 270 Elasticity Applied to Aeronautics
AE 272 Precision Measurements
AE 274 Problems in Aero-elasticity
AE 290 Aeronautics Seminar
AM 150 Vibration & Flutter

THIRD YEAR (AS3) AT UNIV. OF MINNESOTA

Fall Term	Winter Term
AE 116 Advcd. Airplane Stresses	AE 117 Advcd. Airplane Stresses
AE 240 Dynamics of Airplane Structures	AE 241 Dynamics of Aircraft
AE 201 Aerodn. Comprs. Fluids	AE 202 Compress Fluids
Thesis	Thesis

Spring Term

AE 118 Stresses in Aircraft Structures
AE 119 Structural Test of Aircraft
AE 204 Supersonic Aerodynamic Lab.
Thesis

GAS TURBINE PROPULSION SYSTEMS

THIRD YEAR (AT3) AT RENSSELAER POLYTECHNIC INSTITUTE

Fall Term	Spring Term
G12.30 Thermo. of Hi-Veloc. Flow	G12.41 Turbines & Jets Cycles
G12.40 Gas Turb. Comb. & Stability	G1.13 Dynamics & Stab. of Airc.
G4.52 Chem. of Combustion	G16.67 Nuclear Physics
G13.62 Hi-Temp Metallurgy	G12.99 Thesis
G1.17 Comprs. & Incomprs. Flow	

COMMUNICATIONS

C - Group

Objective

To prepare selected officers for communications, operational and staff duties; and to better fit them for command duties. This curriculum majors in practical communications, operations, tactics, and elementary electronics. Students are required to enroll in the Naval War College correspondence course in Strategy and Tactics.

First Term

Co-101(C)	Typing & Radio Code	0-4
Co-110(C)	Communication Procedure	2-2
Co-120(C)	Comm. Org. & Secur.	2-1
Co-131(C)	Tactics	2-2
Co-135(C)	Corr. Course in Strategy & Tactics	-
Es-186(C)	Fund. of Radio Comm.	4-4
Es-281(C)	Electronics Fund.	2-2
		11-16

Second Term

Co-102(C)	Radio Code & Procedure	0-4
Co-111(C)	NXT and Toll Traffic Procedures	2-2
Co-121(C)	Basic Rapid Comm. Plan	2-1
Co-132(C)	Tactics	2-2
Co-135(C)	Corr. Course in Strategy & Tactics	-
Es-282(C)	Vacuum Tube Circuits	4-4
Es-786(C)	R.F. Energy Trans.	3-2
		13-15

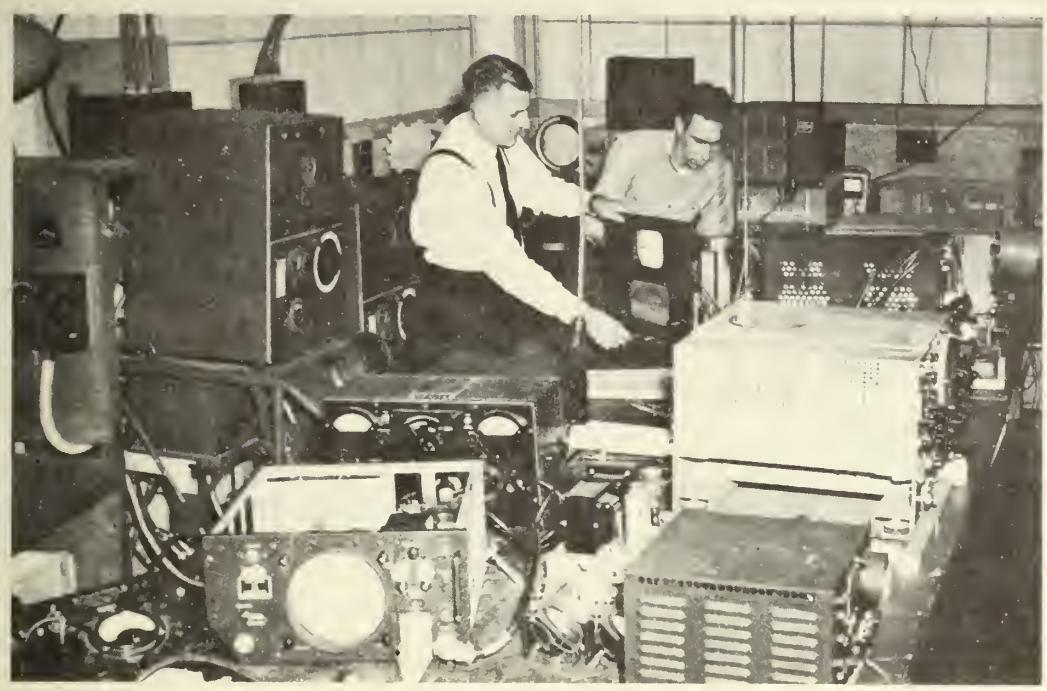
Third Term

Co-103(C)	Visual & Voice Proc	0-3
Co-112(C)	Intern. & Comm. Comm	1-1
Co-122(C)	Communication Plans (Type & Task Force)	2-3
Co-133(C)	Tactics	2-2
Co-135(C)	Corr. Course in Strategy & Tactics	-
Es-283(C)	Vacuum Tube Circuits	4-3
Es-286(C)	Pulsing & H.F. Circuits	3-2
*SL-101	New Weapon Develop	0-1
		12-15

Fourth Term

C0-104(C)	Comm. & Other Nav. Organ	2-1
Co-113(C)	Correspondence & Mail	1-0
Co-114(C)	Crypto Systems Instruc	0-2
Co-123(C)	Comm. Plans (Amphib.)	1-3
Co-134(C)	Tactics	2-2
Co 135(C)	Corr. Course in Strategy & Tactics	-
Es 386(C)	Trans. & Receivers	3-3
Es 586(C)	Special Systems	3-3
*SL 101	New Weapon Develop.	0-1
		12-15

*Lecture course - no academic credit.



Television Laboratory, U. S. Naval Postgraduate School, Annapolis, Md.

ELECTRONICS ENGINEERING

Objective

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

THREE YEAR CURRICULA
(Presented at graduate level)

FIRST YEAR (E1)

First Term			Second Term		
Ma-101(C)	Intro. to Eng. Math	5-0	Ma-102(C)	D. A. Equations & Series	5-0
Es-111(C)	Electricity (D. C.)	4-4	Es-112(C)	Electricity (A. C.)	4-3
Es-211(C)	Electron Tubes & Circuits	2-3	Es-212(C)	Electron Tubes & Circuits	2-3
Ph-211(C)	Geom. & Phys. Optics	3-0	Ph-212(B)	Phys. Optics & Dynamics	3-3
			*IE -101	Industrial Engineering	0-1
		14-7			14-10

Third Term			Fourth Term		
Ma-103(B)	Funct. of Sev. Var & Vect. Anal	5-0	Ma-104(A)	Part. Diff. Eq. & Rel. Topics	5-0
Es-113(C)	Circuit Analysis & Meas.	3-3	Es 114(C)	Circuit Analysis & Meas	3-3
Es-213(C)	Electron Tubes & Cir	4-4	Es 214(C)	Electron Tubes & Cir.	4-3
Ph 113(B)	Dynamics	3-0	Ph 311(A)	Electrostatics & Magnetostatics	3-0
*SL 101	New Weapons	0-1	*SL 102	New Weapons	0-1
*IE 103	Industrial Engineering	0-1	*IE 104	Human Engineering	0-1
		15-8			15-8

*Lecture course - no academic credit.

ELECTRONICS ENGINEERING (Continued)

SECOND YEAR (E2)

First Term

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

Second Term

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

Third Term

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

Fourth Term

Es 624(A) Electromagnetics	3-0
Es 123(A) Adv. Circuit Theory	3-0
Es 226(A) U.H.F. Tubes	4-3
Es 322(B) Radio Systems	3-3
	13-6

THIRD YEAR (E3)

First Term

Es 736(B) Antennas, Trans. Lines	3-3
Es 133(A) Adv. Circuit Theory	3-0
Es 431(B) Radar System Eng	3-3
Es 333(B) Radio Systems	2-3
	11-9

Second Term

EE 662(A) Servomechanisms	3-3
Es 531(B) Special Systems	3-3
Es 432(B) Radar System Eng	3-6
Es 831(A) Thesis Seminar	2-0
	11-12

Third Term

This term is spent in an industrial electronics laboratory, such as Bell Telephone Co., R.C.A., or General Electric Co. 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 532(B) Special Systems	3-3
Es 036(C) Electronics Admin	2-0
Es 832(A) Thesis Seminar	4-0
Es 836(A) Project Seminar	1-0
Ph 631(A) Atomic Physics	4-0
	14-3

TWO YEAR CURRICULA
(Presented at undergraduate level)

FIRST YEAR (E1)

Follow (E1) curriculum

SECOND YEAR (E2c)

First Term

Es 227(C) U.H.F. Tubes	3-2
Es 326(B) Radio Systems	3-3
EE 314(C) AC & DC Machines	3-4
Ph 427(B) Fundamental and Applied Acoustics	4-0
Total	13-9

Second Term

Es 327(B) Radio Systems	4-3
Es 126(C) R.F. Measurements	2-6
Es 421(B) Radar Fundamentals	2-3
Ph 428(B) Underwater Acoust	2-3
Total	10-15

ELECTRONICS ENGINEERING (Continued)

SECOND YEAR (E2c) (Continued)

Third Term		Fourth Term	
Es 328(B) Radio Systems	2-3	Es 423(B) Radar Systems Eng	3-6
Es 422(B) Radar Systems Eng.	3-3	Es 722(B) Antennas and Wave Propagation	3-3
Es 721(B) Antennas and Wave Propagation	3-3	Es 522(B) Special Systems	3-3
Es-521(B) Special Systems	3-3	Es 036(C) Electronics Administration	2-0
Total	11-12	Total	11-12

ELECTRONICS ENGINEERING (SONAR)

Objective

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

FIRST YEAR (E1)

Follow (E1) curriculum

SECOND YEAR (E2)

Follow (E2) curriculum except substitute Ph-424(A) Sonar Systems and Developments for Es-322(B) Radio Systems.

THIRD YEAR (EW3)
at University of California at Los Angeles

Fall Term	Spring Term
Phys 214 Advanced Acoustics	Phys 266 Propagation of Waves in Fluids
Phys 220A Theoretical Mechanics	Phys 264 Advanced Acoustics Seminar
Phys 114C Acoustics Laboratory	Phys 290 Acoustics Research
Phys 124 Nuclear Structure	Phys 117 Hydrodynamics
	Phys 119 Kinetic Theory

Physics Laboratory, U. S. Naval Postgraduate School, Annapolis, Md.

PHYSICS CURRICULA

Objective

The objective of these curricula is to prepare officers for duties in connection with the application of Physics to such types of fundamental research and development as may be required by the Naval Establishment. Only students having the necessary qualifications will be admitted to these curricula.

FIRST YEAR (Ph1)

First Term

Ph-240(C)	Geom. and Phys. Optics	3-3
Ch 102(C)	Gen. Inorganic Chem	4-2
Ma 181(C)	Directional Derivatives and Line Intervals	5-0
		12-5

Second Term

Ph-141(B)	Analytical Mechanics	4-0
Ph 241(B)	Polarized Light	1-3
Ph 341(C)	Elect. and Magnetism	4-2
Ma 182(B)	Dif. Eqs. and Vector Analysis	5-0
		14-5

Third Term

Ph 142(B)	Analytical Mechanics	4-0
Ph 342(B)	Elect. and Magnetism	3-3
Ma 183(B)	Complex Variables and Dif. Eqs. of Theoretical Physics	5-0
		12-3

Fourth Term

Ph 343(B)	Elect and Magnetism	3-0
Ph 640(B)	Atomic Physics	3-3
Ma 184(A)	Matrices Tensors and Variations	5-0
		11-3

PHYSICS CURRICULA (Continued)

SECOND YEAR (Ph2)

First Term		Second Term	
Ph 361(A) Electromagnetism	3-0	Ph 143(A) Advanced Mechanics	3-0
Ph 421(A) Acoustics	3-0	Ph 540(B) Kin. Theory of Gases	3-0
Ph 426(B) Acoustics Lab	0-3	Ch 442(C) Physical Chemistry	4-2
Ph 530(B) Physical Thermodynamics	3-0	Thesis*	
Thesis*			
	9-3		10-2

Third Term		Fourth Term
Ph 721(A) Intro. to Quan. Mech	4-0	Elective**
Elective**		Elective**
Thesis*		Thesis*

* The student will choose a thesis topic with the approval of the staff. The research involved may be either experimental or theoretical.

** Elective courses may be selected from advanced courses in the Physics Department or in other departments in the Naval Postgraduate School, subject to the needs of the individual student. Possible courses would include Theoretical Physics, Nuclear Physics, Theory of Solids, Statistical Mechanics, Spectroscopy, X-rays and Crystallography, Theory of Metals, Mathematics and Chemistry.

NAVAL ENGINEERING (APPLIED) CURRICULA

NAVAL ENGINEERING (APPLIED) NA GROUPS

Objective

The general objective of these curricula is to develop officers competent to:

(a) Direct the inspection, installation, operation and maintenance of naval machinery and equipment (excepting radio and sound equipment) over which the Bureau of Ships has cognizance, or for which the Engineering Officer afloat is held responsible by the U.S. Navy Regulations.

Specifically, the objective is to provide officers, subject to having attained suitable rank and experience, competent to perform the following duties:

(a) Engineering officers of all types of naval vessels and staff engineers afloat.

(b) Maintenance and repair assignments in the Bureau of Ships, on repair ships, at navy yards, and repair bases.

(c) Inspectors of naval machinery and material.

SECOND YEAR (NA2) 1950 - 1952 GROUP

First Term		Second Term	
EE 452(C) Syn. Mach. & Induc. Motors	3-4	ME 830(C) Mach. Design	4-2
ME 122(C) Thermodynamics	3-2	EE 751(C) Electronics	3-4
ME 522(C) Str. of Materials	4-0	ME 221(C) Mar. P.P. Equip	3-2
ME 601(C) Materials Testing Lab.	0-2	ME 421(C) Hydro-Dynamics	3-2
Mt 301(A) High Temp. Materials	3-0	*IE 101 Industrial Eng	0-1
Total	13-8	Total	13-11

* Lecture course— no academic credit.

NAVAL ENGINEERING (APPLIED) CURRICULA (Continued)

SECOND YEAR (NA2) 1950 - 1952 GROUP (Continued)

Third Term

EE 551(B)	Trans. Lines & Filters	3-2
ME 222(C)	Mar. P.P. Equip	3-4
NE 102(C)	Marine Eng. (Main Prop)	3-0
*IE 103	Industrial Eng.	0-1
*SL101	New Weapons	0-1
ME 422(C)	Hydro-Equip	2-2
	Total	11-10

Fourth Term

ME 217(C)	Int. Comb. Eng. (Diesel)	4-2
EE 651(B)	Transients & Servos	3-4
ME 223(B)	Mar. P.P. Anal	2-4
NE 101(C)	Marine Eng. (Main Prop.)	3-0
NE 103(C)	Marine Eng. (Dept. Org.)	1-0
*IE 104	Human Eng	0-1
*SL 102	New Weapons	0-1
	Total	13-12

* Lecture course — no academic credit.

Chemical Engineering Laboratory, U. S. Naval Postgraduate School, Annapolis, Maryland.

CHEMICAL ENGINEERING

CHEMICAL ENGINEERING CURRICULA — NC GROUPS

Objective

The objective of these curricula is to provide the training necessary for a selected group of officers to:

(a) Supervise and direct activities at the Standards Branch, Bureau of Ships involving chemical processes.

(b) To act in an advisory capacity with civilian establishments in the development and production of materials for the naval service.

(c) To be able to appreciate developments in industry involving materials other than metals, such as paints, protective coatings, plastics, etc., and advise the Bureau of Ships as to the suitability of such developments in solving problems of maintenance and repair.

FIRST YEAR (NC)

First Term		Second Term	
Ma 171(C) Special Topics in Calc	3-0	Ma 172(C) Fourier Series	3-0
Ma 201(C) Graph & Mech. Comp.	0-2	EE 251(C) A.C. Circuits	3-4
Mc 101(C) Engineering Mechanics I	3-0	Ch 221(C) Qualitative Anal	3-2
Ch 101(C) General Chemistry	3-2	Ge 101(C) Phys. Geology	3-0
EE 171(C) Elect. Circ. & Fields	3-4	ME 500(C) Str. of Materials	3-0
		ME 601(C) Mat. Test. Lab	0-2
Total	12-8	Total	15-8

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CHEMICAL ENGINEERING (Continued)

FIRST YEAR (NC) (Continued)

Third Term		Fourth Term	
Ma 173(B) Funct. of Sev. Var	3-0	Ch 521(A) Plastics	3-2
Ch 231(C) Quantitative Anal	2-4	Ch 611(C) Thermodynamics	3-2
Ch 311(C) Organic Chem.	3-2	Ch 312(C) Organic Chem.	3-2
Ch 411(C) Phys. Chem	3-2	Ch 412(C) Phys. Chem.	2-2
Ge 302(C) Determ. Mineralogy	1-4	Ge 241(C) Geol. of Petrol	2-2
Total	12-12	Total	13-10

Intersessional Field Trip.

SECOND YEAR (NC2)

First Term		Second Term	
Ch 541(A) Reaction Motors	2-2	Ch 413(A) Adv. Phys. Chem.	2-2
Ch 612(C) Thermodynamics	3-2	Ch 111(A) Fuel & Oil Chem.	2-2
Cr 271(B) Crystal. & X-Ray	3-2	EE 751(C) Electronics	3-4
Mt 201(C) Phys. Met.	3-2	ME 421(C) Hydro Mechanics	3-2
Mt 301(A) High Temp. Mat.	3-0	ME 711(C) Mech. of Mach	3-2
		*IE 101 Industrial Eng.	0-1
Total	14-8	Total	13-13

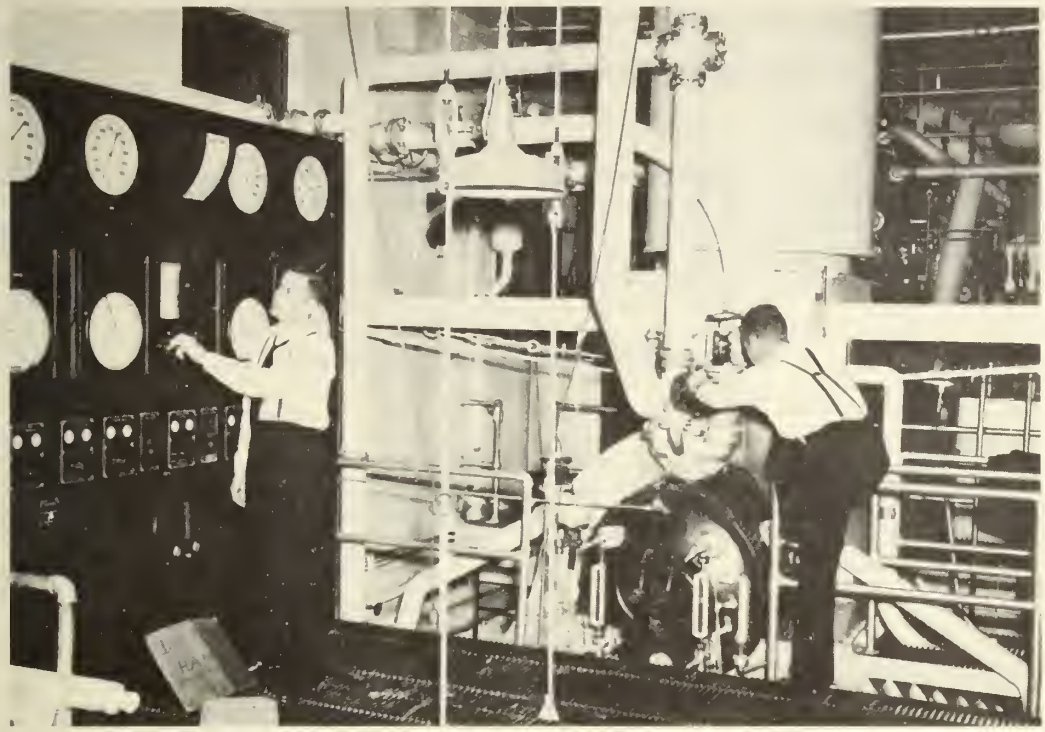
Third Term		Fourth Term	
Ch 701(C) Chem. Eng. Calc.	3-2	Ma 301(B) Statistics	3-2
Ch 321(A) Qual. Org. Anal.	2-2	Ch 800(A) Chem. Seminar	2-0
Ch 323(A) Chem. of High Pol.	3-0	Ch 322(A) Adv. Org. Chem	3-2
Mt 201(C) Phys. Met	3-2	Mt 202(C) Phys. Met.	3-2
ME 422(B) Hydromechanics	2-2	ME 310(B) Heat Transfer	3-2
Ph 610(B) Atomic Physics	3-0	IE 104 Human Eng.	0-1
*IE 103 Industr. Eng	0-1	SL 102 New Weapons	0-1
*SL 101 New Weapons	0-1		
Total	16-10	Total	14-10

Intersessional Field Trip for students selected for a third year.

THIRD YEAR (NC3)

At Lehigh University for selected students.

*Lecture course — no academic credit.



Mechanical Engineering Boiler Laboratory, U. S. Naval Postgraduate School, Annapolis, Maryland.

MECHANICAL ENGINEERING CURRICULA — NH GROUPS

Objective

The objective of these curricula is to develop officers competent to direct the inspection, installation, maintenance, operation and repair of naval machinery and equipment, excepting radio and underwater sound equipment.

Specifically, the objective is to provide officers, subject to having attained suitable rank and experience, competent to perform the following duties:

(a) Engineer officer of all types of naval vessels, and staff engineers afloat.

(b) Assignment to the operation and maintenance divisions of the Bureau of Ships.

(c) Assignment to navy yards, repair ships, and repair bases in connection with production, or maintenance and repair.

(d) Assignment to test and research activities such as the Naval Boiler Laboratory, Engineering Experiment Station, Naval Research Laboratory, and Material Test Laboratory.

(e) Inspectors of naval machinery and material.

THIRD YEAR (NH3) 1949-1952 GROUP

First Term		Second Term	
ME 216(A) Mar. P.P. Design	2-4	Mt 301(A) High Temp. Mat	3-0
ME 513(A) Theory of Elasticity	3-0	ME 612(A) Exp. Stress Analysis	3-2
ME 411(C) Hydrodynamics	3-2	ME 412(A) Hydrodynamics	4-2
ME 811(C) Mach. Design	3-2	ME 812(B) Adv. Mach. Design	3-4
NE 101(C) Mar. Eng. (Main Prop.)	3-0		
Total	14-8	Total	13-8

MECHANICAL ENGINEERING (Continued)

THIRD YEAR (NH3) 1949-1952 GROUP (Continued)

Third Term			Fourth Term		
NE 102(C)	Mar. Eng. (Aux. Mach.)	3-0	Ae 431(A)	Turb. & Comp	4-0
ME 217(C)	Int. Comb. Eng.	4-2	NE 103(C)	Eng. Dept. & Org	1-0
	Thesis	2-16		Thesis	2-20
	Total	9-18		Total	7-20

SECOND YEAR (NH2) 1950 — 1953 GROUP

First Term			Second Term		
ME 112(B)	Thermodynamics	4-2	ME 211(C)	Mar. P.P. Equip	3-2
Ch 561(A)	Physical Chem	3-2	ME 411(C)	Hydrodynamics	3-2
ME 511(C)	Str. of Materials	5-0	ME 512(A)	Str. of Materials	5-0
EE 452(C)	Synch. Mach. & Induct. Motors	3-4	EE 751(C)	Electronics	3-4
			IE 101(C)	Ind. Org	0-1
	Total	15-8		Total	14-9

Third Term			Fourth Term		
ME 212(C)	Mar. P.P. Equip	3-4	ME 217(C)	Int. Comb. Eng	4-2
ME 412(A)	Hydrodynamics	4-2	Ae 431(A)	Turbines & Compr	4-0
ME 611(C)	Mat. Testing Lab	2-2	ME 513(A)	Theory of Elast	3-0
Mt 201(C)	Phys. Met	3-2	Mt 202(C)	Phys. Met.	3-2
*IE 103	Ind. Org	0-1	*IE 104	Human Eng	0-1
*SL 101	New Weapons	0-1	*SL 102	New Weapons	0-1
	Total	12-12		Total	14-6

Intersessional Field Trip
*Lecture course — no academic credit.

THIRD YEAR (NH3) 1950 — 1953 GROUP

First Term			Second Term		
ME 215(A)	Mar. P.P. Anal.	2-4	ME 216(A)	Mar. P.P. Design	2-4
ME 310(B)	Heat Transfer	3-2	ME 811(C)	Mach. Design.	3-2
ME 612(A)	Exp. Stress Anal	3-2	EE 651(B)	Trans. & Servos	3-4
Mt 203(B)	Phys. Met	2-2	Mt 301(A)	High Temp. Mat	3-0
NE 101(C)	Mar. Eng. (Main Prop)	3-0			
	Total	13-10		Total	11-10

Third Term			Fourth Term		
NE 102(C)	Mar. Eng. (Aux. Mach.)	3-0	NE 103(C)	Eng. Dept. & Org	1-0
ME 812(C)	Adv. Mach. Design	3-4		Thesis	2-20
	Thesis	2-10			
	Total	8-14		Total	3-20

MECHANICAL ENGINEERING (Continued)

FIRST YEAR (NH) GROUP ENTERING 1951

First Term

Ma 101(C)	Intro. to Eng. Math	5-0
Ma 201(C)	Graph. & Mech. Comp	0-2
Mc 101(C)	Engineering Mechanics I	3-0
Ch 101(C)	General Chemistry	3-2
EE 171(C)	Elect. Circ. & Fields	3-4
	Total	14-8

Second Term

Ma 102(C)	Diff. Equa. & Series	5-0
Ph 610(B)	Atomic Physics	3-0
Mc 102(C)	Engineering Mechanics II	3-0
Ch 111(A)	Fuel & Oil Chemistry	2-2
EE 251(C)	A.C. Circuits	3-4
	Total	16-6

Third Term

Ma 103(B)	Funct. Sev. Var. & Vector Anal	5-0
Mc 201(A)	Methods of Dynam	2-2
Mt 201(C)	Physical Met	3-2
EE 351(C)	D.C. Machinery	2-2
EE 451(C)	Transf. & Synchros	2-2
	Total	14-8

Fourth Term

Ma 104(A)	Part. Diff. Equations	5-0
Mt 202(C)	Phys. Met. (Ferrous)	3-2
ME 111(C)	Thermodynamics	4-2
EE 542(C)	Synch. Mach. & Induct. Motors	3-4
	Total	15-8

Intersessional Field Trip.

SECOND YEAR (NH2) 1951-1953 GROUP

First Term

ME 112(B)	Thermodynamics	4-2
ME 511(C)	Str. of Materials	5-0
Mt 203(B)	Phys. Met	2-2
Mt 301(A)	High Temp. Mat.	3-0
NE 101(C)	Mar. Eng. (Main Prop.)	3-0
	Total	17-4

Second Term

ME 221(C)	Mar. P.P. Equip	3-2
ME 522(B)	Mat. & Elasticity	4-0
ME 611(C)	Mat. Test. Lab	2-2
ME 421(C)	Hydrodynamics	3-2
ME 711(C)	Mech. of Machines	3-2
*IE 101	Ind. Org	0-1
	Total	15-9

Third Term

ME 222(C)	Mar. P.P. Equip.	3-4
ME 622(B)	Exper. Str. Anal	2-2
ME 422(C)	Hydro. Equip	2-2
ME 712(A)	Dynamics of Machines	3-2
NE 102(C)	Mar. Eng. (Aux. Mach.)	3-0
*IE 103	Ind. Org.	0-1
*SL 101	New Weapons	0-1
	Total	13-12

Fourth Term

ME 217(C)	Int. Comb. Eng.	4-2
ME 223(B)	Mar. P.P. Anal	2-4
ME 820(C)	Machine Design	2-4
EE 751(C)	Electronics	3-4
NE 103(C)	Mar. Eng. Org	1-0
*IE 104	Human Eng.	0-1
*SL 102	New Weapons	0-1
	Total	12-16

*Lecture course — no academic credit.

MECHANICAL ENGINEERING (Continued)

SECOND YEAR (NHA2) 1951-1954 GROUP

First Term

ME 112(B)	Thermodynamics	4-2
ME 511(C)	Str. of Materials	5-0
Mt 203(B)	Phys. Met	2-2
Mt 301(A)	High Temp. Materials	3-0
NE 101(C)	Mar. Eng. (Main Prop.)	3-0
	Total	17-4

Second Term

ME 611(C)	Materials Test. Lab	2-2
ME 211(C)	Mar. P.P. Equip	3-2
ME 512(A)	Str. of Materials	5-0
ME 411(C)	Hydrodynamics	3-2
ME 711(C)	Mech. of Machines	3-2
*IE 101	Ind. Org	0-1
	Total	16-9

Third Term

ME 212(C)	Mar. P.P. Equip	3-4
ME 412(A)	Hydrodynamics	4-2
ME 712(A)	Dynamics of Mach	3-2
NE 102(C)	Mar. Eng. (Aux. Mach.)	3-0
*IE 103	Ind. Org	0-1
*SL 101	New Weapons	0-1
	Total	13-10

Fourth Term

ME 513(A)	Theory of Elasticity	3-0
ME 310(B)	Heat Transfer	3-2
Ae 431(A)	Turb. & Comp	4-0
Ph 450(B)	Underwater Acoustics	3-2
*IE 104	Human Eng	0-1
*SL 102	New Weapons	0-1
	Total	13-6

Intersessional Field Trip.

THIRD YEAR (NHA3) 1951-1954 GROUP

First Term

ME 215(A)	Mar. P.P. Anal	2-4
ME 612(A)	Exp. Str. Analysis	3-2
Ch 561(A)	Phys. Chemistry	3-2
Ph 240(C)	Phys. Optics	3-3
	Total	11-11

Second Term

ME 216(A)	Mar. P.P. Design	2-4
ME 811(C)	Machine Design	3-2
Ch 521(A)	Plastics	3-2
EE 751(C)	Electronics	3-4
	Total	11-12

Third Term

ME 812(B)	Machine Design	3-4
EE 551(B)	Trans. Lines, Filters	3-2
	Thesis	2-14
	Total	8-20

Fourth Term

ME 217(C)	Int. Comb. Eng	4-2
EE 651(B)	Trans. & Servos	3-4
NE 103(C)	Mar. Eng. Org	1-0
	Thesis	2-12
	Total	10-18

*Lecture Course — no academic credit.

MECHANICAL ENGINEERING (Equalization)

Objective

To further prepare officers of ED classification for engineering assignments under the cognizance of the Bureau of Ships involving inspection, installation maintenance and repair of naval machinery and equipment, with the exception of radio and underwater sound equipment.

This will be a two-year curriculum at the Naval Postgraduate School. This curriculum is in the process of formulation.

MECHANICAL ENGINEERING (Equalization) (Continued)

GAS TURBINE CURRICULA

Objective

The objective of these curricula is by means of practical and theoretical instruction to qualify a selected group of officers for:

(a) Evaluating future trends in the field of gas turbine and jet propulsion and advising as to the limitations and capabilities of such means as applicable to propulsion requirements of naval vessels.

(b) Directing and supervising research and development in the field of gas turbine and jet propulsion as may be applicable to propulsion of naval vessels.

(c) Acting in an advisory capacity with civilian establishments in the development and production of such naval machinery as may in the future be operated by the use of gas turbines and jet propulsion.

FIRST YEAR (NJ) GROUPS ENTERING PRIOR 1951

First Term		Second Term	
Ma 101(C) Intro. to Eng. Math	5-0	Ma 102(C) Diff. Equation & Series	5-0
Ma 201(C) Graph. & Mech. Comp	0-2	Mc 102(C) Engineering Mechanics II	3-0
Mc 101(C) Engineering Mechanics I	3-0	ME 141(C) Eng. Thermo	4-2
Ch 101(C) Gen. Chemistry	3-2	Ae 100(C) Basic Aerodynamics	3-4
EE 171(C) Elect. Cir. & Fields	3-4		
Total	14-8	Total	15-6

Third Term		Fourth Term	
Ch 111(A) Fuel & Oil Chemistry	2-2	Ma 104(A) Part. Diff. Eq. & Rel. Topics	5-0
Ma 103(B) Funct. of Sev. Var. & Vector Anal.	5-0	Ch 412(C) Physical Chemistry	2-2
Ch 411(C) Physical Chemistry	3-2	Mt 202(C) Physical Met. (Ferrous)	3-2
Mt 201(C) Physical Metallurgy	3-2	ME 143(A) Eng. Thermo	4-4
ME 142(A) Eng. Thermo	2-2		
Total	15-8	Total	14-8

Intersessional Field Trip.

SECOND YEAR (NJ2) GROUPS ENTERING PRIOR 1951

First Term		Second Term	
Mt 301(A) High Temp. Materials	3-0	Ma 106(A) Complex Var. & Laplace Tr.	4-0
Ma 105(A) Fourier Series & Boundary Value Problems	4-0	EE 251(C) A. C. Circuits	3-4
ME 522(C) Strength of Materials	4-0	Ch 701(C) Chem. Eng. Calculations	3-2
ME 601(C) Mat. Testing Lab.	0-2	*IE 101 Ind. Organization	0-1
Ae 501(A) Theory of Aero	4-0	Ae 502(A) Theory of Aero	4-0
Total	15-2	Total	14-7

*Lecture course — no academic credit.

GAS TURBINE (Continued)

SECOND YEAR (NJ2) GROUPS ENTERING PRIOR 1951 (Continued)

Third Term			Fourth Term		
Mt 203(B)	Physical Metallurgy	2-2	ME 310(B)	Heat Transfer	3-2
EE 771(C)	Electronics	3-2	Ch 541(A)	Reaction Motors	2-2
EE 451(C)	Transf. & Synchros	2-2	EE 452(C)	Synchros. Mach. & Induc. Motors	
Ae 503(A)	Supersonic Aerodynamics	3-2	Ae 431(A)	Gas Turbines & Jets	4-0
Ae 451(C)	Gas Turbine Seminar	3-0	Ae 452(C)	Gas Turbine Seminar	3-0
*IE 103	Ind. Engineering	0-1	*IE 104	Ind. Engineering	0-1
*SL 101	New Weapons	0-1	*SL 102	New Weapons	0-1
Total		13-10	Total		15-10

THIRD YEAR (NJ3)
At Massachusetts Institute of Technology

Term I - Summer	Term II - Fall
M351 Adv. Calc. for Engineers	2.491 Flow of Compress. Fluids
M352 Adv. Calc. for Engineers	2.213 Gas Turbines
2.40 Heat Engineering	10.70 Combustion, Prin. of
	- - Thesis

Term III - Spring

2.28 Fluid Machinery
2.214 Gas Turbines
- - Thesis

FIRST YEAR (NJ) GROUP ENTERING 1951

First Term			Second Term		
Ma 101(C)	Intro. to Eng. Math	5-0	Ma 102(C)	Diff. Equ. & Series	5-0
Ma 201(C)	Graph. & Mech. Comp	0-2	Mc 102(C)	Plane Dynamics	3-0
Mc 101(C)	Statics & Kinematics	3-0	Ae 100(C)	Aerodynamics	3-4
Ch 101(C)	General Chemistry	3-2	EE 251(C)	A. C. Circuits	3-4
EE 171(C)	Elect. Circ. & Fields	3-4			
Total		14-8	Total		14-8

Third Term			Fourth Term		
EE 451(C)	Transf. & Synchro	2-2	Ma 104(A)	Part. Diff. Equa	5-0
Ma 103(B)	Funct. Ser. Var	5-0	Ch 611(C)	Thermodynamics	3-2
Mc 201(A)	Methods of Dyn	2-2	EE 452(C)	Synch. Mach	3-4
Mt 201(C)	Phys. Met	3-2	Ch 412(C)	Phys. Chemistry	2-2
Ch 411(C)	Phys. Chemistry	3-2			
Total		15-8	Total		13-8

Intersessional Field Trip

GAS TURBINE (Continued)

SECOND YEAR (NJ2) GROUP ENTERING 1951

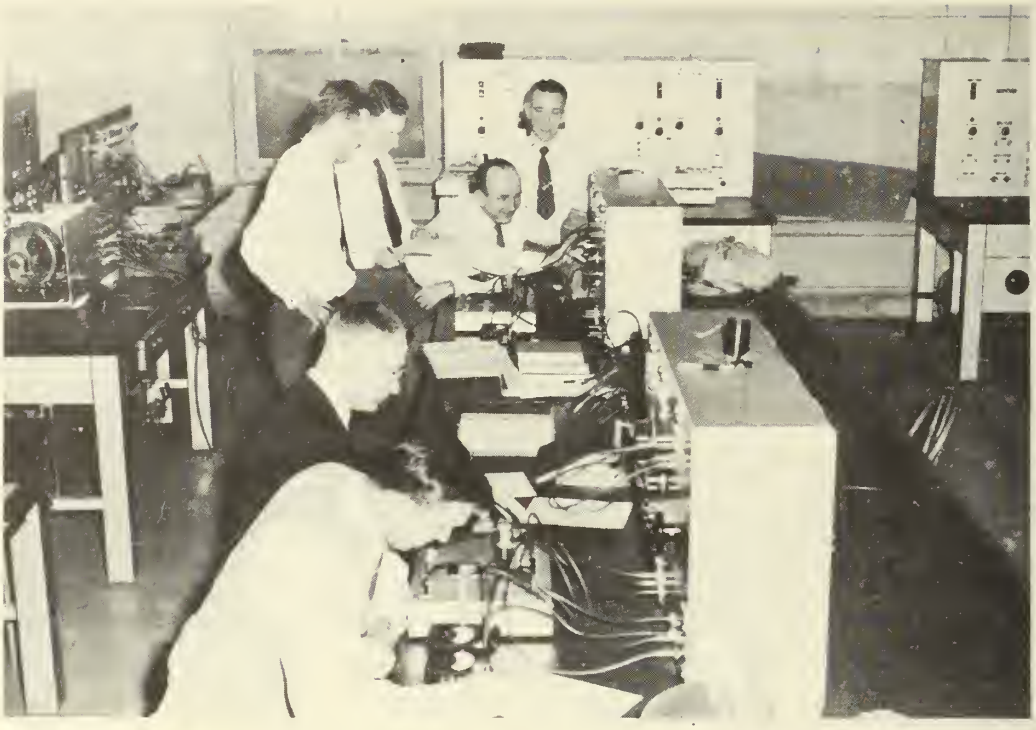
First Term			Second Term		
Ma 105(A)	Fourier Series	4-0	Ma 106(A)	Complex Variables	4-0
Ae 501(A)	Theory of Aero	4-0	Ae 502(A)	Theory of Aero	4-0
Ch 541(A)	Reaction Motors	2-2	ME 611(C)	Mat. Test Lab	2-2
ME 511(C)	Str. of Materials	5-0	Ch 111(C)	Fuel & Oil Chem	2-2
Ch 612(C)	Thermodynamics	3-2	Mt 202(C)	Phys. Met	3-2
			IE 101(C)	Ind. Org	0-1
	Total	18-4		Total	15-7

Third Term			Fourth Term		
Ae 451(C)	Gas Turbine Sem	3-0	Mt 301(A)	High Temp Mat	3-0
Ae 503(A)	Supersonic Aero	3-2	Ae 452(C)	Gas Turbine Sem	3-0
Ch 701(C)	Chem. Eng. Cal	3-2	Ae 431(A)	Gas Turbine & Jets	4-0
ME 622( )	Exp. Stress Anal	2-2	ME 310(B)	Heat Transfer	3-2
Mt 203(B)	Phys. Met	2-2	EE 751(C)	Electronics	3-4
*IE 103	Ind. Eng	0-1	*IE 104	Human Eng	0-1
*SL 101	New Weapons	0-1	*SL 102	New Weapons	0-1
	Total	13-10		Total	16-8

* Lecture course — no academic credit.

THIRD YEAR (NJ3)

At Massachusetts Institute of Technology.



Electrical Laboratory, U. S. Naval Postgraduate School, Annapolis, Maryland.

ELECTRICAL ENGINEERING CURRICULA

Objective

The objective of these curricula is to develop officers in technical electrical engineering to direct the inspection, installation, maintenance, operation and repair of naval machinery and equipment, with the exception of radio and underwater sound equipment.

Specifically, the objective is to provide officers, subject to have attained suitable rank and experience, competent to perform the following duties:

(a) Engineer officers of all types of naval vessels, and staff engineers afloat.

(b) Assignment to the operation and maintenance divisions of the Bureau of Ships.

(c) Assignment to navy yards, repair ships, and repair bases in connection with production, or maintenance and repair.

(d) Assignment to test and research activities such as the Naval Boiler Laboratory, Engineering Experiment Station, Naval R search Laboratory, and Material Test Laboratory.

(e) Inspectors of naval machinery and material.

SECOND YEAR (NL2) GROUPS ENTERING PRIOR 1951

First Term			Second Term		
Ma 105(A)	Fourier Ser. & Boundary Value Probs.	4-0	Ma 106(A)	Complex Var. & Laplace	4-0
EE 471(C)	Trans. Async. Mach. & Synchros.	4-5	EE 472(C)	Synchronous Mach.	4-5
ME 112(B)	Thermodynamics	4-2	EE 971(A)	Seminar	1-0
Mt 203(B)	Phys. Metallurgy	2-2	ME 411(C)	Hydromechanics	3-2
			ME 211(C)	Mar. P.P. Equipment	3-2
			*IE 101	Ind. Org	0-1
	Total	13-8		Total	14-9

* Lecture course - no academic credit.

ELECTRICAL ENGINEERING (Continued)

SECOND YEAR (NL2) GROUPS ENTERING PRIOR 1951 (Continued)

Third Term			Fourth Term		
Ph 361(A)	Electromagnetism	3-0	ME 310(B)	Heat Transfer	3-2
EE 571(B)	Trans. Lines & Filters	3-4	Ph 362(A)	Electromagnetic Waves	3-0
EE 971(A)	Seminar	1-0	EE 772(B)	Electronics	3-2
ME 212(C)	Mar. P.P. Equipment	3-2	EE 971(A)	Seminar	1-0
EE 771(B)	Electronics	3-2	Ma 301(B)	Statistics	3-2
*IE 103	Ind. Org.	0-1	*IE 104	Human Eng	0-1
*SL 101	New Weapons	0-1	*SL 102	New Weapons	0-1
	Total	13-10		Total	13-8

Intersessional Field Trip

*Lecture course — no academic credit.

THIRD YEAR (NL3) GROUPS ENTERING PRIOR 1951

First Term			Second Term		
EE 871(A)	Elect. Mach. Design	4-0	Mt 301(A)	High Temp. Met	3-0
EE 671(A)	Transients	3-4	EE 872(A)	Elect. Mach. Design	4-0
ME 215(A)	Mar. P.P. Analysis	2-4	EE 971(A)	Seminar	1-0
NE 101(C)	Mar. Eng. (Main Prop.)	3-0	EE 672(A)	Servo. Mechanisms	3-4
				Thesis	3-0
	Total	12-8		Total	14-4

Third Term			Fourth Term		
EE 873(A)	Elect. Mach. Design	4-0	ME 217(C)	Int. Comb. Eng	4-2
EE 971(A)	Seminar	1-0	EE 971(A)	Seminar	1-0
NE 102(C)	Mar. Eng. (Aux. Mach.)	3-0	NE 103(C)	Mar. Eng. Org	1-0
	Thesis	9-0		Thesis	12-0
	Total	17-0		Total	18-2

FIRST YEAR (NL) GROUPS ENTERING 1951

First Term			Second Term		
Ma 101(C)	Intro. to Eng. Math	5-0	ME 500(C)	Str. of Materials	3-0
Ma 201(C)	Graph. & Mech. Comp	0-2	Ma 102(C)	Diff. Equ. & Series	5-0
Mc 101(C)	Engineering Mechanics I	3-0	Mc 102(C)	Engineering Mechanics II	3-0
Ch 101(C)	General Chemistry	3-2	Ch 111(A)	Fuel & Oil Chemistry	2-2
EE 171(C)	Elect. Circ. & Fields	3-4	EE 271(C)	A.C. Circuits	3-2
			ME 601(C)	Mat. Test Lab	0-2
	Total	14-8		Total	16-6

Third Term			Fourth Term		
Ph 610(B)	Atomic Physics	3-0	Ma 104(A)	Part. Diff. Equa	5-0
Ma 103(B)	Funct. Sev. Var & Vector Analysis	5-0	Mt 202(C)	Phys. Met. (Ferrous)	3-2
Mc 201(A)	Methods of Dynamics	2-2	ME 111(C)	Thermodynamics	4-2
Mt 201(C)	Physical Met	3-2	EE 371(C)	D.C. Machinery	3-2
EE 272(C)	A.C. Circuits	2-2			
	Total	15-6		Total	15-6

Intersessional Field Trip

ELECTRICAL ENGINEERING (Continued)

SECOND YEAR (NL2) 1951-1953 GROUP

First Term

EE 471(C)	Trans. Asynch. & Synchros	3-4
ME 112(B)	Thermodynamics	4-2
Mt 203(B)	Phys. Metallurgy	2-2
Mt 301(A)	High Temp. Met.	3-0
NE 101(C)	Mar. Eng. (Main Prop.)	3-0
	Total	15-8

Second Term

EE 472(C)	Synchronous Mach.	3-4
EE 651(B)	Transients & Servos	3-4
EE 971(A)	Seminar	1-0
ME 221(C)	Mar. P.P. Equipment	3-2
ME 421(C)	Hydromechanics	3-2
*IE 101	Indust. Org.	0-1
	Total	13-13

Third Term

EE 571(B)	Trans. Lines & Filters	3-4
EE 771(B)	Electronics	3-2
EE 971(A)	Seminar	1-0
ME 222(C)	Mar. P.P. Equipment	3-4
NE 102(C)	Mar. Eng. (Aux. Mach.)	3-0
*IE 103	Ind. Org.	0-1
*SL 101	New Weapons	0-1
	Total	13-12

Fourth Term

EE 772(B)	Electronics	3-2
EE 971(A)	Seminar	1-0
ME 217(C)	Int. Comb. Engines	4-2
ME 310(B)	Heat Transfer	3-2
NE 103(C)	Mar. Eng. Org	1-0
*IE 104	Human Eng	0-1
*SL 102	New Weapons	0-1
	Total	12-8

*Lecture course — no academic credit.

SECOND YEAR (NLA2) 1951-1954 GROUP

First Term

EE 471(C)	Trans. Asynch. & Synchros	3-4
ME 112(B)	Thermodynamics	4-3
Mt 203(B)	Phys. Metallurgy	2-2
Mt 301(A)	High Temp. Met.	3-0
NE 101(C)	Mar. Eng. (Main Prop.)	3-0
	Total	15-8

Second Term

Ma 106(A)	Comp. Var. & Laplace	4-0
EE 472(C)	Synchronous Mach.	3-4
EE 971(A)	Seminar	1-0
ME 221(C)	Mar. P.P. Equipment	3-2
ME 421(C)	Hydromechanics	3-2
*IE 101	Ind. Org	0-1
	Total	14-9

Third Term

EE 571(B)	Trans. Lines & Filters	3-4
EE 771(B)	Electronics	3-2
EE 971(A)	Seminar	1-0
ME 222(C)	Mar. P.P. Equipment	3-4
NE 102(C)	Mar. Eng. (Aux. Mach.)	3-0
*IE 103	Ind. Org.	0-1
*SL 101	New Weapons	0-1
	Total	13-12

Fourth Term

EE 772(B)	Electronics	3-2
EE 971(A)	Seminar	1-0
Ma 301(B)	Statistics	3-2
ME 223(B)	Mar. P.P. Analysis	2-4
ME 310(B)	Heat Transfer	3-2
*IE 104	Human Eng	0-1
*SL 102	New Weapons	0-1
	Total	12-12

*Lecture course — no academic credit.
Intersessional Field Trip.

ELECTRICAL ENGINEERING (Continued)

THIRD YEAR (NLA3) 1951-1954 GROUP

First Term

Ma 105(A) Fourier Ser. & Boundary Value Problems	4-0
EE 671(A) Transients	3-4
EE 871(A) Elect. Mach. Design	4-0
Ph 361(A) Electromagnetism	3-0
Total	14-4

Second Term

EE 672(A) Servomechanisms	3-4
EE 872(A) Elect. Mach. Design	4-0
EE 971(A) Seminar	1-0
Ph 362(A) Electro. Waves	3-0
EE 972(A) Thesis	2-6
Total	13-10

Third Term

EE 873(A) Elect. Mach. Design	4-0
EE 971(A) Seminar	1-0
EE 972(A) Thesis	2-20
Total	7-20

Fourth Term

ME 217(C) Int. Comb. Engines	4-2
EE 971(A) Seminar	1-0
NE 103(C) Mar. Eng. Org	1-0
EE 972(A) Thesis	2-18
Total	8-20

Metallurgical Engineering Laboratory, U. S. Naval Postgraduate School, Annapolis, Maryland.

METALLURGICAL ENGINEERING

METALLURGICAL CURRICULA — NM GROUPS

The objective of these curricula is to provide the training necessary for a selected group of officers to be:

(a) Capable of supervising and directing activities at the Standards Branch Bureau of Ships relating to metals and alloys.

(b) To advise the Bureau of Ships of developments in metallurgy that may be of value in ship design, maintenance, and operation.

(c) To be capable of directing and supervising research activities involving metals and alloys, and direct activities in Naval Establishments concerned with production, maintenance, and repair.

FIRST YEAR (NM)

First Term		Second Term	
Ma 151(C) Intro. to Eng. Math	4-0	Ma 152(B) Diff. Equa. &Boundary Value Probs	4-0
Ma 201(C) Graph. & Mech. Comp	0-2	Mc 102(C) Engineering Mechanics I	3-0
Mc 101(C) Engineering Mechanics 1	3-0	Ch 221(C) Qual. Anal	3-2
Ch 101(C) General Chem	3-2	ME 500(C) Str. of Mat	3-0
EE 171(C) Electr. Circ. & Fields	3-4	ME 601(C) Mat. Test Lab	0-2
		EE 251(C) A.C. Circuits	3-4
Total	13-8	Total	16-8

METALLURGICAL ENGINEERING (Continued)

FIRST YEAR (NM) (Continued)

Third Term			Fourth Term		
Ma 153(B)	Vector Anal. & Intro. to Partial Dif. Eqs	3-0	Ma 154(A)	Partial Diff. Eq. & Functions of Comp. Var.	3-0
Ch 231(C)	Quant. Anal	2-4	Ch 611(C)	Thermodynamics	3-2
Ch 411(C)	Phys. Chem	3-2	Ch 412(C)	Phys. Chem	2-2
Mt 201(C)	Phys. Met	3-2	Mt 202(C)	Phys. Met	3-2
Ph 610(B)	Atomic Physics	3-0	Mt 203(B)	Phys. Met	2-2
	Total	14-8		Total	13-8

Intersessional Field Trip.

SECOND YEAR (NM2)

First Term			Second Term		
Cr 271(B)	Cry. & X-ray	3-2	Mt 204(A)	Phys. Met	3-4
Ch 612(C)	Thermodynamics	3-2	Mt 205(A)	Adv. Phys. Met	3-4
Mt 301(A)	High Temp. Met	3-0	ME 711(C)	Mech. of Mach	3-2
EE 314(C)	D.C. & A.C. Mach	3-4	ME 421(C)	Hydro. Mech.	3-2
Mt 102(C)	Prod. of Steel	3-0	*IE 101	Ind. Eng.	0-1
	Total	15-8		Total	12-13

Third Term			Fourth Term		
Mt 103(C)	Prod. of Metals	3-0	Ma 301(B)	Statistics	3-2
Mt 302(A)	Alloy Steels	4-2	Mt 303(A)	Met. Seminar	2-0
Ch 521(A)	Plastics	3-2	Mt 401(A)	Phys. of Met	3-0
ME 422(B)	Hydromech.	2-2	Mt 206(A)	Adv. Phys. Met	3-2
ME 622( )	Exp. Stress Anal	2-2	Ch 531(A)	Phys. Chem.	3-0
*IE 103	Ind. Eng	0-1	ME 310(B)	Heat Transfer	3-2
*SL 101	New Weapons	0-1	*IE 104	Human Eng.	0-1
			*SL 102	New Weapons	0-1
	Total	14-8		Total	17-8

Intersessional Field Trip for students selected for a third year.

THIRD YEAR (NM3)

At Carnegie Institute of Technology for selected students.

*Lecture course — no academic credit.

PETROLEUM ENGINEERING NP Groups

PETROLEUM CURRICULA — NP GROUPS

Objective

The objective of these curricula is, by means of practical and theoretical instruction, to qualify certain officers of the U. S. Navy in the technology of petroleum production, refining, and utilization of by-products therefrom, in preparation for future duties involving the development, properties, uses, and application of fuels and lubricants in the Naval Establishment.

PETROLEUM ENGINEERING NP Groups (Continued)

FIRST YEAR (NP)

First Term		Second Term	
Ma 171(C) Special Topics in Calc.	3-0	Ma 172(C) Fourier Series	3
Ma 201(C) Graph & Mech. Comp	0-2	Ch 221(C) Qual. Anal	3
Mc 101(C) Engineering Mechanics I	3-0	Ch 111( ) Fuel & Oil Chem	2
Ch 101(C) General Chem	3-2	Ge 101(C) Phys. Geology	3
EE 171(C) Elect. Circ. & Fields	3-4	ME 500(C) Str. of Materials	3
		ME 600(C) Mat. Test Lab	0
Total	12-8	Total	14

Third Term		Fourth Term	
Ch 231(C) Quant. Anal	2-4	Ch 412(C) Phys. Chem	2
Ch 411(C) Phys. Chem	3-2	Ge 241(C) Geol. of Petrol	2
Ch 315(C) Org. Chem	3-4	Ge 401(C) Petrol. & Petrogr.	2
Ge 302(C) Determ. Min	1-4	Mt 202(C) Phys. Met	3
Mt 201(C) Phys. Met.	3-2	Cr 301(B) Cryst. & Min.	3
Total	12-16	Total	12-

Intersessional Field Trip.

*Lecture course — no academic credit.

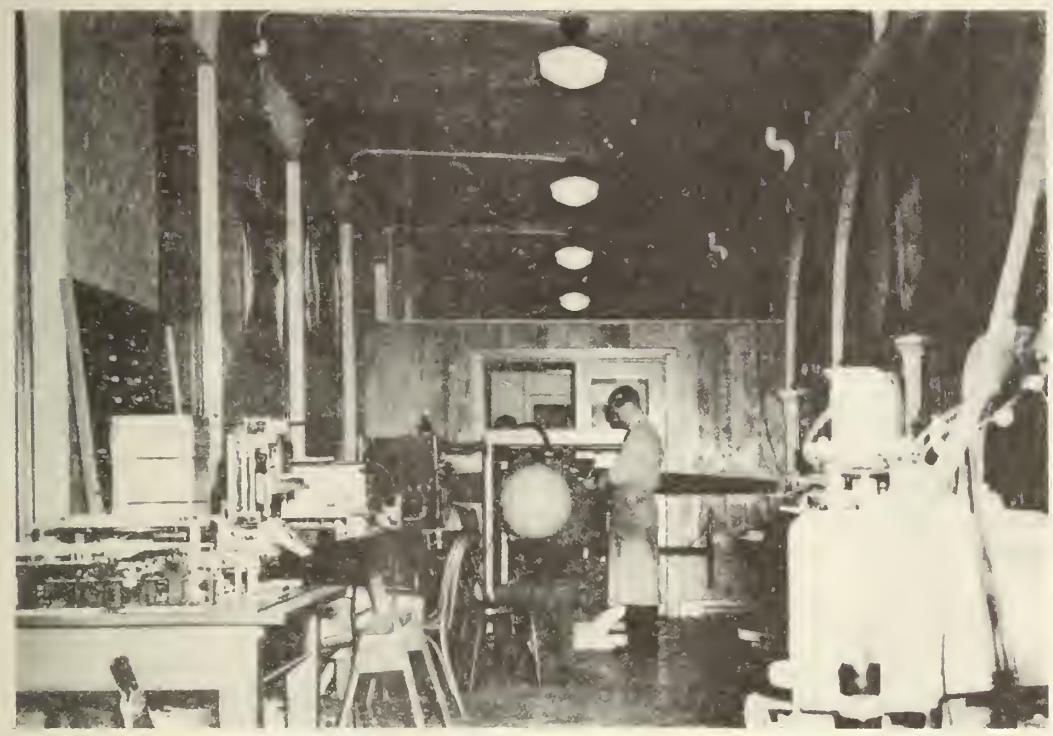
SECOND YEAR (NP2)

At Lehigh University

Intersessional Field Trip for students selected for a third year.

THIRD YEAR (NP3)

At Lehigh University for selected students.



Ordnance Laboratory, U. S. Naval Postgraduate School, Annapolis, Maryland.

ORDNANCE ENGINEERING CURRICULA

The objective of all Ordnance Engineering curricula is to prepare officers for shore duty assignments under the cognizance of the Bureau of Ordnance. This duty includes technical and technical administrative billets within the Bureau of Ordnance and in its field activities, which include the Naval Ordnance Test Stations, the Naval Proving Ground, the Naval Ordnance Laboratory, the Naval Ammunition Depots and Magazines, the Naval Gun Factory, the Naval Ordnance Plants and the Naval Powder Factory. While the curricula are definitely pointed toward shore duty assignments in ordnance activities, the knowledge acquired will be of exceedingly great value in gunnery billets afloat.

ORDNANCE ENGINEERING

GENERAL ORDNANCE CURRICULA — O GROUPS

Objective

The objective of the Ordnance Engineering (General) curricula is to prepare officers for future duties as inspectors of ordnance material, to equip them to deal with problems of development and production in Bureau of Ordnance establishments, and to give them the basic technical education to become expert operators of ordnance equipment afloat.

FIRST YEAR (O)

First Term			Second Term		
Ma 151(C)	Intro. to Eng. Math	4-0	Ma 152(B)	Diff. Equa. & Boundary Value Probs	4-0
Mc 101(C)	Engineering Mechanics I	3-0	Mc 102(C)	Engineering Mechanics II	3-0
Ch 101(C)	General Chem	3-2	Ch 711(C)	Chem. Eng. Calc	3-2
EE 151(C)	D. C. Circuits & Fields	3-4	EE 241(C)	A. C. Circuits	3-2
Or 120(C)	Surface Fire Control	2-0	Ph 250(C)	Optics	3-2
			*IE 101	Prin. Indust. Org	0-1
Total		15-6	Total		16-7

ORDNANCE ENGINEERING (Continued)

FIRST YEAR (O) (Continued)

Third Term

Ma 153(B)	Vector Analysis & Intro. to Part. Dif. Equations	3-0
Ph 610(C)	Atomic Physics	3-0
Ch 631(A)	Chem. Eng. Thermo	3-2
EE 461(C)	Transformers & Synchros	3-2
Ma 301(B)	Statistics	3-2
Or 131(C)	A.A. Fire Control	2-0
*IE 103	Applied Indust. Org	0-1
*SL 101	New Weapons Lect	0-1
	Total	17-8

Fourth Term

Ma 154(A)	Part. Diff. Eq. & Functions of Complex Variables	3-0
EE 462(B)	Asyn. Motors & Spec. Machines	4-2
Ph 450(B)	Underwater Acoustics	3-2
Ch 401(A)	Physical Chem	3-2
Mc 421(A)	Interior Ballistics	2-0
Or 132(C)	A.A. Fire Control	2-0
*IE 104	Psychophysical Sys. Lect.	0-1
*SL 102	New Weapons Lect	0-1
	Total	17-8

Intersessional Field Trip.
*Lecture course — no academic credit.

SECOND YEAR (O2)

First Term

ME 500(C)	Strength of Materials	3-0
ME 601(C)	Mat. Test. Lab	0-2
Ch 541(A)	Reaction Motors	2-2
Mt 201(C)	Intro. Phys. Metallurgy	3-2
EE 655(B)	Filters, Lines & Transients	4-2
Or 141(C)	Guided Missiles	2-0
	Total	14-8

Second Term

ME 441(C)	Fluid Mechanics	3-2
Mt 202(C)	Ferrous Phys. Met	3-2
EE 751(C)	Electronics	3-4
ME 542(B)	Adv. Strength of Mat	3-0
Or 142(C)	Guided Missile Guidance	2-0
	Total	14-8

Third Term

ME 442(A)	Compressible Flow	3-2
Mt 203(B)	Phys. Met	2-2
EE 745(A)	Electronic Control & Meas	3-3
Es 447(C)	Electronic Pulse Tech	3-0
Mc 401(A)	Exterior Ballistics	3-0
Or 151(C)	Underwater Ord.	2-0
*IE 103	Applied Ind. Org. Lect	0-1
*SL 101	New Weapon Lect	0-1
	Total	16-9

Fourth Term

ME 740(C)	Kinematics & Mach. Design	3-2
Mt 301(A)	High Temp. Materials	3-0
EE 662(A)	Servomechanisms	3-3
Ch 521(A)	Plastics	2-2
Mc 402(A)	Dyn. of Rigid Body	3-0
Or 152(C)	Underwater Ord.	2-0
*IE 104	Psycho. Sys. Res. Lect	0-1
*SL 102	New Weapon Lect	0-1
	Total	16-9

Intersessional Field Trip.

*Lecture course — no academic credit.

THIRD YEAR (03)

At M. I. T.

Fall Term

16.40 Space Kin. & Gyro. Inst. Theory
16.41 Intro. to F. C. Inst.
16.43 F. C. Inst. Lab.
6.291 Princ. of Radar
6.536 Mech. Computation
- - Thesis

Spring Term

16.42 Adv. F.C. Inst.
16.46 Adv. F.C. Lab.
6.292 Princ. of Radar
- - Thesis

ORDNANCE ENGINEERING (Continued)

JET PROPULSION ORDNANCE CURRICULA — OJ GROUPS

Objective

The objective of these curricula is to prepare officers for duties in connection with research and development in the ordnance specialization indicated above.

FIRST YEAR (OJ)

First Term			Second Term		
Ma 151(C)	Intro. to Eng. Math	4-0	Ma 152(B)	Diff. Equa. & Boundary Value Probs	4-0
Mc 101(C)	Engineering Mechanics I	3-0	Mc 102(C)	Engineering Mechanics II	3-0
Ch 101(C)	Gen'l Chem	3-2	Ch 711(C)	Chem. Eng. Calc.	3-2
EE 151(C)	DC Circuits & Fields	3-4	EE 241(C)	A. C. Circuits	3-2
Or 120(C)	Surface F. C.	2-0	Ae 100(C)	Basic Aerodynamics	3-4
			Ae 001(C)	Aero. Lectures	0-2
			*IE 101	Prin. Indust. Org	0-1
	Total	15-6		Total	16-11

Third Term			Fourth Term		
Ma 153(B)	Vector Analysis & Intro. to Partial Diff. Eqs	3-0	Ma 154(C)	Partial Diff. Eq. & Functions of Complex Var	3-0
Ch 631(A)	Chem. Eng. Thermo	3-2	Ch 401(A)	Physical Chem	3-2
EE 461(C)	Transformer & Synchros	3-2	EE 462(B)	Asychronous Motors Special Machines	4-2
Ma 301(B)	Statistics	3-2	Mc 421(A)	Interior Ballistics	2-0
Ae 121(C)	Tech. Aerodynamics	3-2	Ae 136(B)	Aircraft Performance	3-2
*SL 101	New Weapons Lect	0-1	*SL 102	New Weapons Lect	0-1
*IE 103	Applied Indust. Org	0-1	*IE 104	Psychophysical Sys. Lect.	0-1
	Total	15-10		Total	15-8

Intersessional Field Trip.

SECOND YEAR (OJ2)

First Term			Second Term		
ME 500(C)	Strength of Material	3-0	Me 542(C)	Strength of Materials	3-0
ME 601(C)	Mets. Testing Lab.	0-2	EE 751(C)	Electronics	3-4
Ch 541(A)	Reaction Motors	2-2	Mt 202(C)	Ferrous Phys. Met	3-2
Mt 201(C)	Intro. Phys. Met	3-2	Ae 502(A)	Hydro-Aero Mech. II	4-0
Ae 501(A)	Hydro-Aero-Mechanics	4-0	Or 142(C)	Guided Missile Guidance	2-0
Or 141(C)	Guided Missiles	2-0			
	Total	14-6		Total	15-6

Third Term			Fourth Term		
Mt 203(B)	Phys. Met	2-2	Mt 310(A)	High Temp. Met.	3-0
EE 745(A)	Electronic Control & Meas.	3-3	EE 662(A)	Servomechanism	3-3
Mc 401(A)	Exterior Ballistics	3-0	Mc 402(A)	Dynamics & Missiles & Gyros	3-0
Ae 503(A)	Compressibility	4-0	Me 740(C)	Kinematic & Mach. Design	3-2
Or 151(C)	Underwater Ord	2-0	Ch 301(C)	Organic Chem.	3-2
Or 131(C)	AAFC	2-0	Or 152(C)	Underwater Ord	2-0
Sl 101	New Weapons Lect.	- -	Sl 102	New Weapons Lect.	- -
IE 103	Applied Indust. Org	- -	IE 104	Psychophysical System.	- -
	Total	16-5		Total	17-7

Intersessional Field Trip

*Lecture course — no academic credit.

JET PROPULSION ORDNANCE (Continued)

THIRD YEAR (OJ3)
At Cal. Inst. of Technology

First Term	Second Term	Third Term
AE 261 Hydrodynamics	Same as	Same as
AE 272 Precision Meas.		
AE 290 Aeronautics Seminar	First	First
JP 121 Rockets		
JP 130 Thermal Jets	Term	Term
JP 170 Jet Prop. Lab.		
JP 200 Chem. Probs. in Jet Prop.		
JP 210 High Temp. Design Probs.		
JP 280 Research Jet Probs.		

METALLURGICAL ORDNANCE CURRICULA — OM GROUPS

Objective

The objective of these curricula is to prepare officers for duties in connection with research and development in the ordnance specialization indicated above.

FIRST YEAR (OM)

First Term		Second Term	
Ma 151(C) Intro. Eng. Math	4-0	Ma 152(B) Diff. Equa. & Boundary Value Probs	4-0
Mc 101(C) Statics & Kinematics	3-0	Ch 221(C) Qual. Analysis	3-2
Ch 101(C) Gen'l. Chem	3-2	Ph 610(C) Atomic Physics	3-0
EE 151(C) Elec. & Mag	3-4	EE 241(C) A. C. Theory	3-2
Or 120(C) Surface F.C.	2-0	ME 500(C) Strength of Mat	3-0
		ME 601(C) Materials Testing Lab	0-2
		*IE 101 Princ. Indust. Org. Lect	0-1
Total	15-6	Total	16-7

Third Term		Fourth Term	
Ma 153(B) Vector Analysis & Intro. to Partial Diff. Eq	3-0	Ma 154(A) Partial Diff. Eq. & Function of Complex Var.	3-0
Ch 231(C) Quantitative Analysis	2-4	Mt 203(B) Phys. Met. (Special topic)	2-2
Ch 411(C) Phys. Chem	3-2	Ch 412(C) Phys. Chem	3-2
Mt 201(C) Intro. Phys. Met	3-2	Mt 202(C) Ferrous Phys. Met	3-2
EE 461(C) Transformers & Synchros.	3-2	EE 462(B) Asynchronous Motor & Special Machines	4-2
*SL 101 New Weapons Lect	0-1	*SL 102 New Weapons Lect	0-1
*IE 103 Applied Indust. Org. Lect	0-1	*IE 104 Psycho. Systems Res	0-1
Total	14-12	Total	15-10

Intersessional Field Trip
*Lecture course — no academic credit.

METALLURGICAL ORDNANCE (Continued)

SECOND YEAR (OM2)

First Term			Second Term		
Mt 102(C)	Production of Steel	3-0	Mt 205(A)	Adv. Phys. Met	3-4
Mt 301(A)	High Temp. Materials	3-0	Mt 204(A)	Phys. Met	3-4
Cr 271(B)	Crystal & X-Ray Tech	3-2	ME 542(C)	Adv. Strength of Mat	3-0
Ph 240(C)	Optics	3-3	EE 751(C)	Electronics (Basic)	3-4
EE 665(B)	Filters Trans. Lines & Transients	4-2			
	Total	16-7		Total	12-12

Third Term			Fourth Term		
Mt 103(C)	Production non-ferrous Metals	3-0	Mt 401(A)	Physics of Metals	3-0
Mt 302(A)	Alloy Steels	4-2	Ch 531(A)	Phys. Chem. of Met	2-0
Ch 521(A)	Plastics	2-2	Mt 303(A)	Metals Seminar	2-0
ME 622(B)	Exp Stress Analysis	2-2	Mt 206(A)	Adv. Phys. Met	3-2
EE 745(A)	Electronic Control & Meas	3-3	Ma 301(B)	Statistics & Qual. Con	3-2
*SL 101	New Weapons Lect	0-1	EE 662(A)	Servomechanisms	3-3
*IE 103	Applied Indus. Org. Lect	0-1	*SL 102	New Weapons Lect	0-1
			*IE 104	Psycho. Sys. Res. Lect	0-1
	Total	14-11		Total	16-9

*Lecture — no academic credit.
Intersessional Field Trip

THIRD YEAR (OM3)

At Carnegie Inst. of Technology

First Semester	Second Semester
GE 655a Met. Problems	GE 655b Met. Problems
GE 664a Adv. Phys. Met.	GE 664a Adv. Phys. Met.
GE 657a Alloy Steels	GE 657b Alloy steels
GE 674a Grad. Seminar	GE 674b Grad. Seminar
GE 663 Crystallography	GE 660 Phys. Chem. of Met. Reactions
GE 697 Ordnance Met.	GE 663c Radiography
E 651 Mechanical Met.	E 647 Non-ferrous Metallograph
E 647 Non Ferrous Metallog.	
E 641 Ferrous Metallog. (audit)	
E 630 Ferrous Metallurgy (audit)	

CHEMICAL ORDNANCE CURRICULA — OP GROUPS

Objective

The objective of these curricula is to prepare officers for duties in connection with research and development in the ordnance specialization indicated above.

CHEMICAL ORDNANCE (Continued)

FIRST YEAR (OP)

First Term

Ma 151(C)	Intro. Eng. Math	4-0
Mc 101(C)	Engineering Mechanics I	3-0
Ch 101(C)	Gen'l Chem	3-2
EE 151(C)	Elec. & Mag	3-4
Cr 120(C)	Surface F. C	2-0
	Total	15-6

Second Term

Ma 152(B)	Diff. Equa. and Boundary Value Probs	4-0
ME 500(C)	Strength of Materials	3-0
ME 601(C)	Materials Testing Lab	0-2
Ch 221(C)	Qual. Analysis	3-2
Ch 711(C)	Chem. Eng. Calc	3-2
EE 241(C)	A. C. Theory	3-3
*IE 101	Princ. Indust. Org. Lect	0-1
	Total	16-10

Third Term

Ma 153(B)	Vector Analysis & Intro. to Partial Diff. Eq	3-0
Ch 231(C)	Quantitative Analysis	2-4
Ch 311(C)	Organic Chem	3-2
Ch 411(C)	Phys. Chem	3-2
EE 461(C)	Transformer & Synchros	3-2
*SL 101	New Weapons Lect	0-1
*IE 103	Applied Indust. Org. Lec	0-1
	Total	14-12

Fourth Term

Ma 154(A)	Partial Diff. Eq. & Function of Complex Var	3-0
Ch 611(C)	Thermodynamics	3-2
Ch 312(C)	Organic Chem	3-2
Ch 412(C)	Phys. Chem	3-2
EE 462(B)	Asynchronous Motors & Special Machines	4-2
*SL 102	New Weapons Lect	0-1
*IE 104	Psychro. Sys. Res. Lect	0-1
	Total	16-10

SECOND YEAR (OP2)

First Term

Ch 541(A)	Reactions Motors	2-2
Ch 612(C)	Thermodynamics Tech	3-2
Cr 271(B)	Crystallography & X-ray	3-2
Mt 201(C)	Intro. Phys. Met	3-2
EE 665(B)	Filters, Transmission Lines & Transients	4-2
	Total	15-10

Second Term

Ch 413(A)	Adv. Phys. Chem	2-2
Mt 202(C)	Ferrous Phys. Met	3-2
EE 751(C)	Electronics (Basic)	3-4
Ph 250(C)	Optics	3-2
Ph 610(C)	Atomic Physics	3-0
	Total	14-10

Third Term

Ch 521(A)	Plastics	2-2
EE 745(A)	Electronic Cont. & Meas.	3-3
Ch 111(A)	Fuel & Oil Chem	2-2
Ch 323(A)	Chem. of High Polymers	3-0
Ch 321(A)	Organic Qual. Analysis	3-2
Or 151(C)	Underwater Ord	2-0
*SL 101	New Weapons Lect	0-1
*IE 103	Applied Indus. Eng. Lect	0-1
	Total	15-11

Fourth Term

Ma 301(B)	Statistics & Qual. Cont	3-2
EE 662(A)	Servomechanisms	3-3
Ch 800(A)	Chem. Seminar	2-0
Ch 322(A)	Adv. Organic Chem	3-2
Or 152(C)	Underwater Ord	2-0
*SL 102	New Weapons Lect	0-1
*IE 104	Psycho. Sys. Res. Lect	0-1
	Total	13-9

Intersessional Field Trip

*Lecture course — no academic credit.

CHEMICAL ORDNANCE (Continued)

THIRD YEAR (OP3)

At Lehigh University.

First Semester	Second Semester
Chem. 220 Adv. Phys. Chem.	Chem. 221 Adv. Phys. Chem.
Chem. 157 Qual. Organic Anal.	Chem. 158 Adv. Organic Chem.
Chem. 202 Adv. Inorganic Chem.	Chem. 232 Adv. Analytical Chem.
Chem. 2-- --- Chem. Research	Chem. 2-- --- Chem. Research
Ph. 160 Intro. to Modern Phys. Theories	Ph. 161 Intro. to Modern Phys. Theories

SPECIAL PHYSICS ORDNANCE CURRICULA — OX GROUPS

Objective

The objective of these curricula is to prepare officers for duties in connection with research and development in the ordnance specialization indicated above.

FIRST YEAR (OX)

Summer Term		Fall Term	
Es 111(C) D. C. Electricity	4-4	Es 112(C) A. C. Electricity	4-3
Ma 181(C) Directional Derivations & Line Intervals	5-0	Ma 182(B) Dif. Eqs. & Vect. Anal	5-0
Mr 101(C) Atmos. Circulation	3-0	Ph 141(B) Analytical Mech	4-0
Ch 101(C) Gen. Inorganic Chem.	3-2	Or 142(C) Guided Missiles Guid	2-0
Or 141(C) Guided Missiles	2-0	Ph 250(C) Optics	3-2
Total	17-6	Total	18-5

Winter Term		Spring Term	
Ma 183(B) Comp. Var. & Diff. Eqs. of Theoretical Physics	5-0	Ma 194(A) Matrices, Laplace Transforms. & Variations	5-0
EE 451(C) Transformers & Synchros	2-2	EE 651(B) Servomech. & Transients	3-4
Es 113(C) Circuit Anal. & Meas.	3-3	Es 114(C) Circuit Anal. & Meas.	3-3
Es 261(C) Electron Tubes & Cir	3-2	Es 262(C) Electron Tubes & Cir.	3-2
*SL 101 New Weapons Dev. Lect.	0-1	*SL 102 New Weapons Dev. Lect.	0-1
Ph 142(B) Analytical Mechanics	4-0		
Total	17-8	Total	14-10

SECOND YEAR (OX2)

At M. I. T.

Summer Term

First Half	Second Half
8.071 Thermo. & Statist. Mech.	6.80 Elec. Meas. Lab.
6.20 Elect. Cont. & Meas.	8.08 Electronics

Intersessional Field Trip

*Lecture course — no academic credit.

SPECIAL PHYSICS ORDNANCE (Continued)

SECOND YEAR (OX2) (Continued)

Fall Term	Spring Term
6.623 Pulse Circuits Prin.	8.101T Atomic Structure Lab.
8.71 Int. to Theo. Physics I	8.72 Int. to Theo. Physics II
L17 Scientific German	8.102 Electronic Devices Lab.
6.561 Network Theory Adv.	8.06 Nuclear Physics
8.05 Atomic Physics	6.633 Electronic Circuit Theory

Intersessional Field Trip

THIRD YEAR (OX3)

At M. I. T.

Fall Term	Spring Term
8.511 Nuclear Physics I	8.512 Nuclear Physics II
8.57 Int. to Nuclear Engineering	8.513 Nuclear Physics Lab.
8.60T Spec. Prob. in Nuclear Physics	Thesis
8.361 Quantrum Theory of Matter	

OPERATIONS ENGINEERING

OPERATIONS ANALYSIS CURRICULA — RO GROUPS

Objective

The objective of these curricula is to further educate selected officers in general engineering and science, in basic principles of operations research, and in the application of those principles to naval problems. Operations research may be defined as "a scientific method of providing commanders with a quantitative basis for decisions regarding operations under their control."

Field work in this course will consist of active participation in the solving of current problems under the direction of Commander Operational Development Force.

FIRST YEAR (RO)

First Term		Second Term	
Ma 181(C) Directional Derivatives & Line Intervals	5-0	Ma 182(B) Dif. Eqs. & Vector Analysis	5-0
Ma 251(C) Graphical and Mech. Comp	0-4	Ma 381(B) Probability I	4-0
Ph 240(C) Geom. Optics and Phys. Opt.	3-3	Ph 141(B) Mechanics	4-0
Ch 101(C) General Chemistry	3-2	Ph 341(C) Electricity & Mag	4-2
Or 120(C) Surface Fire Control	2-0		
Total	13-9	Total	17-2

Third Term		Fourth Term	
Ma 183(B) Complex Variable & Dif. Eqs. of Theoretical Physics	5-0	Ma 184(A) Matrices, Tensors & Variations	5-0
Ph 142(B) Mechanics	4-0	Ph 362(A) Electromagnetic. Waves	3-0
Ph 361(A) Electromagnetism	3-0	Ph 640(B) Atomic Physics	3-3
Ma 382(A) Probability II	2-0	Oa 101(A) Applications of Probability & Kinematics to Operations Analy.	5-0
Oa 100(A) Classical Prob. in Operations Analysis	2-0	Or 132(C) A. A. Fire Control	2-0
Or 131(A) A. A. Fire Control	2-0	*IE 104 Psycho. Sys. Research	0-1
Total	18-0	Total	18-4

Intersessional Period — Six Weeks Practical Work.

*Lecture course — no academic credit.

OPERATIONS ENGINEERING (Continued)

SECOND YEAR (RO2)

First Term			Second Term		
Ph 421(A)	Acoustics	3-0	Ph 425(A)	Acoustics	3-2
Ph 530(B)	Thermodynamics	3-0	Es 446(C)	Introduction to Radar	2-2
Ma 581(A)	Theory of Games	4-0	Ph 540(B)	Kinetic Theory	3-0
Ma 383(A)	Statistics	2-3	Oa 103(A)	Formulation & Solution of Real Problems in Operations Analysis	5-3
Oa 102(A)	Measures of Operational Effectiveness & Effort	4-0			
Or 151(C)	Underwater Ordnance	2-0	Or 152(C)	Underwater Ordnance	2-0
	Total	18-3		Total	15-7

Six Months Practical Work

RADIOLOGICAL DEFENSE ENGINEERING

RADIOLOGICAL DEFENSE ENGINEERING CURRICULA — RZ GROUPS

Objective

The objective of these curricula is to qualify officers of the armed services in the fundamental sciences especially in those pertaining to nuclear and medical physics and in those associated with the problems that arise from the application of atomic energy.

FIRST YEAR (RZ)

Summer Term			Fall Term		
Ma 181(C)	Directional Derivatives and Line Intervals	5-0	Ma 182(B)	Dif. Eqs. and Vector Anal	5-0
Ph 240(C)	Geom. & Phys. Optics	3-3	Ph 141(B)	Analytical Mechanics	4-0
Ch 102(C)	Gen. Inorganic Chem.	4-2	Ph 341(C)	Electricity & Magnetism	4-2
Mr 101(C)	Atmosph. Circulation	3-0	Ch 213(C)	Quantitative Analysis	3-4
	Total	15-5		Total	16-6

Winter Term			Spring Term		
Ma 183(B)	Complex Var. & Dif. Eqs. of Theoretical Physics	5-0	Ma 184(A)	Matrices, Tensors & Variations	5-0
Ph 342(B)	Electricity & Magnet	3-3	Ph 343(B)	Electricity & Magnet	3-0
Ph 142(B)	Analytical Mechanics	4-0	Ph 640(B)	Atomic Physics	3-3
Ch 315(C)	Organic Chem	3-4	Ch 442(C)	Physical Chem	4-2
			Ph 540(B)	Kinetic Theory of Gases	3-0
	Total	15-7		Total	18-5

SECOND YEAR (RZ2)

At Univ. of Calif.

Summer Term

First Session		Second Session
Zoology 1A	General Zoology	Physiology 113 Adv. Physio.
Physiology 1A	General Physiology	

RADIOLOGICAL DEFENSE ENGINEERING (Continued)

SECOND YEAR (RZ2)

At Univ. of Calif.

Fall Semester	Spring Semester
Ph 121 Intro. to Atomic Structure	Ph 124 Radioactivity & Nuclear Struct.
Ph 128 & 128L Radiation Meas.	Biochem 103 Animal Biochemistry
Chem 123 Nuclear Chemistry	Biochem 206 Phy. Biochem.
Phys 100A (General & Comparative (Physiology	Ph 126 & 126L Biological Applications of Artificial Radioactivity
Pharmacology 142 - Pharmacology	Bact. 7 Gen'l Bacteriology

Intersessional Field Trip.

THIRD YEAR (RZ3)

At Univ. of Calif.

Fall Semester	Spring Semester
Ph 231A Adv. Quantum Mech. & Nuclear Physics	Ph 231B Adv. Quantum Mech. & Nuclear Physics
Ph 290 Seminar	Ph 290 Seminar
Pub Hlth 288 Public Health, Disaster Control	Phys 100D Gen'l Physiology
Chem. Rad. or extension of Ph 290	Final Comprehensive Exam.

SECOND YEAR (RZ2)

At Ohio State University

Summer Quarter

Zoology	401	General Zoology
Physics	726	Methods of Theoretical Physics
Physics	727	Methods of Quantum Mechanics I
Bacteriology	607	General Bacteriology

Autumn Quarter

Physics	721	Nuclear Physics
Physics	740	Introduction to Theoretical Physics
Physiology	601	Advanced Physiology
Anatomy		Histology

Winter Quarter

Physics	741	Introduction to Theoretical Physics
Physiol.	602	Advanced Physiology
Physiol.	646	Radiation Physiology

Spring Quarter

Physics	613	Electromagnetic Field Phenomena
Physiol.	603	Advanced Physiology
Physics	633	Nucleonic Meas.& Instrument
Elective		

Intersessional Field Trip.

RADIOLOGICAL DEFENSE ENGINEERING (Continued)

THIRD YEAR (RZ3)

At Ohio State University

Autumn Quarter

Physics	720	X-rays and Atomic Structures
Physics	950	Research in Physics
Physiol.	628	Physical Chem. Biology

Winter Quarter

Physics	820	Theory of the Atomic Nucleus
Physics	950	Research in Physics
Chem.	795	Celloid Chem.

Spring Quarter

Physics	821	Theory of the Atomic Nucleu
Physics	950	Research in Physics
Physiol.	645	Biophysics

PART III

COURSE DESCRIPTIONS

Descriptive name of course is followed by two numbers, separated by a hyphen. The first number is classroom hours, the second laboratory hours.

THE STATUS 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 semester credit-hour.

AEROLOGY

Mr Courses

Mr-101(C) Fundamentals of Atmospheric Circulation 3-0

This course serves as an introductory course in Meteorology, especially as it concerns large-and small-scale circulations, and the variations of these with height. It is designed primarily to give student officers in related subjects the required meteorological backgrounds, and, at the same time, to outline possible inter-relationships between the subjects.

Text: Introduction of Meteorology; Petterssen.

Prerequisites: None.

Mr-110(C) Radiological Defense 2-0

This course is devoted to discussions of explosion phenomena, the effects of blast and radiation, the aerological problem of fall-out, decontamination, and organization and training for radiological defense, the principle of operation and use of various instruments for measuring radiation intensity and dosage.

Text: USF 85

Prerequisites: Ph-190(C); Mr-302(C); for MA group. Mr-323(A) for M2 and MW2.

Mr-200(C) Introduction to Synoptic Meteorology 3-0

This course serves as a preparation for advanced study of synoptic meteorology. It is primarily an introduction to synoptic meteorology as a survey course, considering in turn the composition of the atmosphere, general circulation, air masses and air-mass changes, fronts, cyclones and anti-cyclones, weather analysis and weather forecasting.

Text: Introduction to Synoptic Meteorology; Petterssen.

Prerequisites: None.

Mr-201(C) Weather Maps and Codes 2-12

This course is concerned with the problems of observing, transmitting, and preparing for analysis the facts of the state of the atmosphere. It therefore considers the methods, instruments, and conventions used in observing; the reduction of the observed facts into short coded messages; and the decoding and plotting of the date on the standard charts used for weather analysis. A series of lectures and motion pictures is presented to give the student officers an outline of the principles of meteor-

ology. Finally, the students analyze an idealized and a six-hourly series of weather maps.

Texts: Hydrographic Office Publication H.O. 206: U. S. Weather Bureau-Circulars "S" and "N", Radiosonde Code, International Code: Aerographer's Manual.

Prerequisites: None.

Mr-202(C) Surface Weather Map Analysis and Forecasting 2-12

The principles of surface weather map analysis are demonstrated by having the students analyze current daily weather charts; correlate upper wind data with the surface charts; observe the local surface weather elements; discuss the map analysis; and make trial forecasts.

Text: Handbook of Meteorology; Berry, Bollay, Beers: Practical Aids in Weather Map Analysis; Lockhart: Weather Analysis and Forecasting; Petterssen.

Prerequisites: Mr-200(C); Mr-201(C).

Mr-203(C) Weather Analysis and Forecasting 2-12

This course is a continuation of course Mr-202(C). More advanced methods of current weather map analysis and forecasting are presented; and emphasis is placed on the application of analysis and forecast techniques previously presented in the theoretical courses. The students are taught the usefulness of upper air observations in determining air-mass characteristics, movements, etc. Daily forecasts and map discussions are included.

Texts: Handbook of Meteorology; Berry, Bollay, Beers: Constant Pressure Analysis; NavAer 50-1R-177: Constant Pressure and Differential Analysis; Haltiner, Eaton: A Collection and Evaluation of Weather Forecasting Rules; NavAer 50-1R-204.

Prerequisites: Mr-202(C); Mr-301(C); Mr-402(C).

Mr-204(C) Advanced Weather Analysis and Forecasting 0-15

This course is a continuation of course Mr-203(C). The student officers are taught to analyze and forecast the weather in accordance with the most advanced applied methods, using all available sources of information, including the surface maps, upper-level charts, wind-aloft dats, and meteorograph and radiosonde observations. The course is coordinated with course Mr-205(C), where in the upper level charts are drawn, and differential analysis, cross-sections and prognostic charts are prepared. In addition, the students are required to analyze special weather sequences for selected localities of the world.

Text: None

Prerequisites: Mr-203(C); Mr-302(C); Mr-403(C).

Mr-205(C) Upper Air Analysis 0-10

The course is devoted entirely to upper-air analysis (supplemented by surface map analysis in Mr-204(C) including constant-pressure analysis, cross-sections, etc.

Text: None.

Prerequisites: Mr-302(C); Mr-203(C); Mr-403(C).

Mr-210(C) Introduction to Synoptic Meteorology 5-0

This course is a survey of synoptic meteorology, designed to serve as a preparation for study of the various topics considered in subsequent advanced courses in meteorology, and as a preparation for laboratory study of weather map analysis and forecasting. It studies successively the thermodynamic properites of air and water vapor; the radioactive properties of the earth and its atmosphere; the general circulation of the atmosphere and of the oceans; and the major aspects of air-mass and frontal analysis.

Texts: Descriptive Meteorology; Willett: Handbook of Meteorology; Berry, Bollay, Beers.

Prerequisite: None.

Mr-211(C) Weather Maps and Codes 2-6

This course is ooncerned with the problems of observing, transmitting, and preparing for analysis the facts of the state of the atmosphere. It therefore considers the methods, instruments, and conventions used in observing and the reduction of the observed facts into short coded messages; the decoding and plotting of the data on the standard charts used for weather analysis. A series of lectures and motion pictures in presented to give the student officers an outline of the principles of meteorology.

Texts: Hydrographic Office Publication H.O. 206; U. S. Weather Bureau - Circulars 'S' and 'N', Radiosonde Code, International Code: Aerographer's Manual.

Prerequisites: None.

Mr-212(C) Surface Weather Map Analysis 1-12

The first principles of surface weather map analysis are demonstrated by having the student analyze an idealized series of weather maps based upon weather observations in the United States. This series is accompanied by a written discussion of each map, giving the criteria to be applied for acceptable analysis. A sequence of maps, at six-hourly intervals, is next analyzed in order to develop concepts of historical sequence and movement and development of systems. This concerns data for North America and the Eastern and Western approaches thereto. The latter portion of the course is devoted to daily analysis of the cur-

rent weather charts, including ocean areas; correlation of upper winds with the surface data; practical observations of local weather elements; group discussions of the map analysis; and trial forecasting.

Texts: Handbook of Meteorology; Berry, Bollay, Beers: Practical Aids in Weather Map Analysis; Lockhart: Weather Analysis and Forecasting; Petterssen.

Prerequisites: Mr-211(C).

Mr-213(C) Map Analysis and Forecasting 0-9

This course is a continuation of Course Mr-212(C). More advanced methods of current weather map analysis and forecasting are presented. The air-mass and frontal concepts are stressed, and the application of analysis and forecast techniques previously presented in the theoretical Course Mr-210(C) are brought out.

Text: None.

Prerequisites: Mr-212(C); Mr-210(C).

Mr-214(C) Weather Analysis and Forecasting 2-9

This is a continuation of Course Mr-213(C). The students are taught the usefulness of upper-air observations in determining air-mass characteristics, movements, etc.; and the correlation of these observations with the surface map analysis and the forecasts. This, together with additional surface analysis techniques and practical applications of the technical course Mr-321(A) introduces the students to three-dimensional weather analysis. Map discussions and practices forecasting are continued.

Texts: Handbook of Meteorology; Berry, Bollay, Beers: Weather Analysis and Forecasting; Petterssen: Constant Pressure Analysis; NavAer 50-1R-177: Constant Pressure and Differential Analyses; Haltiner and Eaton: NavAer 50-1R-216.

Prerequisites: Mr-213(C); Mr-411(B).

Mr-221(B) Weather Analysis and Forecasting 2-9

This course continues the instruction given in Course Mr-214(C). The students are required to become familiar with upper-level charts, and prepare surface prognostic charts. These are correlated with the surface map analysis to give a three-dimensional analysis. The weather analysis discussions and forecasts are continued.

Texts: Handbook of Meteorology; Berry, Bollay, Beers: Weather Analysis and Forecasting; Petterssen; A Collection and Evaluation of Weather Forecasting Rules; NavAer 50-1R-204.

Prerequisites: Mr-214(C); Mr-321(A); Mr-412(A).

Mr-222(B) Weather Analysis and Forecasting 0-12

A continuation of Course Mr-221(B).

Text: None.

Prerequisites: Mr-221(B); Mr-322(A).

Mr-223(B) Advanced Weather Analysis and Forecasting 0-9

A continuation of Course Mr-222(C) with the addition of surf and swell forecasting.

Text: None.

Prerequisites: Mr-222(B); Mr-229(A); Mr-323(A).

Mr-224(B) Advanced Weather Analysis and Forecasting 0-15

This course is a continuation of Course Mr-223(C). The student officers are taught to analyze and forecast the weather in accordance with the most advanced methods, using all available sources of information, including the surface maps, local conditions, upper-level charts, winds aloft, and meteorgraph and radiosonde observations. The course is coordinated with Course Mr-225(B) wherein the upper-level charts are drawn, and differential analyses, cross-sections and prognostic charts are prepared. In addition, the students are required to analyze special weather sequences for selected localities of the world.

Text: None.

Prerequisite: Mr-223(B).

Mr-225(B) Upper-Air Analysis 0-10

The course is devoted entirely to upper-air analysis (supplemented by surface map analysis in Mr-224(B) including constant-pressure analysis, cross-sections, etc.)

Text: None.

Prerequisite: Mr-223(B).

Mr-226(B) Advanced Weather Analysis and Forecasting 2-9

Basic principles of weather map analysis are reviewed and more advanced methods of map analysis and forecasting are presented. Students are taught the usefulness of upper air observations in determining air-mass characteristics, movement of pressure systems, etc. The concept of three-dimensional weather analysis is stressed by the use of upper level charts and differential analyses. Group discussion of the map analysis, and practice forecasts are included.

Texts: Handbook of Meteorology; Berry, Bollay, and Beers, Weather Analysis and Forecasting: Petterssen, Constant Pressure Analysis: NavAer 50-1R-177, Constant Pressure and Differential Analysis: Haltiner and Eaton, NavAer 50-1R-216.

Prerequisites: Mr-411(B); Mr-520(C); Mr-204(C) and Mr-205(C) or equivalent.

Mr-227(B) Upper Air Analysis and Forecasting 2-9

This course continues the instruction begun in course Mr-226(B). The students analyze upper air (constant pressure) charts, make differential analyses, and prepare prognostic surface and upper air charts using three-dimensional techniques. Analyses of radiosonde observations are carried out to determine the stability of the atmosphere, and atmospheric cross-sections are analyzed. Discussions of the analyses and practice forecasts are continued.

Texts: Handbook of Meteorology: Berry, Bollay, and Beers, Weather Analysis and Forecasting: Petterssen, A Collection and Evaluation of Weather Forecasting Rules, NavAer 50-1R-204.

Prerequisites: Mr-226(B); Mr-321(A); Mr-412(A); Mr-229(A).

Mr-228(A) Southern Hemisphere and Tropical Meteorology 2-0

The course consists of lectures and reading assignments dealing with the synoptic aspects of Southern Hemisphere meteorology, tropical synoptic models (with particular emphasis on the tropical cyclone), and tropical forecasting.

Texts: Handbook of Meteorology; Berry, Bollay, Beers: Climatology; Haurwitz, Austin,

Prerequisites: Mr-321(A); Mr-214(C).

Mr-229(A) Selected Topics in Applied Meteorology 2-0

The course consists of lectures and reading assignments dealing with arctic and antarctic meteorology, extended range forecasting, recent developments concerning the theory and observations of the general circulation, and such further recent developments as time permits.

Texts: Selected NavAer and U. S. W. B. Publications.

Prerequisites: Mr-221(B); Mr-228(A); Mr-322(A).

Mr-230(A) Operational Forecasting 0-10

This course is a continuation of previous laboratory courses in weather analysis and forecasting. Using all available techniques, students analyze upper air and sea-level weather charts, prepare stability analyses and atmospheric cross sections, and construct prognostic charts. The information thus analyzed is correlated to prepare operational weather forecasts for various situations, including flight forecasts, ocean area forecasts, local station forecasts, and forecasts for selected types of naval operations.

Texts: None.

Prerequisites: Mr-227(B); Mr-323(A); Mr-422(A).

Mr-301(C) Synoptic Meteorology I 5-0

This course deals with the fundamental theoretical concepts of synoptic meteorology, covering air-mass and frontal characteristics, wind and pressure systems, the general circulation, climatology, and oceanography.

Texts: Weather Analysis and Forecasting; Petterssen: Handbook of Meteorology; Berry, Bollay, Beers.

Prerequisites: Mr-200(C); Ph-190 (C); Ma-161(C).

Mr-302(C) Synoptic Meteorology II 5-0

This course is a continuation of Mr-301(C), covering such topics as the thermal wind, differential analysis, the mechanism of pressure changes; stability and instability, Southern Hemisphere and tropical synoptic meteorology, long range and single-station forecasting.

Texts: Weather Analysis and Forecasting; Petterssen: Handbook of Meteorology; Berry, Bollay, Beers.

Prerequisites: Mr-301(C); Mr-402(C); Mr-162(C).

Mr-321(A) Dynamic Meteorology I 3-0

The course consists of lectures and concurrent reading assignments from the texts on the following topics: scalar and vector fields; surfaces of discontinuity; solenoids and the circulation theorems; tertiary circulations; secondary circulations of thermal and dynamic types; streamlines and trajectories; hydrostatics and the thermal wind; stability, convection and subsidence.

Texts: Dynamic Meteorology; Holmboe, Forsythe, Gustin: Weather Analysis and Forecasting; Petterssen.

Prerequisites: Mr-411(B); Mr-210(C); Ph-196(C); Ma-103(B).

Mr-322(A) Dynamic Meteorology II 3-0

The course is a continuation of Mr-321(A), covering the following topics: continuity and tendency equations; convergency and divergence; vorticity; frontogensis and frontolysis, stability; atmospheric waves; the general circulation and its influence on the formation of air masses.

Texts: Dynamic Meteorology; Holmboe, Forsythe, Gustin: Weather Analysis and Forecasting; Petterssen.

Prerequisites: Mr-321(A); Ma-134(A).

Mr-323(A) Dynamic Meteorology III 3-0

This course is a continuation of Mr-322(A) and considers the following topics: general effects of viscosity; equations of motion for laminar and turbulent flow; dynamic similarity; wind variation in the surface layer; energy changes in wind system; transfer of air properties by turbulent mass exchange; diurnal

temperature variations; transformation of air masses.

Texts: Handbook of Meteorology; Berry, Bollay, Beers: Physical and Dynamical Meteorology; Brunt.

Prerequisites: Mr-322(A); Ma-135(C).

Mr-402(C) Meteorological Charts and Diagrams 3-0

The course proceeds from a treatment of elementary thermodynamics to its applications to meteorology, with particular emphasis on thermodynamic charts and diagrams. Atmospheric stability and the techniques for forecasting instability phenomena are discussed.

Texts: Mimeographed notes titled "Elementary Meteorological Thermodynamics"; Haltiner.

Prerequisites: Ph-190(C); Ma-161(C).

Mr-403(C) Physical Meteorology 4-0

This course is a qualitative treatment of (1) radiation, solar and terrestrial, and its effect on atmospheric processes; (2) elementary theory of turbulence and diffusion and the effect of these processes on wind structure and air-mass modification.

Texts: Handbook of Meteorology; Berry, Bollay, Beers: Dynamic Meteorology; Haurwitz.

Prerequisites: Ph-190(C); Ma-162(C).

Mr-404(C) Wave, Swell and Surf Forecasting 1-2

This course begins with a brief description of the characteristics of surface water waves and proceeds to a study of the methods of forecasting the state of the sea and surf conditions, together with appropriate problems.

Texts: Wind Waves and Swell; Hydrographic Office Publication H.O. Misc. 11,275; Breakers and surf; H.O. 234.

Prerequisites: Mr-302(C); Mr-403(C)

Mr-410(C) Meteorological Instruments 2-2

Standard naval meteorological instruments are studied and used by the students. Additional instrumentation peculiar to (1) cold climates, (2) very high elevations, and (3) micrometeorological elements is investigated generally. Special attention is paid to errors and to reliability of observation.

Texts: Meteorological Instruments; Middleton: Aerographer's Manual; Circular "P"; U. S. Weather Bureau: Instrument Workbook; Form.

Prerequisite: Ph-196(C) or Ph-190(C).

Mr-411(B) Thermodynamics of Meteorology 5-2

This course considers the following topics: the physical variables; first and second laws of thermodynamics; concept of entropy; equation of state; properties of gases; properties of water and moist air; thermodynamic diagrams; air mass identification indices; geopotential determinations; convection, stability criteria.

Texts: Dynamic Meteorology; Holmboe, Forsythe, Gustin: Handbook of Meteorology; Berry, Bollay, Beers.

Prerequisites: Mr-210(C); Ma-102(C); Ph-196(C).

Mr-412(A) Physical Meteorology 3-0

This course deals with (1) solar and terrestrial radiation, and (2) the physics of atmospheric phenomena in which optical or scattering effects are produced by clouds, fogs, raindrops, haze, etc.

Texts: Heat Transfer by Infrared Radiation in the Atmosphere; Elsasser; Meteorology; Albright.

Prerequisites: Ph-196(C) or Ph-191(C); Mr-4111(B); Ma-103(B).

Mr-420(A) Wave, Swell and Surf Forecasting 2-0

This course considers the following topics: the characteristics of surface water waves; generation of waves; methods of forecasting sea and swell; methods of forecasting breakers and surf conditions; under water depth determinations; and methods of locating rubber rafts adrift at sea.

Texts: Wind Waves and Swell; Hydrographic Office Publication H.O. Misc. 11,275: Breakers and Surf; H.O. 234.

Prerequisites: Mr-322(A); Ma-135(C).

Mr-422(A) The Upper Atmosphere 5 0

A study of the distribution of certain of the meteorological elements, including the composition of the upper atmosphere. A survey is made of the various layers of the upper atmosphere, together with the physical processes taking place in these layers. Wherever possible, the interplay of these processes with the meteorology of the troposphere is considered.

Texts: Atomic Physics; Semat: Terrestrial Magnetism and Electricity; Fleming: Physical State of the Upper Atmosphere; Haurwitz.

Prerequisites: Mr-323(A); Mr-412(A).

Mr-510(C) Climatology 2-0

This course considers the major continental and oceanic regions of the world with respect to their dominant weather characteristics and covers the meteorological and oceanographic processes that are important in the development of these characteristics.

Text: Climatology; Haurwitz, Austin.

Prerequisites: Mr-212(C); Mr-210(C).

Mr-520(B) Climatology and Oceanography 3-0

The meteorological and oceanographic processes important to the development of the

dominant weather characteristics of the major continental and oceanic regions of the world are considered. Special emphsis is placed on the general circulation of the atmosphere and its relation to radiation and heat balance. The use of statistical methods to solve climatological problems and develop objective forecasting rules is stressed.

Texts: Oceanography for Meteorologists; Sverdrup Climatology; Haurwitz and Austin.

Prerequisite: None.

Mr-810(C) Seminar 2-0

Students study and prepare synopses of current publications and original data concerning meteorology, and present them for group discussion.

Text: None.

Prerequisite: Mr-229(A).

Mr-921(A) Thesis I 2-0

Students are expected to begin research on problems selected by themselves or assigned to them. Each student will be directed and assisted in his work by a staff member qualified in the special field of the problem selected.

Text: None.

Prerequisites: Mr-229(A); Mr-323(A); Ma-331(A).

Mr-922(A) Thesis II 4-0

This course is a continuation of Mr-921(A). The work begun in Mr-921(A) will be completed and prepared in proper form for presentation to the Academic Council and/or for publication.

Text: None.

Prerequisites: Mr-921(A); Mr-422(A).

Mr-923(A) Thesis III 3-0

This course is a continuation of Mr-922(A) for students of the MS Curriculum. The thesis will be completed and prepared in proper form for presentation to the Academic Council and/or for publication.

Text: None.

Prerequisites: Mr-323(A); Mr-422(A); Mr-922(A).

AERONAUTICS

Ae Courses

Ae-001(C) Aeronautical Lecture Series 0-1

Lectures on general aeronautical engineering subjects by prominent authorities from the Bureau of Aeronautics, research laboratories, and from industry.

Prerequisite: None.

Ae-002(C) Aeronautical Lecture Series 0-2

Lectures on electrical engineering subjects in connection with aeronautical engineering by prominent authorities from the Bureau of Aeronautics, research laboratories, and from industry.

Prerequisite: None.

Ae-100(C) Basic Aerodynamics 3-4

Properties of fluids; statics of fluids; flotation; Bernoulli's theorem; fluid velocity and pressures; photostatic tube; the venturi tube; cavitation; theory of life; circulation; blade screws and propellers; viscosity; viscous flows; vortices; flow in pipes; flow through orifices; laminar and turbulent boundary layer flows; separation phenomena; surface friction; resistance of floating bodies; dynamics of compressible fluids.

The P. W. periods include experimental work in the wind tunnel, allied to the topics above; technical analysis and report writing.

Text: Fluid Mechanics; Dodge, Thompson: Elementary Fluid Mechanics; Rouse.

Prerequisites: None.

Ae-121(C) Technical Aerodynamics 3-2

Characteristic flows and pressures about bodies; surface friction; wake drag; aerodynamic characteristics of airfoil sections, three dimensional air foil theory; induced drag; aspect ratio corrections; biplanes; interference drag; high lift devices; velocity polar; relative motion.

The P. W. periods include wind tunnel experiments, analysis and technical report writing on topics allied to the above class work.

Text: Airplane Design - Performance; Warner: Engineering Aerodynamics; Diehl: Elementary Applied Aerodynamics; Hemke: Wind Tunnel Testing; Pope.

Prerequisite: Ae-100(C).

Ae-131(C) Technical Aerodynamics— Performance 4-2

The aerodynamic characteristics of the airplane; the propeller and engine characteristics; sea level performance; performance at altitudes; superchargers; range and endurance; special performance problems; charts.

The P. W. periods are devoted to computations and performance analysis.

Text: Same as in Ae-121(C).

Prerequisite: Ae-100(C).

Ae-132(B) Flight Analysis 3-2

Parametric study of aircraft performance, flight test procedure, flight data reduction, special flight problems.

Practical work: Practical problems dealing with the above.

Text: Airplane Design - Performance; Warner: Engineering Aerodynamics; Diehl, Flight Testing; Hamlin.

Prerequisites: Ae-100(C), Ae-121(C), 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.

Practical work: analysis of performance of an aircraft will be made based upon wind tunnel tests in the laboratory - practical problems from flight test will aslo be analyzed.

Text: Airplane Design - Performance; Warner: Engineering Aerodynamics; Diehl: Elementary Applied Aerodynamics; Hemke: Wind Tunnel Testing; Pope: Flight Testing; Hamlin.

Prerequisites: Ae-100(C), Ae-121(C).

Ae-141(A) Dynamics, I 3-4

Fundamental definitions, the forces and moments of the entire airplane, the equations of motion, the moments of the wing, tail and other parts of the airplane, C.G. location on static stability, neutral points, maneuver points, fixed control and free control stability, elevator, aileron rudder effectiveness, control design festures, maneuverability and controllability, turns and loops.

The laboratory work consists of wind tunnel experimentation and analysis of the above topics on models.

Text: USNPS Notes; Higgins: Aircraft Stability and Controllability; Perkins: Flight Testing; Hamlin.

Prerequisites: Ae-100(C), Ae-121(C), Ae-131(C).

Ae-142(A) Dynamics, II 3-4

The Eulerian equations of motion, the moments of inertia of aircraft, the aerodynamic reactions and derivatives solution of the symmetrical or longitudinal motion, analysis of the longitudinal motion, solution of the asymmetrical or lateral motion, analysis of the lateral motion, effect of control freedom, effect of controls and response, spins.

The laboratory works consist of wind tunnel experimentation on models to study some of the above problems.

Text: Same as in Ae-141(A).

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, dynamical longitudinal stability, dynamic lateral stability, force and moment derivations, stability charts, controllability, maneuverability, three dimensional motions, spins.

The P.W. consists of experimentation and analysis of static and dynamic stability of some particular aircraft.

Text: Same as in Ae-141(A).

Prerequisites: Ae-100(C), Ae-121(C), Ae-131(C) or Ae-136(B).

Ae-151(B) Aeronautical Seminar 2-0

This seminar is primarily in the technical aerodynamics of airplanes, on matters dealing especially with performance and test methods of the Test Pilot Training Division, NATC Patuxent River, Md. It is in preparation for the flight test program given in the fourth term.

Text: Airplane Aerodynamics; Dommasch, Sherby and Connolly.

Prerequisite: Ae-132(B).

Ae-152(B) Aeronautical Seminar 2-0

This is a continuation of Ae-151(B) in the same field.

Text: Same as Ae-151(B).

Prerequisite: Ae-151(B).

Ae-200(C) Rigid Body 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 trusses, Maxwell diagrams, plantom members; compound and complex trusses; plane distributed force systems, composition and resolution, funicular polygons; centroids, moments of inertia, properties of aircraft sections; moler circle of inertia, ellipse of inertia, gyration ellipse; mass moments of inertia, application to aircraft, balance diagrams; simple, compound and complex space frames; load lines, shear and bending moment diagrams, interrelationship; influence lines and elementary applications.

Text: Analysis and Design of Airplane Structures; Bruhn: Airplane Structures, 3rd Ed. Vol. 1; Niles and Newell: Statics; Timoshenko and Young.

Prerequisite: To be taken with Mc 101, with same prerequisites.

Ae-201(C) Stress Analysis 4-2

The course is in continuity with ME-500, and emphasizes diagrammatic methods, applied especially to: analysis of beam including statically indeterminate cases, frame elements, variable cross section, shearing effect on bending displacement; plane stress, principal stresses; influence lines and elementary applications.

Text: Strength of Materials Vol. I; Timoshenko: Airplane Structures Vol. I; Niles, Newell: Analysis and Design of Airplane Structures; Bruhn: USNPS Stencils.

Prerequisite: Ma-102(C).

Ae-202(C) Stress Analysis

This course is in continuity with Ae-201(C) and considers: strain energy, applications to impact loading, Castigliano theorem, displacement calculations, redundant trusses; virtual energy, applications to deflection and statically indeterminate problems, Maxwell-Mohr method; law of reciprocal deflections; influence line application to deflections; buckling of bars, the flexible column, critical loads, energy methods; curved bars.

Text: Strength of Materials Vols. I and II; Timoshenko: Airplane Structures Vols. I and II; Niles, Newell: Analysis and Design of Airplane Structures; Bruhn: USNPG Stencils.

Prerequisite: Ae-201(C).

Ae-203(A) Stress Analysis 4-0

This course is in continuity with Ae-202(C) and considers: curved bars (continued), rotating machine parts, circular bars in bending and/or twist, energy methods on curved frames, beams loaded by forces not in principal axes of section, cases with unsymmetrical cross-section; short beams in compression and bending, cores; torsion, non-circular sections, membrane analogy, combined with bending, close soiled helical spring, crank throw, thin open or hollow sections, torsional shear flow; center of twise, shear flow; beam columns, single panel, multipanel, charts; beam tie; polar diagrams.

Text: Same as in Ae-202(C).

Prerequisite: Ae-202(C).

Ae-204(A) Stress Analysis 4-0

This course is in continuity with Ae-203(A) and considers: Thin stiff plates under lateral load, bent to cylinder, in pure bending in two perpendicular directions, axially symmetrical problems; axially symmetrical membrane problems; discontinuity effects in shells, beam on elastic foundation and application, cylinder and hemisphere, flat plate and cylinder, hollow ring and cylinder; thick-walled spheres and cylinders, applications to rotating discs; selected topics from theory of elasticity; stress concentration.

Text: Strength of Materials, Vol. I and II, Timoshenko; Airplane Structures, Vol. I and II, Niles and Newell; Analysis and Design of Airplane Structures; Bruhn: Airplane Structural Analysis and Design, Sechler and Dunn: USNPS Stencils.

Prerequisite: Ae-203(A).

Ae-211(C) Stress Analysis I 4-0

This course is in continuity with Ae 200, and starts the analysis of elastic bodies, applied to aircraft structures and machines. Topics are: the elementary states of stress in ties, struts, shear members, circular shafts, simple beams, short beam struts, coves, simple columns, thin cylinders, extended discussion of deflection of straight beams, frames with straight members; statically indeterminate cases using diagrammatic and moment-distribution methods; beams of variable I; trussed beams and wing cells.

Text: Analysis and Design of Airplane Structures; Bruhn: Airplane Structures, 3rd Ed., Vol. 1; Niles and Newell: Strength of materials, Vol. 1; Timoshenko.

Prerequisite: Ae 200.

Ae-212(C) Stress Analysis II 4-2

This course is in continuity with Ae 211. It considers the general state of plane stress, stress flow 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 critical beam stresses and deflection; shear flow in bending under transverse loads, center of twist; bending when neutral axis is not a principal axis or when load line is off the center of twist, 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, single and multi-panel charts; beam ties; polar diagrams.

Text: Analysis and Design of Airplane Structures; Bruhn: Airplane Structures, Vols. I and II; Niles and Newell: Strength of Materials, Vols. I and II; Timoshenko.

Prerequisite: Ae 211.

Ae-213(B) Stress Analysis III 4-2

This course is in continuity with Ae 212. It considers various forms of strain energy, and also 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 deflections, influence line applications; energy methods applied to buckling; curved bars, stresses and deflections; rotating machine parts.

Text: The same as in Ae 212.

Prerequisite: Ae 212.

Ae-214(A) Stress Analysis IV 3-0

This course is in continuity with Ae 213, and considers: the general three dimensional state of stress, strain and displacement, elastic equations; thin stiff plates under lateral load, bent to cylinder, or in bending to mutually perpendicular directions; axially symmetrical plates; axially symmetrical membranes; discontinuity effects in shells, beam on elastic foundation, applications to cylinder and hem-

isphere or flat plate or hollow ring; thick walled spheres and cylinders under inner and outer pressures, application to rotating discs.

Text: The same as in Ae 213.

Prerequisite: Ae 213.

Ae-215(A) Advanced Stress Analysis 4-0

This is in continuity with Ae 214 and considers 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.

Text: The same as in Ae 214 plus Airplane Structural Analysis and Design; Sechler and Dunn.

Prerequisite: Ae 214.

Ae-302(B) Airplane Design II 1-4

Topics as given for Ae 312(B).

Text: As given for Ae 312(B).

Prerequisites: Ae 311(C).

Ae-311(C) Airplane Design, I 2-4

Topics are: critical loading conditions, load-factors, V-g diagrams, strength envelopes, detail methods of layout and analysis of a light plane.

P. W. requirements are for the condition of high angle 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.

Text: Same as Ae-203(C) and Airplane Design Manual; Teichmann: Airplane Structural Analysis and Design; Sechler and Dunn: C. A. R. 04: C. A. M. 04: Navy Specifications and Manuals.

Prerequisite: Ae-202(C).

Ae-312(B) Airplane Design, II 2-4

Topics include: wing spar analysis, wing truss analysis, fuselage analysis including Maxwell Diagram; design of one wing spar on basis, shearresistant web, tension field web, composite spar of two materials; design of elevator torque tube in bending and twist for given loading condition, design of several members of the fuselage truss as columns and as ties; design of indicated fittings.

Text: Same as in Ae-311(C), Ae-203(A).

Prerequisite: Ae-311(C), Ae-203(A).

Ae-321(A) Advanced Aircraft Structures 4-0

Topics include: rectangular plates in pure bending, in bending and under loading in middle surface, buckling, crippline; advanced deflection problems, Williot diagram; deformation in the plastic state; advanced stability considerations, beam columns, rings and tubes, latticed columns variable section torsional cases.

Text: Those of Ae-204(A) and Ae-311(C).

Prerequisites: Ae-312(B), Ae-204(A).

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.

Text: Engineering Thermodynamics, Kiefer Stuart & Kinney: Aerodynamics of a Compressible Fluid; Liepmann, Puckett: Applied Heat Transmission; Stevens. Gas Tables; Keenan & Kaye.

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. Fuel mixtures, ignition, flame propogation and stability are discussed. Utilization and conversion and mechanical aspects. The latter is continued in a survey of current engine design and construction.

Text: Internal Combustion Engines; Lichty: Internal Combustion Engines; Taylor & Taylor: USNPS Stencils.

Prerequisite: ME-132(C) or Ae-410(B).

Ae-421(B) Aircraft Propulsion 3-2

Sea level and altitude performance characteristics of piston engines, propellers, turbojet and turbo-prop engines are analyzed. Maximum performance, cruise control, laboratory and flight testing, and test data correction methods are discussed. Aircraft performance is reviewed 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.

Text: Aircraft Power Plants; Fraas: Airplane Propeller Principles; Nelson: Jet Propulsion; Air Technical Service Command: USNPS Stencils.

Prerequisites: Ae-411(B), Ae-131(C).

Ae-431(A) Internal Flow in Aircraft Engines 4-0

Momentum theorem, thrust equations, gas turbine cycle analysis, 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, control analysis of aircraft gas turbines.

Text: Jet Propulsion; ATSC: Jet Propulsion and Gas Turbines; Zucrow: 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.
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).
Prerequisite: Ae-451(C).

Ae-501(A) Hydro-Aero-Mechanics I 4-0
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 infinate wing.
Text: Airfoil and Airscrew Theory; Glauert: Fluid Dynamics; Streeter.
Prerequisite: Ae-131(C).

Ae-502(A) Hydro-Aero-Mechanics II 4-0
Viscous Fluids, Navier-Stokes equation and special solutions, Prandtl boundary layer theory, skin friction, 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, compressible fluids.
Text: Same as Ae 501(A).
Prerequisite: Ae 501(A).

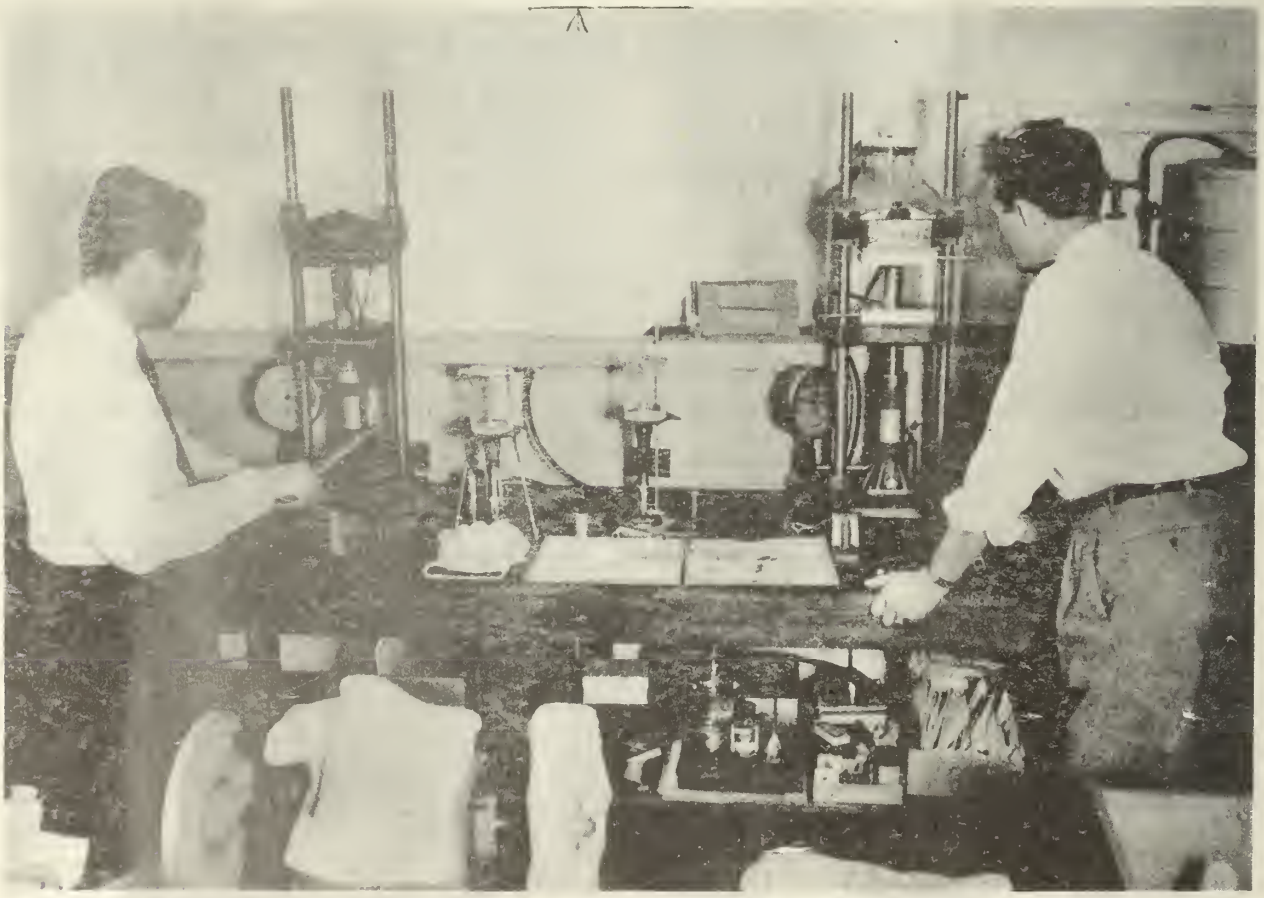
Ae-503(A) Compressibility I 4-0
Viscous fluid theory, compressible flow, thermodynamic fundamentals, adiabatic flow equations, propogation of plane disturbances, one- dimensional channel flow, oblique shock waves and shock reflections, optical measurement techniques, Navier-Stokes equations, Prandtl boundary layer theory, Poisenille flow, Saminar boundary layer theory, turbulence, turbulent boundary layer theory, transition.
Text: Foundations of Aerodynamics; Kuethe & Schetze: Aerodynamics of a Compressible Fluid; Liepmann & Puckett: Theoretical Gas Dynamics; Sauer.
Prerequisite: Ae 410(B), Ae 502(A).

Ae-504(A) Compressibility II
Two-and three-dimensional flow, 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 to be conducted in conjunction with class discussions.
Text: Same as for Ae 503(A).
Prerequisite: Ae 503(A).

CHEMISTRY

Ch Courses

General Inorganic Chemistry	Ch-101(C)	Physical Chemistry Advanced	Ch-413(A)
General Inorganic Chemistry	Ch-102(C)	Physical Chemistry	Ch-442(C)
Fuel and Oil Chemistry	Ch-111(A)	Plastics	Ch-521(A)
General and Petroleum Chemistry	Ch-121(B)	Physical Chemistry (For Metallurgical Students)	Ch-531(A)
Quantitative Analysis	Ch-213(C)	Reaction Motors	Ch-541(A)
Qualitative Analysis	Ch-221(C)	Radio Chemistry	Ch-551(A)
Quantitative Analysis	Ch-231(C)	Physical Chemistry	Ch-561(A)
Organic Chemistry	Ch-301(C)	Chemistry of Special Fuels	Ch-581(A)
Organic Chemistry	Ch-311(C)	Thermodynamics	Ch-611(C)
Organic Chemistry	Ch-312(C)	Thermodynamics	Ch-612(C)
Organic Chemistry	Ch-315(C)	Chemical Engineering Thermodynamics	Ch-613(A)
Organic Qualitative Analysis	Ch-321(A)	Thermodynamics	Ch-631(A)
Organic Chemistry, Advanced	Ch-322(A)	Chemical Engineering Calculations	Ch-701(C)
The Chemistry of High Polymers	Ch-323(A)	Chemical Engineering Calculations	Ch-711(C)
Physical Chemistry (Ord.)	Ch-401(A)	Chemistry Seminar	Ch-800(A)
Physical Chemistry	Ch-411(C)		
Physical Chemistry	Ch-412(C)		



Plastics Laboratory, U. S. Naval Postgraduate School, Annapolis, Maryland.

Ch-101(C) General Inorganic Chemistry 3-2

The subject matter includes a consideration of general chemical principles such as the modern concept of the atom, kinetic theory, chemical equilibrium, chemical calculations, reaction rates and a brief discussion of specialized topics (corrosion, explosives, etc.) which are of interest to officers in the naval services.

The laboratory work consists of experiments selected to illustrate principles discussed in the lecture.

Text: Principles of Chemistry; Hildebrand

Prerequisites: None.

Ch-102(C) General Inorganic Chemistry 4-2

This course deals with the properties of substances and their atomic and molecular structure, weight relations in chemical reactions, valence, electronic structure and oxidation-reduction reactions. Theoretical topics considered include the properties of gases, reaction rates and chemical equilibrium.

The laboratory work consists of experments in qualitative analysis on a seminicro scale, illustrating reactions and principles discussed in the lectures.

Text: General Chemistry; Pauling; Introduction to Semimicro Qualitative Analysis; Curtman.

Prerequisites: None.

Ch-111(A) Fuel And Oil Chemistry 2-2

The subject matter includes the chemistry, properties and production of fuels and lubricants; the theory of combustion and knocking; the theory of fluid film and boundary lubrication, the significance of tests on petroleum products and problems on the analysis of Orsat data and stoichiometry of combustion.

The laboratory work includes conducting some of the standard tests on fuels and lubricants and problems on interpretation of data from Orsat analysis and combustion calculations.

Text: Chemical Technology of Petroleum; Gruse and Stevens: Significance of Tests on Petroleum Products; A.S.T.M.: Fed. Spec. VV-L791b.

Prerequisite: Ch-101(C).

Ch-121(B) General And Petroleum Chemistry 4-2

The subject matter includes a consideration of chemical principles such as atomic structure, states of matter, ionization, chemical equilibria, etc.; and a survey of the chemistry, properties and production of fuels and lubricants. The theories of combustion, knocking and lubrication are presented. Study is made of the interpretation of results of standard test procedures and Orsat analysis. The laboratory work consists of experiments illustrating principles discussed in the lectures; and performing some of the standard tests on fuels and lubricants.

Text: Principles of Chemistry, Hildebrand: Chemical Technology of Petroleum, Gruse and Stevens: Significance of Tests on Petroleum Producers; A.S.T.M.- Federal Specifications for Lubricants and Liquid Fuels, VV-L-791b

Ch-213(C) Quantitative Analysis 3-4

This course deals with 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: Quantitative Analysis; Pierce and Haenisch.

Prerequisite: Ch-102(C).

Ch-221(C) Qualitative Analysis 3-2

This is the first part of a course in analytical chemistry and includes the treatment of the theory of ionization, chemical equilibrium, solubility product, complexion 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: Introduction to Semimicro Qualitative Analysis; Curtman

Prerequisite: Ch-101(C) or Ch-121(B).

Ch-231(C) Quantitative Analysis 2-4

This course is a continuation of Ch-221, and deals with the theoretical principles and calculations involved in quantitative analysis.

The laboratory work consists of typical volumetric and gravimetric determinations.

Text: Quantitative Analysis; Pierce and Haenisch.

Prerequisite: Ch-101(C) or Ch-121(B); Ch-221(C).

Ch-301(C) Organic Chemistry 3-2

This course deals with the properties, reactions and relationships of the principal classes of organic compounds, a brief summary of aliphatin and aromatic compounds.

The laboratory work includes both preparative experiments and experiments illustrating reactions discussed in the lectures.

Text: Organic Chemistry, Fuson Connor, Price and Snyder.

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 and aromatic compounds.

The laboratory work is designed to illustrate important reactions of organic compounds.

Text: Organic Chemistry; Brewster.
Prerequisite: Ch-101(C).

Ch-312(C) Organic Chemistry 3-2

The second half of a course in organic chemistry, dealing chiefly with aromatic compounds, following Ch-311(C). Organic synthetic methods are emphasized.

The laboratory work includes the preparation of selected organic compounds.

Text: Organic Chemistry; Brewster.
Prerequisite: Ch-311(C).

Ch-315(C) Organic Chemistry 3-4

This course deals with the properties, reactions and relationships of the principal classes of organic compounds, as a basis for work in the biological sciences.

The laboratory work furnishes descriptive material illustrating reactions discussed in the lectures.

Text: Organic Chemistry; Fuson Connor, Price and Snyder.
Prerequisites: Ch-102(C); Ch-213(C).

Ch-321(A) Organic Qualitative Analysis 2-2

This course consists of the identification of organic compounds on the basis of physical properties, solubility behavior, classification reactions and the preparation of derivatives.

Text: Identification of Organic Compounds; Shriner and Fuson.
Prerequisites: Ch-301(C); Ch-312(C) or Ch-315(C).

Ch-322(A) Organic Chemistry, Advanced. 3-2

This course is concerned principally with reactions involved in the synthesis of organic compounds, with particular attention to reaction mechanisms and electronic explanations of the behavior of organic compounds.

Text: Advanced Organic Chemistry; Fuson; Principles of Ionic Organic Reactions; Alexander.
Prerequisites: Ch-301(C); Ch-312(C) or Ch-315(C).

Ch-323(A) The Chemistry of High Polymers 3-0

This course deals with the synthetic and structural aspects of high polymer chemistry, and includes discussion of both synthetic and natural high polymers.

Text: Chemistry of Plastics and High Polymers; Ritchie.
Prerequisites: Ch-301(C); Ch-312(C) or Ch-315(C); Ch-512(A).

Ch-401(A) Physical Chemistry (ord.) 3-2

This is a fundamental course in physical chemistry for ordnance students. The subject matter includes topics such as gases, liquids, solutions, thermochemistry, chemical thermodynamics, with particular emphasis placed on chemical equilibrium and chemical kinetics. Numerical problems on gas mixtures, combustion calculations, equilibria in explosion products adiabatic flame temperatures, etc., form an integral part of the course.

The laboratory work consists of experiments illustrating principles discussed in the lectures.

Text: Outlines of Physical Chemistry; Daniels: Experimental Physical Chemistry; Daniels, Mathews and Williams.
Prerequisites: Ch-101(C) or equivalent; Ch-631(A) or equivalent.

Ch-411(C) Physical Chemistry 3-2

This course involves a study of the physico-chemical properties of matter and the laws governing chemical behavior. Topics include gases, solids, molecular structure, thermodynamics, thermochemistry, liquids and solutions.

The laboratory work consists of experiments designed to illustrate principles discussed in the lectures.

Text: Outlines of Physical Chemistry; Daniels: Experimental Physical Chemistry; Daniels, Mathews and Williams.
Prerequisite: Ch-101(C) or Ch-121(B).

Ch-412(C) Physical Chemistry 3-2

This course is a continuation of Ch-411. Topics include chemical equilibrium, chemical kinetics, electrical conductance, electromotive force, colloids and atomic and nuclear structure.

The laboratory work consists of experiments designed to illustrate principles discussed in the lectures.

Text: Outlines of Physical Chemistry: Daniels: Experimental Physical Chemistry; Daniels, Mathews and Williams.
Prerequisite: Ch-411(C).

Ch-413(A) Physical Chemistry (Advanced) 2-2

A graduate course in selected topics in physical chemistry. Electronic configurations, dipole moments, physical chemistry of the solid state and the liquid state, etc.

The laboratory work consists of experiments designed to supplement the material covered in the classroom.

Prerequisites: Two terms of physical chemistry, one term of thermodynamics.

Ch-442(C) Physical Chemistry 4-2

This course involves a study of the laws governing the chemical behavior and the physico-chemical properties of matter. Some of the topics considered are gases, liquids, solids, solutions, thermochemistry, chemical thermodynamics, chemical equilibrium, chemical kinetics, electrochemistry and colloids.

Problems are assigned and laboratory experiments are performed to illustrate the principles discussed in the lectures.

Text: Outlines of Physical Chemistry; Daniels: Experimental Physical Chemistry; Daniels, Mathews and Williams.

Prerequisite: Ch-101(C) or Ch-102(C).

Ch-521(A) Plastics 3-2

The subject matter includes a study of the nature and types of plastics, their properties, applications, and limitations as an engineering material. Natural and synthetic rubbers are included.

The laboratory exercises consist of the preparation of typical plastics, a study of their physical and chemical properties, and identification tests.

Text: Fundamentals of Plastics; Richardson and Wilson.

Prerequisite: Ch-101(C) or Ch-121(B)

Ch-531(A) Physical Chemistry (for metallurgical students) 2-0

A continuation of the study of physical chemistry, emphasizing certain aspects of particular importance in metallurgy. Chemical equilibria in reduction processes, in deoxidation, and in carburizing-decarburizing; principles of controlled atmospheres; activity and activity coefficients in metal solutions; concentration gradients and diffusion effects. Numerical problems form an integral part of the course.

Prerequisites: Physical Chemistry and Mt-202(C).

Ch-541(A) Reaction Motors 2-2

The subject matter includes the theory and design of rocket motors and thermal jet engines, nozzles, solid and liquid propellants and the applications of these devices to military uses. Numerical problems form an integral part of the course.

Text: Rocket Propulsion Elements; Sutton.

Prerequisite: One term of Thermodynamics.

Ch-551(A) Radiochemistry

A seminar course with discussions on the important aspects of radioactivity from the standpoint of the chemical transformations which accompany it and which it may induce; the possible health hazards associated with radioactivity, safety measures and decontamination problems; techniques for measurement and study of ionizing radiation.

Prerequisite: None.

Ch-561(A) Physical Chemistry

This is a fundamental course in physical chemistry for students who are non chemistry majors. The subject matter includes topics such as gases, liquids, solutions, thermochemistry, chemical thermodynamics, with particular emphasis placed on chemical equilibrium and chemical kinetics. Numerical problems on gas mixtures, combustion calculations, equilibria in combustion products, flame temperatures, etc., form an integral part of the course.

The laboratory work consists of experiments illustrating principles discussed in the lectures.

Text: Outlines of Physical Chemistry; Daniels: Experimental Physical Chemistry; Daniels, Mathews and Williams.

Prerequisite: Ch-111(A) or 121(B).

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 rate control; etc.

Prerequisite: None.

Ch-611(C) Thermodynamics 3-2

A study of the fundamentals of thermodynamics; the concept of energy and transformations; thermodynamic properties of substances, ideal gases; thermochemistry. Numerical problems form an integral part of the course.

Text: Principles of Engineering Thermodynamics, 2nd Ed.; Kiefer, Stewart and Kinney: Introduction to Chemical Engineering Thermodynamics; Smith: Chemical Engineers Handbook; Perry: Thermodynamic Properties of Steam; Keenan and Keyes: Gas Tables; Keenan and Kaye.

Prerequisite: Ch-101(C).

Ch-612(C) Thermodynamics 3-2

A continuation and extension of Ch-611, with application of the principles of thermodynamics to the unit operations and unit processes of chemical engineering practice. Numerical problems are used extensively in illustrating principles.

Text: Introduction to Chemical Engineering Thermodynamics; Smith: Chemical Engineering Handbook; Perry: Thermodynamics Properties of Steam; Keenan and Keyes: Gas Tables; Keenan and Keyes.

Prerequisite: Ch-611(C).

Ch-613(A) Chemical Engineering Thermodynamics 3-2

The subject matter is an extension of previous studies in mechanical thermodynamics to include the thermodynamic analysis and solution of chemical engineering problems. It is designed for non-chemical majors. The course includes a specialized treatment of the thermal and thermodynamic properties of materials; thermo-chemistry; equilibrium and the phase

rule; phase relations; chemical equilibria and energy relations, particularly at higher temperatures and pressures. Strong emphasis is placed on numerical or quantative application of principles by solution of problems.

Text: Introduction to Chemical Engineering Thermodynamics; Smith: Chemical Engineers Handbook; Perry.

Prerequisites: One term of Physical Chemistry and one term of Thermodynamics.

Ch-631(A) Thermodynamics 3-2

An extension of Ch-711(C) to include thermodynamic analyses which are fundamental and requisite to the solution of many ordnance problems.

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. This course supplies a prerequisite for subsequent study of rocket motors or interior ballistics.

Text: Thermodynamics of Firearms; Robinsion: Introduction to Chemical Engineering Thermodynamics; Smith.

Prerequisite: Ch-711(C) or Ch-701(C).

Ch-701(C) Chemical Engineering Calculations 3-2

This course is especially designed to develop facility in the recognition and solution of engineering problems involving mass and energy relationships in chemical and physical-chemical reactions. Problems based on combustion, distillation, absorption, evaporation, crystallization, humidification and other unit operations and processes are dealt with. Problems are chosen from engineering practice whenever possible.

Text: Chemical Process Principles, Part I; Hougen and Watson: Industrial Stoichiometry; Lewis and Radasch: Chemical Engineers Handbook; Perry.

Prerequisite: Ch-101(C) or Ch-121(B).

Ch-711(C) Chemical Engineering Calculations 3-2

An introductory course in chemical engineering. Stoichiometry; material and energy balances in various unit operations and in typical chemical reactions, processes and plants; principles of thermochemistry; composition of equilibrium mixtures. Numerical problems selected from ordnance applications form an integral part of the course.

Text: Chemical Process Principles, Part I; Hougen and Watson: Thermodynamics of Firearms; Robinson.

Prerequisite: None.

Ch-800(A) Chemistry Seminar 2-0

This course involves library investigations of assigned topics, and reports on articles in the current technical journals.

Prerequisites: None.

COMMUNICATIONS

Co-101(C) Typing and Radio Code 0-4

This course is the first in the operating communication series and is intended to provide opportunity for students to learn to type by the touch system in order to facilitate participation in courses Co-102(C), CO-114(C), and to meet the general needs of Communication Officers in typing. When students attain a speed of 30 wpm they will be started on Radio Code. Students who have not reached 30 wpm by the end of the term will be examined periodically during later terms until they have attained this typing speed.

Prerequisites: None.

Co-102(C) Radio Code and Procedure 0-4

This course is a continuation of Co-101(C) and is intended to bring students' operating ability in Morse Code up to a level to permit them to operate on slow speed CW circuits. Actual operating on slow speed CW circuits is then used to give experience in log keeping. message servicing and circuit discipline.

Prerequisite: Co-101(C)

Co-103(C) Visual and Voice Procedures 0-3

This course is the third in the operating communications series. It is designed to make the student proficient by actual operation in voice radio, flashing light, semaphore and flag hoist. Transmission of flag hoist signals is demonstrated.

Prerequisites: Co-102(C); Co-110(C).

Co-104(C) Communication and Other Pertinent Naval Organizations 2-1

This course is the final one of the operational communication series. It covers the organizational problems of the communication service ashore and afloat and the latest developments. The recitation periods are devoted in part to seminar presentation of the organization and duties of communication organizations and partly to the other phases of naval organization. The practical work periods are used for lectures by competent officers from the field on the various phases of the communication service in which they are currently performing duty.

Prerequisites: None.

Co-110(C) Communication Procedure 2-2

In this course the student officer learns the principles of effective message drafting. He studies radio telegraph, visual and voice procedures, use of operating signals, prosigns, call signs, routing indicators, and delivery groups. He applies the principles and rules learned in various forms of naval messages.

Prerequisites: None

Co-111(C) NTX and Toll Traffic Procedures 2-2

This course covers tape relay procedures and instructions and handling and abstracting of toll traffic.

Prerequisites: None.

Co-112(C) International and Commercial Communications 1-1

This course covers international agreements, frequencies and navigational aids. In addition it covers communications with merchant ships and communications with the Coast Guard. The operation of various commercial companies and their interrelationship with the U.S. Naval Communication Service is included.

Prerequisites: None.

Co-113(C) Correspondence and Mail 1-0

This course consists of lectures and written exercises on office management, files and filing, and correspondence; with a brief summary of the duties of the shipboard Communication Officer in connection with the Postal Service.

Prerequisites: None.

Co-114(C) Crypto Systems Instruction 0-2

The student is taught the actual handling and manipulation of cryptographic aids and devices and is given sample texts to encrypt and decrypt using all effective systems. In addition, the overall cryptographic plan of the U. S. Navy is studied through practical works on the subject.

Prerequisites: Co-101(C); Co-120(C).

Co-120(C) Communication Organization and Security 2-1

In this course the student officer is acquainted with the organization of the Naval Communication System, the reasons for its existence, and the communication policies established including the principles and rules for security and registered publication handling.

Prerequisites: None.

Co-121(C) Communication Plans (Basic Rapid Comm. Plan) 2-1

This is the second of the series of formal study courses covering communication subjects. It is based primarily on the study of the basic rapid communication plan.

Prerequisites: Co-120(C).

Co-122(C) Communication Plans (Type and Task Force) 2-3

This course is a continuation of the formal study of communication planning. It covers the application of principles learned to the development of typical communication plans for Surface Action Force, Carrier Task Force, Escort of Convoy, and Submarine Force Operations. The practical work covers the interpretation of typical COMPLANS and the preparation of exercise plans.

Prerequisites: Co-120(C); Co-121(C).

Co-123(C) Communication Plans - Amphibious 1-3

This course is the final formal study of communication planning. It covers the application of principles learned to the development of typical communication plans for amphibious operations. The practical work covers the interpretation of COMPLANS and the preparation of exercise plans. The completion of this course realizes the objective of furnishing the student with background knowledge required to draw up or assist in drawing up a communication plan suitable to any mission assigned or derived.

Prerequisites: Co-121(C); and Co-122(C).

Co-131(C) Tactics 2-2

By formal study of the Prinicples and Applications of Naval Warfare, General Tactical Instructions, and COC Instructions, the student is prepared for the study in later terms of the procedures developed to solve the tactical problems of specific forces. The practical works emphasize the usefulness of the maneuvering board and COC in the solution of such problems. They also point up the relation of communications to operations, and demonstrate the intimate relationship of flag hoist signals with tactics.

Prerequisite: None

Co-132(C) Tactics 2-2

By study of Surface Action Tactics and the Carrier Task Force Tactical Instructions the student officer learns how the principles studied in the first term are applied to the operations of the Striking Forces. By study of the Long Range Air Reconnaisance and Scouting Instructions and the Logistic Support Force Instructions he learns of the support required for large scale operations. Practical works continue to emphasize the role of communications in tactics, and the utility of flag hoist signals, the maneuvering board and COC.

Prerequisite: Co-131(C).

Co-133(C) Tactics 2-2

This course introduces the student officer to the tactical problems involved in amphibious operations and outlines the procedures developed to solve these problems.

Prerequisite: Co-132(C).

Co-134(C) Tactics 2-2

This course introduces the student officer to the tactical problems of Submarine, Anti-Submarine, and Convoy Escort Commanders, and outlines the procedures developed to solve these problems. Practical works continue to emphasize the role of communications in tactics and the utility of flag hoist signals, the maneuvering board, and COC.

Prerequisite: Co-132(C).

Co-135(C) Tactics 2-2

The student officer is required to complete 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.

CRYSTALLOGRAPHY

Cr Courses

Cr-271(B) Crystallography and X-Ray Techniques 3-2

This course is designed for the student in metallurgy, chemistry, physics, and allied fields, to supply the requisite background for courses which embody such concepts as the physics of the solid state; for example, the physics of metals, optical and x-ray identification of chemical compounds, such as explosive mixtures and studies concerning crystal structures in general.

The student is first 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 forms and combinations in the various systems. The stereographic projection is then studied.

With this foundation, some time is spent on a discussion of the crystal structure of the elements, metals, alloys, and inorganic compounds.

The latter part of the course is devoted to acquainting the student with modern x-ray diffraction and radiographic apparatus and techniques, including: the theory of x-ray diffraction, the Bragg equation, powder methods, single crystal and moving film methods, high temperature diffraction technique as applied to obtaining phase diagrams, back reflection and transmitted beam methods, and practical applications of these methods.

The laboratory work includes: a study of crystal models for symmetry, forms, and combinations; the construction of stereographic projections; and actual practice in the making and interpreting of x-ray diffraction photographs.

Text: Mineralogy; Dana, Ford: Structure of Metals; Barrett.

Prerequisite: Ch-101(C).

Cr-301(B) Crystallography and Mineralogy 3-4

This course is designed primarily for the student who will continue with courses in mineralogy, geology, and petrology.

The student is first 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 forms and combinations in the various systems and classes. The stereographic projection is then studied with special reference to its application to crystallographic problems. The theory of x-ray diffraction and the application of x-ray powder methods is taken up as applied to identification of minerals.

The remainder of the time is spent on the description of some fifty of the more common 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; and as time permits, a start is made in the identification of minerals.

Text: Textbook of Mineralogy; Dana, Ford.

Prerequisite: Ch-101(C).

ELECTRICAL ENGINEERING

EE Courses

EE-111(C) Fundamentals of Electrical Engineering 3-2

This course presents a basic treatment of the general theory of electric and magnetic circuits. Electrical units, Ohm's law, and Kirchoff's laws are studied in detail. The magnetic field and the magnetic properties of iron and steel are included.

Text: Electrical Engineering Vol. I; Dawes.

Prerequisites: Differential and Integral Calculus: Elementary Physics.

EE-151(C) DC Circuits and Fields 3-4

This course provides a thorough foundation in electricity and magnetism with the major emphasis on electric and magnetic circuits. The basic laws are given and many problems and laboratory experiments are assigned to illustrate the theory. The course serves as a preparation for further study in electrical engineering.

Text: Basic Electrical Engineering; Corcoran.

Prerequisites: Differential and Integral Calculus; Elementary Physics.

EE-171(C) Electric Circuits and Fields 3-4

This course provides a very thorough foundation in electricity and magnetism for a curriculum majoring in electrical science. The basic laws are given in detail. Many problems are assigned and laboratory experiments are performed to illustrate the classroom theory. The course serves as a foundation for further advanced study.

Text: Basic Electrical Engineering; Corcoran.

Prerequisites: Differential and Integral Calculus; Elementary Physics.

EE-231(C) DC Machines and AC Circuits 3-2

This course presents the general principles of DC machines, both motors and generators, and of 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: Electrical Engineering, Volumes I and II; Dawes.

Prerequisite: EE-111(C).

EE-241(C) Alternating Current Circuits 3-2

This course presents the essential theory for those curricula that do not require an extensive coverage. It 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 anal-

ysis, coupled circuits, and balanced polyphase circuits are presented. Laboratory and problem work illustrate the basic theory.

Text: Alternating Current Circuits; Kerchner and Corcoran.

Prerequisite: EE-151(C).

EE-251(C) Alternating Current Circuits 3-4

This course presents the essential theory for those curricula that do not require an extensive coverage. It consists of an elementary presentation 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: AC Circuits; Kirchner and Corcoran.

Prerequisite: EE-151(C).

EE-271(C) Alternating Current Circuits 3-2

This course and EE-272 which follows present in a thorough way the basic theory of the alternating current circuit for those curricula that require an extensive coverage. The theory is developed from fundamental physical principles. The course covers single-phase series and parallel circuits, resonance, vector algebra and vector representation of electrical magnitudes, network theorem, non-sinusoidal wave analysis, balanced polyphase circuits, and power measurements in polyphase circuits. Many problems and laboratory work illustrate the basic theory.

Text: AC Circuits; Kirchner and Corcoran.

Prerequisite: EE-171(C).

EE-272(C) Alternating Current Circuits 2-2

This course is a continuation of EE-271. It completes the basic theory of the alternating current circuit for those curricula requiring a thorough preparation for further advanced study. The course includes unbalanced polyphase circuits, instruments and measurements, coupled circuits, bridge theory, and symmetrical components. Many problems and laboratory work illustrate the basic principles.

Text: AC Circuits; Kerchner and Corcoran.

Prerequisite: EE-271(C).

EE-314(C) DC and AC Machinery 3-4

This course presents a brief treatment of electrical machines for those curricula that do not require advanced work in electrical engineering. It consists of an elementary study of DC machines and their characteristics, the alternator, the synchronous motor, and the induction motor. Laboratory and problem work illustrate the principles.

Text: Electrical Engineering, Volumes I and II; Dawes.

Prerequisites: Es-111(C); Es-112(C).

EE-351(C) DC Machinery 2-2

This course presents the fundamentals of direct current machinery with emphasis upon operating characteristics and applications. The external characteristics are developed basic relations. Problems are assigned and laboratory work supplements that of the classroom.

Text: Direct Current Machinery; Pender.

Prerequisite: EE-151(C) or EE-171(C).

EE-371(C) DC Machinery 3-2

This course gives 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: Principles of DC Machines; Langsdorf.

Prerequisite: EE-171(C).

EE-451(C) Transformers and Synchros 2-2

This course gives a general treatment of transformers and synchros for the curricula that do not require an extensive treatment. It covers single-phase transformer principles and operating characteristics including the auto-transformer, constant current transformer, and special transformers. Also, polyphase transformer connections and the polyphase transformer are covered. Single phase and polyphase synchro construction features, operating characteristics, and basic theory are included. A comprehensive analysis is included of the voltage, current, and torque relations for regular and fault synchro conditions. Laboratory and problem work illustrate the theory of the classroom.

Text: Electrical Circuits and Machinery, Vol. II; Hehre and Harness.

Prerequisite: EE-251(C).

EE-452(C) Polyphase Transformers, Synchronous Machines and Induction Motors 3-4

This course is 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: Electrical Circuits and Machinery, Vol. II; Hehre and Harness.

Prerequisite: EE-451(C).

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EE-461(C) Transformers and Synchros. 3-2
This course gives a general treatment of transformers and synchros for the curricula that do not require an extensive coverage. It presents single-phase transformer principles and operating characteristics including the auto-transformer and special transformers. Windings for synchros and induction motors, single-phase and polyphase synchro construction features, operating characteristics, and basic theory are included. A comprehensive analysis of the voltage, current, and torque relations for regular and fault synchro conditions is presented. Laboratory and problem work illustrate the theory of the classroom.
Text: Electrical Circuits and Machinery, Vol. II; Hehre and Harness.
Prerequisite: EE-241(C).

EE-462(B) Asynchronous Motors and Special Machines 4-2
This course gives 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. Also it presents the theory of the amplidyne-motor, rototrol-motor, generator-motor, and motors operating under the conditions of variable voltage and current supply. Emphasis is given the transfer function (ratio of torque output to voltage input) necessary as a preparation for work in servomechanisms. Laboratory and problem work supplement the theory.
Texts: Lecture Notes: Electrical Circuits and Machinery, Vol. II; Hehre and Harness.
Prerequisite: EE-461(C).

EE-471(C) Transformers, Asynchronous Machines, and Synchros. 3-4
This course gives a thorough presentation of the principles and operating characteristics of transformers, asynchronous machines, and synchros for the curricula requiring advanced electrical engineering work leading to design. In detail the basic theory of single-phase and polyphase transformers, including auto transformers, constant current, and special transformers is presented. Polyphase induction motor principles, including armature windings, voltage and mmf waves, and operating characteristics are emphasized. Induction generators, single-phase induction motors, and the commutator type AC motor are included. Synchro theory with an analysis of the voltage, current, and torque relations for normal and fault conditions is presented. Laboratory and problem work supplement the basic theory.
Text: AC Machinery; Bryant and Johnson.
Prerequisite: EE-272(C).

EE-472(C) Synchronous Machines 3-4
This course is a continuation of EE-471. Alternator and synchronous motor characteristics are presented on the basis of cylindrical motor and two reaction theories. Armature winding, voltage and mmf waves, armature reaction, load saturation curves, regulation, and losses are emphasized. Parallel operation, frequency changers, and synchronous converters are presented. Many problems and laboratory work supplement the basic theory.
Text: AC Machinery; Bryant and Johnson.
Prerequisite: EE-471(C).

EE-473(B) Synchros 2-2
This course presents a thorough treatment of the basic theory of synchros and synchro systems for curricula requiring preparation for further advanced study. The mathematical analysis of single phase and polyphase synchro systems covers voltage, current, and torque relations for normal and fault conditions, vector diagrams, and equivalent circuits. Problems and laboratory work supplement the theory. The course is presented in lecture form.
No suitable text is available.
Prerequisite: EE-272(C).

EE-551(B) Transmission Lines and Filters 3-2
This course presents the essential basic principles of transmission lines and filters. The topics covered are transmission line parameters, infinite line, open and shorted lines, reflection, matching, stubs, T and Pi sections, constant K and M derived sections, and composite filters. Problems and laboratory work are included.
Text: Communication Circuits; Ware and Reed.
Prerequisite: EE-251(C).

EE-571(B) Transmission Lines and Filters 3-4
This course presents a thorough coverage of the basic theory of transmission lines and filters for the curricula requiring preparation for further advanced work. The topics covered in detail are transmission line parameters, infinite line, open and shorted lines, reflection, transmission line efficiency, impedance transformation, stubs, T and Pi sections, constant K and M derived sections, and composite filters. Problems and laboratory work supplement the theory.
Text: Communication Circuits; Ware and Reed.
Prerequisites: EE-271(C); EE-272(C).

EE-611(B) Servomechanisms 3-4
This course presents the essential basic prinicples 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: Introduction to Electric Transients; Kurtz and Corcoran.

Prerequisite: EE-314(C).

EE-651(B) Transients and Servos. 3-4

This course presents the essential basic principles of electrical transients and servomechanisms. The topics covered are DC and AC transients in series, parallel, series-parallel, and coupled circuits using the methods of differential equations and Heaviside. The La Place transform method is introduced. An analysis is given of servo-mechanisms with viscous damping and differential and integral control, using the transfer function method. Problems and laboratory experiments illustrate the theory.

Texts: Transients in Linear Systems; Gardner and Barnes; Servomechanism Fundamentals; Lauer, Lesnick and Matson.

Prerequisite: EE-451(C).

EE-655(B) Filters and Transients 3-2

This course presents the essential basic principles of filters and electrical transients. For filters the topics are T and Pi sections and composite filters. In transients the topics include DC and AC transients in series, parallel, series-parallel, and coupled circuits, using the methods of differential equations and Heaviside. The La Place transform method is introduced. Problems are assigned.

Texts: A.C. Circuits; Kerchner and Corcoran: Introduction to Electric Transients; Kurtz and Corcoran.

Prerequisite: EE-251(C).

EE-662(A) Servomechanisms 3-3

This course presents a thorough treatment of the basic theory of servomechanisms for curricula requiring further advanced study. The topics covered are: elementary forms of control systems, servo system follow-up links, analysis of servomechanisms with viscous damping, error rate damping, integral control, transfer function and db - log frequency analysis methods, error rate stabilization networks, typical design calculations, and general considerations. Problems and laboratory work illustrate the theory and the methods of analysis.

Text: Principles of Servomechanisms; Brown and Campbell: Servomechanism Fundamentals; Lauer, Lesnick and Matson.

Prerequisites: EE-462(B), EE-665(B), EE-745(A).

EE-665(B) Lines, Filters, and Transients 4-2

This course presents the essential basic principles of transmission lines and filters. The topics covered are: transmission line parameters, infinite line, open and shorted lines, reflection, matching, stubs. T and Pi sections, constant K and M-derived sections, and composite filters. Also included are: DC and AC transients in series, parallel, series-parallel, and coupled circuits for particular boundary conditions using the methods of differential equations. Heaviside, Fourier, and La Place methods are included. Non-linear constants are presented. Many problems illustrate the basic theory and the methods of analysis.

Text: Transients in Linear Systems; Gardner and Barnes: Introduction to Electric Transients; Kurtz and Corcoran: Communication Circuits; Ware and Reed.

Prerequisites: EE-241(C), Ma-154.

EE-671(A) Transients 3-4

This course presents in a very thorough way the basic theory of electrical transients in networks for the curricula requiring preparation for further advanced study. The topics covered are DC and AC transients in series, parallel, series parallel, and coupled circuits for particular boundary conditions using the methods of differential equations. Heaviside, Fourier, and La Place. Non-linear circuits and forcing functions other than DC and AC are included. Many problems illustrate the basic theory and the methods of analysis.

Text: Transients in Linear Systems; Gardner and Barnes: Introduction to Electric Transients; Kurtz and Corcoran.

Prerequisite: EE-251(C) or EE-272(C).

EE-672(A) Servomechanisms 3-3

This course presents a thorough treatment of the basic theory of servomechanisms for curricula requiring further advanced study. In this course the topics covered are elementary forms of control systems, servo system follow-up links, analysis of servo-mechanisms with viscous damping, error rate damping, integral control, transfer function and db-log frequency analysis methods, error rate stabilization networks, typical design calculations, and general considerations. Problems and laboratory work illustrate the theory and the methods of analysis.

Text: Principles of Servomechanisms; Brown and Campbell.

Prerequisites: EE-671(A); EE-452(C) or EE-473(B).

EE-711(C) Electronics 3-2

This course treats of the fundamental theory of the electron, gaseous conduction, therionic

emission, and electron tube characteristics. 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 curcuits.

Text: Engineering Electronics; Fink.

Prerequisite: EE-251(C).

EE-731(C) Power Electronics 3-2

This course presents the theory of electronics and synchro instruments, and a study of their applications to naval devices. The theory and applications of the various types of electron tubes is covered. Emphasis is placed upon the thyratron tube. Also the theory of the selsyn instrument and its use is included. The laboratory work consists of experiments that demonstrate the characteristics and applications of tubes and selsyns. Remote control is illustrated with laboratory models.

Text: Electronic Engineering Principles; Ryder.

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 used in research laboratories and in industry. It includes the theory of basic circuits such as vacuum tube voltmeters, bridges, direct coupled amplifiers, timing circuits, and frequency sensitive circuits with particular attention to their application in industrial instruments for the measurement and control of current, voltage, frequency, illuminators, speed, pressure, and temperature.

Text: The Electronic Control Handbook; Batcher and Moulic: Applied Electronics; MIT Staff.

Prerequisite: EE-751(C).

EE-751(C) Electronics 3-4

This course treats of electron tube characteristics and the basic circuits in which tubes are used. The theory and application of vacuum tubes and gas tubes are covered including such special tubes as the ignitron, cathode ray tube, and phototube. The basic theory of rectifier and amplifier circuits is developed and illustrated in actual commercial applications. Problems and laboratory work are designed to supplement the classroom presentation.

Text: Electronic Engineering Principles; Ryder.

Prerequisite: EE-451(C).

EE-753(C) Electronics 1-2

This course presents an analysis of electronic control circuits. The use of vacuum and gas-filled tubes in the control of motors, generators, and mechanical devices is well covered. Laboratory work supplements the theory.

Text: None.

Prerequisite: EE-451(C); EE-751(C).

EE-755(A) Electronic Control and Measurement 3-4

This course presents the principles and practice of electronic control and measurement as used in research laboratories and in industry. It includes the theory of basic circuits such as vacuum tube voltmeters, bridges, direct coupled amplifiers, timing circuits and frequency sensitive circuits with particular attention to their application in industrial instruments for the measurement and control of current, voltage, frequency, illuminators, speed, pressure, and temperature.

Text: The Electronic Control Handbook; Batcher and Moulic: Applied Electronics; M.I.T. staff.

Prerequisite: EE-751(C).

EE-771(B) Electronics 3-2

This course consists of a thorough presentation of the theory of electron tubes and circuits in which they are used for those curricula requiring preparation for further advanced work. It includes the theory of electron motion in electric or magnetic fields, vacuum and gas tube characteristics, and the principles of special tubes such 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 power and control applications. Laboratory experiments and problems supplement the basic theory.

Text: Applied Electronics; M. I. T. staff.

Prerequisite: EE-273(C).

EE-772(B) Electronics 3-2

This course is a continuation of EE-771(B). It presents in detail the more complicated electronic circuits encountered in practice with particular attention to the integration of various components in accordance with basic theory of stabilization and feedback.

Text: Applied Electronics; M. I. T. staff.

Prerequisite: EE-771(B).

EE-871(A) Electrical Machine Design 4-0

This course presents a thorough quantitative analysis of machine characteristics using the design approach. It 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: Principles Underlying the Design of Electrical Machinery; Slichter.

Prerequisite: EE-472(C).

EE-872(A) Electrical Machine Design 4-0

This course is a continuation of EE-871(A). It consists of the completion of the quantitative analysis and design of a DC machine and the beginning of a similar analysis of the synchronous machine.

Text: Principles Underlying the Design of Electrical Machinery; Slichter.

Prerequisite: EE-871(A).

EE-873(A) Electrical Machine Design 4-0

This course is a continuation of EE-872(A). It consists of the completion of the quantitative analysis and design of a synchronous machine and a similar analysis and design of the induction machine.

Text: Principles Underlying the Design of Electrical Machinery; Slichter.

Prerequisite: EE-872(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 groups of students. Some appreciation for research methods is developed. In these sessions papers treating of 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.

Prerequisites: A background of advanced work in electrical engineering.

EE-972(A) Thesis

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.

Prerequisites: The first two years of the advanced electrical engineering curriculum.

ELECTRONICS ENGINEERING

Es Courses

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. Army, Navy and Air Force organization; shipyard electronics organization; radio station administration; electronics supply matters are among the topics covered.

Prerequisites: None

Es-111(C) D C Electricity 4-4

This course is laid out to develop a sound conception of electromotive force, potential, resistance, current, a facility in the use of such basic principles as Ohm's law, Kirchhoff's laws, series, parallel, and series-parallel circuits, the theory and use of D-C instruments and bridges, the magnetic circuit, and a simple treatment of D-C transients in RL and RC circuits.

The laboratory is designed, by the inclusion of simple experiments, to make clear the fundamental concepts studied in class. One of its primary aims is to acquaint the students with typical circuit components and basic measuring devices and their proper use.

Text: Fundamentals of Electrical Engineering; Hessler & Carey.

Es-112(C) A C Electricity 4-3

Continuation of Es-111(C). Alternating current principles are introduced; sound conceptions of steady state circuit analysis are developed; reactance, impedance, admittance, conductance, susceptance, network theorems, series and parallel circuits, complex notation, non-sinusoidal waves, resonant circuits, and elementary three phase circuit theory.

Laboratory exercises illustrate principles and introduce measurement instruments.

Text: Alternating Current Circuit Theory; Reed.

Prerequisite: Es-111(C).

Es-113(C) Circuit Analysis and Measurements 3-3

Continuation of Es-112(C). This course is designed to develop the fundamentals and to provide drill in elementary radio circuit anal-

ysis. In addition the student is introduced to the techniques of measurements at radio frequencies. The topics included are: coupled circuits, network theorems, the infinite line, radio frequency bridges, measurements involving complex wave forms in high impedance, high frequency circuits.

Text: Communication Engineering; Everitt: Radio Engineering; Terman: Measurements in Radio Engineering; Terman.

Prerequisite: Es-112(C).

Es-114(C) Circuit Analysis and Measurements 3-3

Continuation of Es-113(C). The topics included are: reflections in lines, the solution of the general line, stubs, derivation and use of circle diagrams, constant K and M-defined filters, impedance transformations, the use of slotted lines in impedance measurements.

Prerequisite: Es-113(C).

Es-121(A) Advanced Circuit Theory 3-2

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.

Text: Communication Networks, Vol. I; Guillemin: Frequency Analysis, Modulation, and Noise; Goldman: Transients in Linear Systems; Gardner and Barnes.

Prerequisite: Es-114(C).

Es-122(A) Advanced Circuit Theory 3-2

Continuation of Es-121(A). The LaPlace transform is employed for solution of transients in typical circuits used in radio and radar.

Text: Transients in Linear Systems; Gardner and Barnes.

Prerequisites: Es-121(A).

Es-123(A) Advanced Circuit Theory 3-0

Continuation of Es-122(A). The transmission line as a communication facility leading to filter theory is treated. Particular 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: Communication Networks, Vol. II; Guillemin.

Prerequisite: Es-122(A).

Es-126(C) Radio Frequency Measurements 2-6

This course is designed to study the techniques of the measurement of voltage, current, power, impedance and frequency bridges 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: Radio Frequency Measurements; Hartshorn.

Prerequisites: Es-114(C), Es-225(A).

Es-134(A) Advanced Circuit Theory 3-0

Continuation of Es-133(A). The theory and basic design of ladder and lattice structure filters are studied together with their transient behavior.

Texts: Communication Networks, Vol. II; Guillemin: Network Analysis and Feedback Amplifiers; Bode.

Prerequisite: Es-133(A).

Es-186(C) Communications Fundamentals 4-4

Course contents cover the fundamental principles of radio communications and basic circuits. Included topics are: fundamentals of energy transmission by means of radio waves; basic alternating current theory; frequency selectivity circuits; coupled circuits.

Text: Radio Engineering; Terman.

Es-211(C) Electron Tubes and Circuits 2-3

This course gives an elementary treatment of thermionic emmission, space charge, diodes, triodes, tetrodes, pentodes, cathode-ray tubes, oscilloscope, gas tubes, thyratrons, rectifiers, power filters and regulated power supplies.

Text: Electronic Circuits and Tubes; Cruft: Electron-tube circuits; Seely: Radio Engineering; Terman.

Prerequisites: None

Es-212(C) Electron Tubes and Circuits 2-3

Continuation of Es-211(C). This course emphasizes the use of the vacuum tube as a switch. Topics are timing, sweep and pulse circuits; audio voltage amplifier, square-wave generator, clippers, clampers, differentiators, integrators, switching, keying, trigger circuits, multivibrators, and oscilloscope circuits.

Text: Electronic Circuits and Tubes; Cruft: Electron-tube Circuits; Seely: Radio Engineering; Terman.

Prerequisite: Es-211(C).

Es-213(C) Electron Tubes and Circuits 4-3

Continuation of Es-212(C). This course covers power amplifiers, video and transformer-coupled voltage amplifiers, phase inverters, cathode follower, inverse feedback, R-F, I-F, and wide-band tuned amplifiers, feedback oscillators.

Text: Electronic Circuits and Tubes; Cruft: Radio Engineering; Terman: Electron-tube Circuits; Seely.

Prerequisite: Es-212(C).

Es-214(C) Electron Tubes and Circuits 4-3
Continuation of Es-213(C) covering oscillators, B-F, R-C, and relaxation oscillators; A-M, F-M, and P-M methods of modulation; diode, square-law, grid and plate detection; AVC, infinite impedance detector, discriminators; receiver principles; polyphase and controlled rectifiers; theory of electrons in metals, emission, semi-conductors, etc.
Text: Electronic Circuits and Tubes; Cruft: Electron-tube Circuits; Seely: Radio Engineering; Terman.
Prerequisite: Es-213(C).

Es-225(A) Electron Tubes 3-6
Continuation of Es-214(C). Noise, electron ballistics, electron optics, cathode-ray tubes, photomultiplier tubes, television tubes; limitations of conventional tubes at ultra-high frequency and transit time effects.
Text: Vacuum Tubes; Spangenberg.
Prerequisite: Es-214(C).

Es-226(A) Ultra-High-Frequency Tubes 4-3
Cavity resonators, klystron and magnetron tubes and circuits, traveling-wave tubes, pulsing circuits, and related laboratory work.
Text: Vacuum Tubes; Spangenberg: Radar System Engineering; Ridenour: Principles of Radar; MIT Staff.
Prerequisites: Es-225(A), Es-623(A).

Es-227(C) Ultra—High Frequency Tubes 3-3
Course contents cover the principles and underlying problems of ultra-high-frequency tubes. Included topics are: limitations of conventional tubes at ultra-high frequency; transit time effects; electron ballistics; cavity resonators; klystrons; magnetrons; traveling-wave tubes. The course emphasizes a descriptive presentation rather than a mathematical one.
Prerequisite: Es-214(C).

Es-256(C) Introduction to Radar Applications of Vacuum Tubes 2-0
The use of a tube as a switch. Clipping device, multivibrators, sawtooth generators, simple R-C transient circuits.
Text: Radar Electronic Fundamentals; Navships 900,016.
Prerequisites: None.

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. Includes emission, characteristics of vacuum and gas tubes, rectifiers and filters, grid-controlled rectifiers, class A amplifiers.
Text: Applied Electronics; M. I. T. Staff.
Prerequisites: Es-111(C), Es-112(C).

Es-262(C) Electron Tubes and Circuits 3-2
Continuation of Es-261(C). Includes feedback amplifiers, class B and C amplifiers, oscillators, modulation and detection.
Text: Applied Electronics; M. I. T. Staff.
Prerequisite: Es-261(C).

Es-281(C) Electronic Fundamentals 2-2
Course contents cover the basic principles of electronics. Included topics are: review of basic mathematical concepts; the underlying physical principles of electron tube operation; characteristics of electron tube operation.
Text: Physics; Robeson: Fundamentals of Vacuum Tubes; Eastman: Mathematics for Electricians & Radiomen; Cooke.
Prerequisites: None.

Es-282(C) Vacuum Tube Circuits 4-4
Continuation of Es-281(C). Course contents cover the operational characteristics of electron tubes and some of their applications. Included topics are: general operational features of diodes, triodes, multigrid tubes and gas tubes; amplification of small alternating voltages; power amplifiers.
Text: Fundamentals of Vacuum Tubes; Eastman: Radio Engineering; Terman.
Prerequisite: Es-281(C).

Es-283(C) Vacuum Tube Circuits 4-3
Continuation of Es-282(C). Course contents cover further applications of electron tubes, in continuation of the course material presented in Es-282(C). Included topics are: sine wave oscillators; amplitude modulation and the A-M transmitter; demodulation and the TRF receiver; frequency translation and the superheterodyne A-M receiver; power supplies; frequency modulation.
Text: Fundamentals of Vacuum Tubes; Eastmen: Radio Engineering; Terman.
Prerequisite: Es-282(C).

Es-286 Pulsing and High-Frequency Circuits 3-2
Course contents cover the principles and underlying problems of pulsing and high-frequency circuit operation. Included topics are: characteristics of nonsimusoidal 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.
Text: Radar Electronic Fundamentals; Navships 900, 016: Principles of Radar; M. I. T. Staff.
Prerequisite: Es-282(C).

Es-321(B) Radio Systems 3-3
This course is the first of a sequence of

five 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.

Text: Radio Engineer's Handbook; Terman: War Department Technical Manual, TM11-486 (Electrical Communication System Engineering): Navy Equipment Instruction Books.

Prerequisites: Es-225(A) and Ma-104(A).

Es-322(B) Radio Systems 3-3

This is 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: Radio Receiver Design; Sturley: Radio Engineer's Handbook; Terman: Microwave Receivers; MIT RadLab: and other selected references.

Prerequisite: Es-321(B).

Es-326(B) Radio Systems 3-3

This course is the first of a sequence of five 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.

Text: Radio Engineer's Handbook; Terman: War Department Technical Manual, TM 11-486 (Electrical Communication System Engineering): Navy Equipment Instruction Books.

Prerequisites: Es-114(C) and Es-214(C).

Es-327(B) Radio Systems 4-3

This is 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 bands. Circuit modifications to include the VHF region and the changes introduced by the use of frequency and phase modulation are also covered.

Text: Radio Receiver Design; Sturley: Radio Engineer's Handbook; Terman: Microwave Receivers; MIT RadLab Staff: and other selected references.

Prerequisite: Es-326(B).

Es-328(B) Radio Systems 2-3

This course continues the systems series. Included 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.

Text: Naval Instruction Books: Instructor's Notes.

Prerequisite: Es-327(B).

Es-333(B) Radio Systems 2-3

This course continues the systems series. Included 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.

Text: Naval Instruction Books: Instructor's Notes.

Prerequisite: Es-322(B)

Es-386(C) Transmitters and Receivers 3-3

Course contents cover the operational characteristics of typical Navy type transmitters and receivers. Included topics are frequency standards and meters; Navy transmitters; Navy receivers.

Text: Lecture Notes: Equipment Instruction Books.

Prerequisites: Es-283(C), Es-786(C).

Es-421(B) Radar Fundamentals 2-3

Course context covers the principles and underlying problems of pulse techniques. Included topics are pulse shaping, switching, clipping, differentiating, integrating, sweep-circuit generators, CRT characteristics such as phosphors and electron optics.

Text: Principles of Radar; M. I. T. Radar School Staff.

Prerequisite: Es-114(C).

Es-422(B) Radar System Engineering 3-3

Fundamental principles of radar. Theory of operation of radar timing circuits, indicators, modulators, transmitters, RF systems and receivers, radar range equation. Related laboratory work given concurrently.

Text: Radar System Engineering; Ridenour: Principles of Radar; M. I. T. Radar School Staff.

Prerequisite: Es-421(B).

Es-423(B) Radar System Engineering 3-6
Continuation of Es-422(B). Study of representative search, fire-control and IFF systems, including airborne, with particular attention to design features. Study of current radar developments. Related laboratory work on current Navy radar equipment.
Text: Radar System Engineering; Ridenour.
Prerequisite: Es-422(B).

Es-431(B) Radar System Engineering 3-3
Fundamental principles of radar. Theory of operation and design features of radar timing circuits, indicators, modulators, transmitters, RF systems and receivers. Related laboratory work given concurrently.
Text: Radar System Engineering; Ridenour: Principles of Radar, Second Ed; M. I. T. Radar School Staff.
Prerequisite: Es-226(A).

Es-432(B) Radar System Engineering 3-6
Continuation of Es-431(B) Study of representative search, firecontrol and IFF systems, including airborne, with particular attention to design features. Study of current radar developments, Related laboratory work on current Navy radar equipment.
Text: Radar System Engineering; Ridenour.
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 firecontrol systems, with emphasis on operational limitations, propagation phenomena, types of presentation, and anti-jam techniques. Laboratory work to emphasize operational techniques of current fire-control systems.
Text: Principles of Radar; M. I. T. Radar School Staff.
Prerequisite: None.

Es-447(C) Electronics Pulse Techniques 3-0
This course presents the basic principles of pulse shaping circuits; clippers, peakers, gaters, etc., etc., pulse forming networks and artificial lines. Also RF, IF, 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: Radar System Engineering; Ridenaur: Principles of Radar; M. I. T. Radar School Staff.
Prerequisite: None.

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, Laboratory on current airborne radar equipment.
Text: Principles of Radar; M. I. T. Radar School Staff.
Prerequisite: None.

Es-521(B) Special Systems 3-3
A continuation of the series starting with Es-326(B). Pulse Modulation principles, pulse time modulation multiplex, principles of television, television receiver and transmitter design practice, facsimile, and basic telemetering systems.
Text: Naval Instruction Books: Instructor's Notes.
Prerequisite: Es-327(B).

Es-522(B) Special Systems 3-3
A continuation of the special systems series. Principles of radio direction finding and navigation, and radio and radar counter-measures.
Text: Very High Frequency Techniques, Vol. I, Loran; M. I. T. RadLab. Staff: Other selected references.
Prerequisite: Es-521(B).

Es-531(B) Special Systems 3-3
A continuation of the series starting with Es-321(B). Pulse modulation principles, pulse time modulation multiples, principles of television, television receiver and transmitter design, facsimile, and basic telemetering systems.
Text: Naval Instruction Books: Instructor's Notes.
Prerequisite: Es-333(B)

Es-532(B) Special Systems 3-3
A continuation of the special systems series. Principles of radio direction finding and navigation, and radio and radar countermeasures.
Text: Very High Frequency Techniques, Vol. I, Loran; MIT RadLab Staff: and other selected references.
Prerequisite: Es-531(B)

Es-586(C) Special Systems 3-3
Course contents cover Navy electronic systems other than communications transmitters and receivers. Included topics are: loran systems; radar systems; image transmission systems; frequency-shift keying techniques; multiplex systems.
Text: Lecture Notes: Equipment Instruction Books.

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 lump 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; scalor and vector potentials; energy stored in electric and in magnetic fields. Text material is considerably amplified in class lectures.

Texts: Fields and Waves in Modern Radio; Ramo and Whinnery.

References: Principles of Electricity and Electromagnetism; Hanwell: Electromagnetic Theory; Stratton: Electromagnetic Waves; Schelkunoff.

Prerequisite: Ma-124

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 co-axial 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: Same as Es-621(A).

Prerequisite: Es-621(A).

Es-623(A) Electromagnetics 4-0

A continuation of Es-622(A). Skin effect and internal impedance, solutions involving Bessel and Hankel functions; calculation 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 cylindrical wave guides.

Text: Same as Es-621(A).

Prerequisite: Es-622(A).

Es-624(A) Electromagnetics 3-0

A continuation of Es-623(A) radial disk transmission lines; resonant cavities; 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: Same as Es-623(A).

Prerequisite: Es-623(A).

Es-721(B) Antennas and Wave Propagation 3-3

This course is 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.

Text: Instructor's Notes: Antennas; Kraus: Antennas; Transmission Lines, and Waveguides; King, Mimno, and Wing.

Prerequisites: Es-327(B), Es-114(C).

Es-722(B) Antennas and Wave Propagation 3-3

Continuation of Es-721(B).

Text: Same as Es-721(B).

Prerequisite: Es-721(B).

Es-736(B) Antennas, Transmission Lines 3-3

This course presents 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 of 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.

Prerequisite: Es-624(A).

Es-786(C) R-F Energy Transmission 3-2

Course contents cover the principles and techniques of energy transmission by means of radio-frequency waves. Included 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. Two hr. P-work periods occasionally used for lecture-demonstrations.

Text: Radio Engineering; Terman; Radar Electronic Fundamentals; NavShips 900, 016.

Prerequisite: Es-186(C)

Es-831(A) Thesis 2-0

This course provides the student with the opportunity for study and research in connection with the preparation of the thesis as required in Electronics Curricula. Few formal classes are scheduled, instead the student is concerned with the choice of a suitable topic and does the necessary preliminary library and laboratory work. Staff members are consulted as the work progresses.

Es-832(A) Thesis 4-0

This course continues and completes the preparation of the thesis begun in Es-831(A).

Es-836(A) Project Seminar 1-0

This course 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.

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.

Prerequisites: None.

FOREIGN LANGUAGE

La Courses

La-101(C) German 2-0

This course will include study of grammar, sufficient for reading intelligently scientific works in German, use of dictionaries, and practice in translating from German to English. The main emphasis will be placed on the acquisition of a large, technical reading vocabulary.

Texts: Shorter College German; Evans, Roseler: Reading German; Morgan, Strothmann: New German Dictionary; Heath.

Prerequisite: None.

La-102(C), La-103(C), La-104(C) La-105(C), La-106(C), La-107(C) and La-108(C) German 2-0

These courses are progressive continuations of the course La-101, and follow one another in the order given. Each course is given in a separate term; is an advancement over the preceding course; and leads to the ability to read technical German publications in Meteorology.

Text: An Anthology of Scientific German; Wilde.

Prerequisite: La-101(C) or the preceding listed La-course.

La-201(C) Russian 2-0

This course will include study of necessary grammatical constructions for reading, use of dictionaries, and practice in translating material from Russian to English. Chief emphasis will be placed on the acquisition of a large, technical reading vocabulary.

Text: Selections from: Estestvoznznie, Teturev; Geografia, Terchova and Erdeli, Fizichekaya Geografia, Barkov and Polovinkin: Colloguial Russian; Sieff: Russian-English Dictionary; Muller.

Prerequisite: None.

La-202(C), La-203(C), La-204(C) La-205(C), La-206(C), La-208(C) Russian 2-0

These courses are progressive continuations of course La-201(C). and follow one another in the order given. Each course is given in a separate term; is an advancement over the preceding course; and leads to the ability to read Russian publications in Meteorology.

Texts: As selected.

Prerequisite: La-201(C) or the preceding listed La-course.

GEOLOGY

Ge Courses

Ge-101(C) Physical Geology 3-0

This course initiates the student into the study of the various geological phenomena. Among the principle topics discussed are: rock-forming minerals; igneous, sedimentary, and metamorphic rocks; weather ring and erosion; stream sculpture; glaciation; surface and subsurface waters; volcanism; dynamic processes; structural geology; and interpretation of topographic maps.

Frequent reference is made to other than the prescribed textbook: The course is given as much as possible to stress those topics of particular interest to the petroleum engineer.

Text: Physical Geology; Longwell, Flint, Knopf.

Prerequisite: None.

Ge-241(C) Geology of Petroleum 2-2

This course includes discussions on the origin, accumulation, and structure which aid in the accumulation of petroleum, its general occurrence and distribution. The important oil fields of the world are then taken up in detail as to the occurrence and associated structures in particular fields. 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, Oceans and Asia. This course is supplemented by reading assignments in the current petroleum and petroleum geology journals.

Text: Principles of Petroleum Geology; Lalicker.

Prerequisite: Ge-101(C)

Ge-302(C) Determinative Mineralogy 1-4

The lectures are designed to familiarize the student with the principles and technique 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: Determinative Mineralogy; Lewis, Hawkins: Textbook of Mineralogy; Dama, Ford.

Prerequisite: Cr-301(B).

Ge-401(C) Petrology and Petrography 2-3

The course consists of 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 sedimentary rocks, their origin and types with particular emphasis on the oil-bearing 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 selections under the petrographic microscope. When practicable, the course is supplemented by trips to nearby localities to study rocks and minerals in the field.

Text: Rocks and rock minerals; Pirsson, Knopf.

Prerequisites: Ge-101(C), Cr-301(B).

INDUSTRIAL ENGINEERING

IE Lecture Courses

IE-101(C) Principles of Industrial Organization (Lecture Course) 0-1

A study of the origin and growth of industrial enterprises, principles of organization, control and production, systems research, standards and standardization, industrial relations, and the effects of science upon industry. This course is presented in a series of ten lectures, given by an authority in the field of Management Engineering, covering the material listed above.

Text: None.

Prerequisites: None

IE-103(C) Applied Industrial Organization (Lecture Course) 0-1

A study of the application of the principles of Industrial Organization to the structure of industrial enterprises. In a series of ten lectures, given by representatives of major industries, an overall picture of the structure of major industrial organizations is presented. The pattern followed is a delineation of the broad aspects of a large organization followed by explanation of the lower echelons of the organization.

Text: None.

Prerequisite: IE-101 or IE-102.

IE-104(C) Physchophysical Systems Research (Lecture Course) 0-1

A series of five lectures given by authorities in the field of Psychophysical Systems Research covering the background of research in human engineering; quantitative methods employed in psychophysical research and tests; optimum physical conditions of operation of instruments; problems of equipment design; basic research in the design of the instruments; the design of tasks; the working environment; the appraisal and design of systems.

Text: None.

Prerequisites: None.

MARINE ENGINEERING

NE Courses

NE-101(C) Main Propulsion 3-0

A practical study of naval steam-turbine-reduction-gear propulsion plants and their auxiliaries. Subjects treated include boilers, forced draft blowers, fuel oil and fuel oil equipment, boiler feed water systems, piping and valves, gaskets and packing, pumps and governors, main turbines, condensers and air ejectors, reduction gears, bearings and shafting propellors, lubrication and lubricants.

Text: Bureau of Ships Manual; Naval Machinery 1946; Bureau of Ships Bulletins of Information.

Prerequisites: None.

NE-102(C) Auxiliary Machinery 3-0

A practical study of naval machinery other than main propulsion machinery. Subjects treated include auxiliary turbines, mechanical measuring instruments, hydraulic speed gears, diesel (auxiliary) engines, compressed air plants, welding and cutting, distilling plants, refrigeration plants, electrical plants (general), generators and voltage regulators, electrical distribution systems, storage batteries, motors and controllers, lighting, interior communication systems, searchlights and electrical measuring instruments.

Text: Bureau of Ships Manual; Naval Machinery 1946; Bureau of Ships Bulletins of Information.

Prerequisites: None.

NE-103(C) Engineering Department ~~Organization~~ 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, navy shipyard overhauls, supplies, spare parts, requisitions, engineering casualty control, safety precautions, engineering competition, and economical operation of engineering plants.

Text: Prepared lecture stencils.

Prerequisites: None.

MATHEMATICS

Ma Courses

Ma-101(C) Introduction to Engineering Mathematics 5-0

Introduction to infinite series, multiple integrals, Hyperbolic functions and differential equations; linear equations and determinants; Graeffe's root-squaring method; elementary operations with complex numbers.

Text: Higher Mathematics; Sokolnikoff and Sokolnikoff: Differential Equations (Revised); Cohen: Elements of the Differential and Integral Calculus; Granville; Smith and Longley.

Prerequisite: A special review course in differential and integral calculus, or equivalent.

Ma-102(C) Differential Equations and Series 5-0

A continuation of Ma-101(C). 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. Vector algebra and the solid analytic geometry of planes & lines.

Text: Higher Mathematics; Sokolnikoff and Sokolnikoff: Elementary Vector Analysis; Weatherburn: New Analytic Geometry; Smith, Gale and Neeley: Calculus; Granville, Smith and Longley.

Prerequisite: 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 curves and surfaces and applications of partial derivatives. Differentiation of vectors; differential operators. Line, surface, and space integrals and applications; divergence theorem and theorems of Green and of Stokes. Curvilinear coordinates. Introduction to analytic functions of a complex variable.

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Text: Higher Mathematics; Sokolnikoff and Sokolnikoff: Elementary and Advanced Vector Analysis; Weatherburn: New Analytic Geometry; Smith, Gale and Neeley: Calculus; Granville, Smith and Longley.

Prerequisite: Ma-102(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 and special cases of higher order partial differential equations with special emphasis on those having constant coefficients. Solution of ordinary differential equations in series; gamma, beta, Bessel and Legendre fucntions; introduction to boundary value problems and orthogonal functions with applications to heat flow vibrations of strings and membranes and flow of electricity in a cable. Interpolation formulas of Newton, Stirling and Lagrange, quadrature formulas and numerical integration of ordinary differential equations and systems.

Text: Higher Mathematics; Sokolnikoff and Sokolnikoff: Differential Equations (Revised); Cohen: Numerical Mathematical Analysis; Scarborough.

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 functions, 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.

Text: Fourier Series and Boundary Value Problems; Churchill: Numerical Solution of Partial Differential Equations; H. W. Emmons (Quart. Appl. Math., 2, 1944, 173-195).

Prerequisite: Ma-104(A).

Ma-106(A) Complex Variable and Laplace Transform 4-0

Analytic functions; Cauchy's theorem and formula, Taylor and Laurent series, residues, contour integration, conformal mapping. 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.

Text: Introduction to Complex Variables and Applications; Churchill: Modern Operational Mathematics in Engineering; Churchill: Transients in Linear Systems; Gardner and Barnes.

Prerequisite: Ma-104(A) or special permission.

Ma-107(A) Orthogonal Functions and Integral Equations 3-0

A study of orthogonal functions and of Sturm-Liouville and other eigenvalue problems, illustrated by Fourier series, Bessel functions, and the polynomials of Legendre, Hermite, Jacobi and Laguerre; solution of integral equations by the method of interation, of Fredholm, and of Hilbert-Schmidt; applications.

Text: Fourier Series and Boundary Value Problems; Churchill: Fourier Series and Orthogonal Polynomials; Jackson: Mathematics of Physics and Chemistry; Margenau and Murphy.

Prerequisite: Permission of Instructor.

Ma-109(A) Topics in Advanced Calculus 3-0

Extension of natural numbers to real number system; basic theorems on limits; continuity and differentiation properties of functions; the definite integral and improper definite integrals; infinite series.

Text: Differential and Integral Calculus, Volume I; Courant.

Prerequisite: Ma-104(A) or Ma-1&4(A) or one of these to be taken concurrently.

Ma-116(A) Matrices and Numerical Methods 4-0

Elementary properties and types of matrices; matrix algebra; calculus of matrices; latent roots and characteristic vectors of matrices; numerical operations with matrices; numerical solution of systems of linear equations and of algebraic equations; numerical methods for solving boundary value problems and ordinary differential equations.

Text: Elementary Matrices; Frazer, Duncan and Collar: Reprints of articles from professional journals.

Prerequisite: Ma-154(A)

Ma-118(A) Mathematics of Stability Analysis

This course covers topics important in the study of aircraft flight performance. These topics include differential operator methods, Laplace transform methods, matrix algebra, Lagringe's equations, complex variable theory and non linear differential equations.

Text: Applied Mathematics for Engineers and Physicists, Pipes.

Prerequisite: Ma 104(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.

Text: Higher Mathematics; Sokolnikoff and Sokolnikoff: Calculus; Granville, Smith and Longley.

Prerequisite: A special review course in differential and integral calculus or the equivalent.

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.

Text: Analytic geometry; Smith, Gale and Neeley: Higher Mathematics; Sokolnikoff and Sokolnikoff: Elementary Vector Analysis; Weatherburn: Differential Equations; Cohen.

Prerequisites: A special review course in differential and integral calculus or the equivalent, 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. Fundamentals of probability. Preliminary considerations in the analysis of observational data. Bernoulli and Poisson distributions.

Text: Advanced Vector Analysis; Weatherburn: Analytic Geometry of Space; Snyder and Sisam: Theory of Probability; Scheffe: Elementary Statistical Analysis; Wilks.

Prerequisite: Ma-103(B)

Ma-135(B) Partial Differential Equations and Numerical Methods 4-0

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.

Text: Differential Equations (Revised); Cohen: Fourier Series and Boundary Value Problems; Churchill: Numerical Mathematical Analysis; Scarborough.

Prerequisite: Ma-103(B)

Ma-151(C) Introduction to Engineering Mathematics 4-0

Partial differentiation; multiple integrals; determinants; solution of linear equations and of algebraic equations; algebra of complex numbers; introduction to infinite series and ordinary differential equations.

Text: Higher Mathematics; Sokonikoff and Sokolnikoff: Ordinary Differential Equations; Golomb and Shanks: Elements of the differential and Integral Calculus; Granville, Smith and Longley: New Analytic Geometry; Smith, Gale and Neelley.

Prerequisite: A special review course in differential and integral calculus, or the equivalent.

Ma-152(B) Differential Equations and Boundary Value Problems 4-0

A continuation of Ma-151(C) systems of ordinary linear differential equations with constant coefficients; the Laplace transform; numerical integration of differential equations; series solutions of differential equations; boundary value problems and orthogonal functions including Fourier series.

Text: Advanced Calculus for Engineers, Hildebrand; Ordinary Differential Equations, Golomb and Shanks.

Prerequisite: Ma-151(C)

Ma-153(B) Vector Analysis and Introduction to Partial Differential Equations 3-0

A continuation of Ma-152(B) introduction to the algebra and 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.

Text: Advanced Calculus for Engineers; Hildegrand: Higher Mathematics; Sokolnikoff and Sokolnikoff: New Analytic Geometry; Smith, Gale and Neelley.

Prerequisite: Ma-152(B)

Ma-154(A) Partial Differential Equations and Functions of a Complex Variable 3-0

A continuation of Ma-153(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.

Text: Advanced Calculus for Engineers; Hildebrand.

Prerequisite: Ma-153(B)

Ma-155(A) Matrices and Engineering Applications 3-0

Elementary properties and types of matrices; the differential and integral calculus of matrices; latent roots and characteristic vectors of matrices; application of matrix theory to linear systems of differential equations; matrix methods in the kinematics and dynamics of mechanical systems; computation of the fastest and slowest modes of vibration of a system by matrix product iteration.

Text: Elementary Matrices; Frazer, Duncan and Collar: Mathematical Methods in Engineering; Karman and Biot.

Prerequisites: Ma-103(B) or Ma-153(B) and Mc-102(C).

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: A first year of College Mathematics; Brink.

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. Partial differentiation and total differential.

Text: Elements of the Differential and Integral Calculus (Revised Edition); Granville, Smith and Longley.

Prerequisite: Ma-161(C).

Ma-171(C) Special Topics in Calculus 3-0

Determinants; Series of Constants Taylor's series and related series; introduction to ordinary differential equations of the commonest types; algebra of complex numbers.

Text: Elements of the Differential and Integral Calculus; Granville. Smith and Longley: USNPS Stencils.

Prerequisite: A special review course in differential and integral calculus, or the equivalent.

Ma-172(C) Fourier Series and Related Topics 3-0

A continuation of Ma-171(C). Hyperbolic functions; series of functions and Fourier Series; partial derivatives.

Text: Calculus; Granville, Smith and Longley: Higher Mathematics; Reddick and Miller.

Prerequisite: Ma-171(C) or Ma-101(C).

Ma-173(B) Functions of Several Variables and Introduction to Vector Methods 3-0

A continuation of Ma-172(C). Solid analytic geometry and elementary vector methods; multiple integrals.

Text: Calculus; Granville, Smith and Longley: Higher Mathematics; Reddick and Miller: New Analytic Geometry; Smith, Gale and Neeley: USNPS Stencils.

Prerequisite: Ma-172(C).

Ma-174(B) Introduction to Laplace Transform and Related Topics 3-0

A continuation of Ma-174(B). Elementary study of functions of a complex variable; linear differential equations of higher order and systems of such equations; introduction to Laplace Transform.

Text: Higher Mathematics; Reddick and Miller: Complex Variables; Churchill: Modern Operational Mathematics in Engineering; Churchill.

Prerequisite: Ma-173(B).

Ma-180(C) Vector Algebra and Geometry 2-0

Coordinates and related concepts in three dimensions; algebra of vectors and complex numbers; lines and planes; determinants and systems of linear equations.

Text: New Analytic Geometry; Smith, Gale and Neelley: Vector Analysis; Phillips: Complex Variables; Churchill.

Prerequisite: A special review course in differential and integral calculus, or the equivalent.

Ma-181(C) Directional Derivatives and Line Integrals 4-0

Partial derivatives; total derivatives; Taylor's expansion in several variables; total differentials; directional derivatives; applications. Definite and indefinite line integrals; directional derivatives and line integrals in vector and complex notation; the elementary transcendental functions; introduction to ordinary differential equations.

Text: Higher Mathematics; Burington and Torrance: Vector Analysis; Phillips: Complex Variables; Churchill.

Prerequisite: A special review course in differential and integral calculus, or the equivalent and Ma-180(C) to be taken concurrently.

Ma-182(B) Differential Equations and Vector Analysis 5-0

First and second order differential equations; the differential equations of vector fields; derivatives of vectors; two-dimensional fluid flow; vector differential operators; multiple integrals; vector integral relations; curvilinear coordinates.

Text: Differential Equations; Cohen: Vector Analysis; Phillips.

Prerequisites: Ma-180(C) and Ma-181(C).

Ma-183(B) Complex Variables and the Differential Equations of Theoretical Physics 5-0

Conformal maps; Cauchy's formula; expansions; residues; series solution of differential equations; the functions of theoretical physics; Fourier series and boundary value problems; numerical methods.

Text: Complex Variables; Churchill: Fourier Series and Boundary Value Problems; Churchill: Mathematics of Physics and Chemistry; Margenau and Murphy.

Prerequisite: Ma-182(B).

Ma-184(A) Matrices, Tensors, and Variations 4-0

Matrices; tensors; calculus of variations.

Text: Mathematics of Physics and Chemistry; Margenau and Murphy: Higher Mathematics; Burington and Torrance.

Prerequisite: Ma-183(B).

Ma-194(A) Matrices, Laplace Transforms, and Variations 4-0

Matrices; Laplace transforms; calculus of variations.

Text: Mathematics of Physics and Chemistry; Margenau and Murphy: Modern Operational Mathematics; Churchill: Higher Mathematics; Burington and Torrance.

Prerequisite: Ma-183(B).

Ma-201(C) Graphical and Mechanical Computation 0-2

Construction of nomograms, including alignment charts, by geometric methods and use of determinants. Improvement of charts by projection. The use of coordinate paper. The theory and use of the planimeter and integrator.

Text: Graphical and Mechanical Computation; Lipka: Nomograms; J. Rybner (G. E. Review, 33, 1930, 164ff.): USNPS Multiliths.

Prerequisite: Ma-101(C), Ma-151(C), Ma-171(C) or one of these to be taken concurrently.

Ma-251(C) Graphical and Mechanical Computation 0-4

The course consists of twenty exercises each occupying one laboratory period. Two exercises are in the theory and use of the planimeter and integrator. The remaining exercises are devoted to the design of diagrams, including: construction of scales to show relations between two variables; construction of nomograms with families of lines or curves to show relations among three variables; alignment diagrams for three variables involving curved scales and curve nets; diagrams for more than three variables and diagrams with more than one index line; alignment diagrams with adjustment for equations in three or more variables; the Lafay-Wertheimer method for constructing a chart or alignment diagram from empirical curves.

Text: Design of Diagrams for Engineering Formulas; Hewes and Seward.

Prerequisite: Ma-101(C), Ma-151(C), Ma-171(C), Ma-180(C), or one of these to 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: Elementary Statistical Analysis; Wilks: Introduction to Mathematical Statistics; Hoel.

Prerequisite: Ma-103(B) (may be taken concurrently).

Ma-331(A) Statistics 4-2

A continuation of Ma-135(C). Continuous frequency distributions. Moments and mathematical expectation. The normal and type III Pearson distributions. Correlation: simple, multiple and partial. Non-linear regressions. Large and small sampling theory and the testing of hypotheses. Applications to problems in aerology.

Text: Mathematics of Statistics; Kenney: Introduction to Mathematical Statistics; Hoel.

Prerequisite: Ma-135(C).

Ma-381(B) Probability 4-0

Discrete probability. Theorems of total and compound probability. Binomial probabilities - limiting cases and methods of evaluation. Expectations. Law of large numbers. Probabilities in continuum - geometrical problems.

Text: Introduction to Mathematica Probability; Uspensky.

Prerequisite: Ma-181(B).

Ma-382(A) Probability and Statistics 2-0

Probability distributions and characteristic functions. Central limit theorem. Multivariate normal distribution. Linear regression and least squares.

Text: Introduction to Mathematical Probability; Uspensky: Introduction to the Theory of Statistics; Mood.

Ma-383(A) Statistics 2-3

Sampling distributions. Point and interval estimation. Tests of hypotheses. Analysis of variance. Sequential analysis. Introduction to modern high-speed electrical computation equipment.

Text: Introduction to the Theory of Statistics; Mood.

Prerequisite: Ma-382(A).

Ma-401(A) Mathematical Computation by Physical Means 2-2

A wide variety of elementary devices which may be used to perform mathematical operations is considered together with instruments which combine them so as to solve problems largely without human intervention.

Text: Theory of Mathematical Machines; Murray: Designing Computing Mechanisms; M. Fry (Machine Design 1945-46) and other reprints.

Prerequisite: Ma-103(B) or Ma-153(B).

Ma-501(A) Theory of Games 4-0

This course presents 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 are investigated, particularly one-person games and two-person zero-sum games with finite and infinite strategies, and the related algebra of matrices and bilinear forms is presented to yield methods for evaluating games; the minimax theorem is presented and properties of minimax strategies are brought out. Games involving three or more persons are taken up and the effects of coalitions studied.

Text: Theory of Games and Economic Behavior; Von Neumann and Morgenstern: Rand Reports: University of Michigan Reports: Statistical Decision Functions; Wald.

Prerequisite: Ma-383(A).

MECHANICS

Mc Courses

Mc-101(C) Engineering Mechanics I 3-0

Review of statics; the free body; distributed forces; centroids; the principle of virtual displacements; stability of equilibrium; rectilinear kinematics and dynamics of a particle; free vibration; forced vibration with and without damping; the principle of impulse and momentum and the principle of work and energy for rectilinear motion; potential energy and conservation of energy; dimensional analysis.

Text: Engineering Mechanics; Timoshenko and Young.

Prerequisite: A special review course in mechanics or the equivalent.

Mc-102(C) Engineering Mechanics II 3-0

Elements of vector analysis including scalar and vector products and the differentiation of vectors; kinematics and dynamics of the curvilinear motion of a particle; angular momentum; motion of a rigid body about a fixed axis; moments and products of inertia; plane motion of a rigid body; time rate of change of a vector presented in a moving coordinate system; principle of the moment of momentum; gyroscope; Coriolis acceleration.

Text: Engineering Mechanics; Timoshenko and Young: Vector Analysis; Phillips.

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. The 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 exercises are designed to furnish practice in the formulation of the differential equations for systems of variable mass.

Text: Principles of Mechanics; Synge and Griffith: Advanced Dynamics; Timoshenko and Young.

Prerequisites: Mc-102(C) and Ma-103(B) (latter may be taken concurrently).

Mc-311(A) Vibrations 3-2

Kinematics of vibrations; harmonic analysis; 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; Lagrangian equations of motion.

Text: Mechanical Vibrations (3rd edition); Den Hartog: Advanced Dynamics; Timoshenko and Young.

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 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, stability considerations being deferred to a later course. Mc-402(A).

Text: A Course in Exterior Ballistics; Ritter.

Prerequisites: Ma-155(A) and Mc-102(C).

Mc-402(A) Dynamics of Missiles and Gyros 3-0

The fundamental principles of the dynamics of rotating rigid bodies are emphasized throughout the course. These principles are applied to a variety of mechanical systems in an effort to demonstrate their wide applicability. Among the applications discussed are the motion of a gyroscope in the gyrocompass, latitude measuring devices and stable elements; the stability, drift and trailing of spinning shells and rockets in flight.

Text: Principles of Mechanics (2nd edition); Synge and Griffith: Motion of a Spinning Shell;

Nielsen and Synge: Advanced Dynamics; Timoshenko and Young.

Prerequisite: Mc-401(A).

Mc-421(A) Interior Ballistics 2-0

Basic physical chemistry of interior ballistics including reaction rates, equilibria and the freezing of equilibria. 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.

Text: Simple Calculation of Thermochemical Properties for Use in Ballistics (OSRD Report 935), Hirschfelder and Sherman: Interior Ballistics (OSRD Report 6468), Curtiss and Wrench: Thermodynamics of Firearms; Robinson.

Prerequisites: Ma-151(C), Mc-102(C), Ch-631(A).

Mc-431(A) Theory of Plasticity of Metals and Strength of Guns 3-0

A detailed presentation of the modern mathematical theory of the plasticity of metals; criterion of yielding; strain-hardening; the complete stress-strain relations; Levy-Mises and Reuss equations; Hencky stress-strain equations; the plastic potential; variational principles; solution of plastic-elastic problems; expansion of spherical shells and cylindrical tubes; theory of the autofrettage process used in the radial expansion of guns.

Texts: Mathematical Theory of Plasticity, Hill; Treatise on the Radial Expansion of Guns, Jeansen.

Prerequisite: Ma-154(A), Mc-102(C) and ME-500(C).

MECHANICAL ENGINEERING

ME Courses

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. Kinetic theory of gases. Associated problems.
Text: Engineering Thermodynamics; Kiefer, Kinney & Stuart.
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, saturation by isobaric cooling, isobaric evaporation and adiabatic expansion and other representative processes, multi-and mono-pressure hygrometric diagrams. Non-ideal gases, their p-v-t correlation by equation and by compressibility diagrams, residual entholpy and entropy functions and their determination from compressibility and throttling data, representative processes and generation of thermodynamic diagrams. Combustion of fuels and material balances, fuel calorimetry, chemical equilibrium and equilibrium constant, rich-mixture and thin-mixture combustion, flame temperatures. Associated problems.
Text: Engineering Thermodynamics; Kiefer, Kinney & Stuart.
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.
Text: Engineering Thermodynamics; Kiefer, Kinney & Stuart.
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 mixtures and their indices, saturation by isobaric cooling, isobaric evaporation and adiabatic expansion, multi-and mono-pressure hygrometric charts.
Text: Engineering Thermodynamics; Kiefer, Kinney & Stuart.
Prerequisite: Ma-102(C)

ME-132(C) Engineering Thermodynamics 3-2
Combustion of fuels and material balances. Internal combustion power cycles, elementary gas turbine power plant, influences of regenerative preheating, reheating et cetera, performance indices. Thermodynamic aspects of the flow of compressible fluids in nozzle, diffuser and duct, compressive shocks, dynamics of the jet and diverted flow. Associated problems.
Text: Engineering Thermodynamics; Kiefer, Kinney & Stuart.
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: Principles of Engineering Thermodynamics; Kiefer, Stuart & Kinney.
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 student solution of practical problems to illustrate the principles discussed in the classroom.
Text: Principles of Engineering Thermodynamics; Kiefer, Stuart & Kinney.
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: Principles of Engineering Thermodynamics; Kiefer, Kinney and Stuart. Steam turbine; Church.
Prerequisite: ME-142(C)

ME-211(C) Marine Power Plant Equipment 3-2
Steam power plant cycles, influence of regenerative feed heating and of reheating, performance indices, Internal combustion power cycles, elementary gas turbine power plant, influences of regenerative preheating 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: Engineering Thermodynamics; Kiefer, Kinney & Stuart: 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: Engineering Thermodynamics; Kiefer, Kinney & Stuart: Refrigeration and Air Conditioning; Raber & Hutchinson; 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 powerplant 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: Marine Engineering; Seward: Bureau Ships publications and data: Marine Engineering; Labberton: PG Stencil 3456 (book)
Prerequisites: 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; study of power plant performance of representative naval power plants by analysis of heat balance and flow diagrams. 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: Marine Engineering; Seward: Marine Engineering; Labberton: Steam Turbines; Church: Bureau Ships publications and data: PG Stencil 3465 (book).

Prerequisite: ME-215(A).

ME-217(C) Internal Combustion Engines (Diesel) 4-2

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 effect 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: Internal Combustion Engines; Lichty; Internal Combustion Engines; Taylor & Taylor.

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: Engineering Thermodynamics; Kiefer, Stuart & Kinney: 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. Associated laboratory work.

Text: Engineering Thermodynamics; Kiefer, Kinney & Stuart: 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 major equipment items. Study of one or more representative naval power plants by analysis of heat balance and flow diagrams.

Text: Marine Engineering; Seward: Bureau Ships publications and data: Marine Engineering; Labberton: Steam Turbines; Church: PG Stencil 3456 (book).

Prerequisites: ME-222(C) and ME-421(C)

ME-310(B) Heat Transmission 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 conditions, 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: Heat Transmission: Jakob: Miscellaneous supplementary material.

Prerequisites: ME-112(B), 411(C).

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 P.W. periods are used for student's solution of related practical problems and for related laboratory tests.

Text: Mechanics of Hydraulic Equipment; PG Stencil No. 2217

Prerequisite: Ma-103(B)

ME-412(A) Hydrodynamics

Fluid-flow kinematic concepts; fundamentals of frictionless fluid flow; theorems and basic flow definitions; three dimensional flow examples; application of complex variables to two-

dimensional fluid flow; two dimensional flow examples; Blasius theorem - flow around cylinders and airfoils; Schwarz-Christoffel theorem - free streamlines; vortex motion; equations for viscous flow; the boundary layer.

Text: Fluid Dynamics; Streetcar.

Prerequisites: ME-411(C) and Ma-104(A).

ME-421(C) Hydromechanics 3-2

Mechanical properties of fluids; hydrostatic pressures and forces; buoyancy and stability; energy of flow; resistance to flow; fluid flow metering; hydraulic force and arrester systems.

Text: PG Stencil No. 2217, Mechanics of Hydraulic Equipment.

Prerequisite: Ma-103(B) or the equivalent.

ME-422(B) Hydromechanics 2-2

Dynamic forces associated with fluid flow; centrifugal pumps; hydrodynamic coupling; dimensional analysis and dynamical similarity. Introduction to the kinematics of flow; stream function and velocity potential; graphical mapping of stream lines.

Text: PG Stencil No. 2217, Mechanics of Hydraulic Equipment.

Prerequisites: Me-431(C) and Ma-103(B) or the equivalent.

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, analysis of plane strain, torsion of circular sectioned members, elementary beam theory, combined loadings and columns.

Text: Elements of Strength of Materials; Timoshenko & MacCullough.

Prerequisites: Ma-101(C) and Mc-801(C) or equivalent.

ME-511(C) Strength of Materials 5-0

Topics in elastic-body mechanics, including tensile and compressive stresses, shearing stress, Hooke's law, thin-walled cylinders, combined stresses, analysis of plane strain, torsion of circular-sectioned members, elementary beam theory, statically indeterminate problems in bending, beams on elastic foundations.

Text: Strength of Materials, Vols. I & II; Timoshenko.

Prerequisites: Ma-101(C) and Mc-801(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: Strength of Materials, Vols. I & II; Timoshenko

Prerequisite: ME-511(C)

ME-513(A) Theory of Elasticity 3-0

Plane-stress considerations, differential equations of equilibrium and compatability, 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: Theory of Elasticity; Timoshenko.

Prerequisite: ME-512(A) or the equivalent.

ME-522(C) Strength of Materials 4-0

Beam columns, problems having radial symmetry, strain energy, fundamental concepts in the theory of elasticity.

Text: Strength of Materials, I & II; Timoshenko: An Introduction to Experimental Stress Analysis; Lee.

Prerequisite: ME-511(C)

ME-540(C) Strength of Materials 5-0

Topics in elastic-body machanics, including plane and three-dimensional stress, general strain, Hook's law, thin-walled cylinders, torsion of circular shaft, elementary beam theory, columns, frames, beams on elastic foundations, beam-columns, thin plates, thick-walled cylinders, theroies of failure.

Text: Strength of Materials, Vols. I & II; Timoshenko.

Prerequisites: Ma-101(C) and Mc-801(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: Elements of Strength of Materials; Timoshenko & MacCullough

Prerequisite: ME-500(C) or ME-511(C)

ME-601(C) Materials Testing Laboratory 0-2

Performance and analysis of standard tests used in determining the mechanical properties of engineering materials, including ones in tension, compression, torsion, shear, transverse, bending, impact, hardness and fatigue.

Text: Testing of Engineering Materials; Muhlenbruch: A.S.T.M. Student Standards.

Prerequisite: Subsequent to or concurrent with ME-500(C), 520(C) or 540(C)

ME-611(C) Materials Testing Laboratory 2-2

Study of the theories of failure, the evaluation of experimental error and experiments involving most of the standard and some non-standard tests used in the determination of the mechanical properties of engineering materials. These tests include: tension, compres-

sion, torsion, shear, transverse bending, impact, hardness, fatigue and column.

Text: Strength of Materials, Vol. II; Timoshenko: Testing and Inspection of Engineering Material; Davis, et al.

Prerequisite: ME-511(C)

ME-612(A) Experimental Stress Analysis 3-2

The course outline 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. The Begg deformator will be used as a check on stress resultants and in determining reaction values for loading models.

Text: Introduction to Experimental Stress Analysis; Lee.

Prerequisites: ME513A 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: An Introduction to Experimental Stress Analysis; Lee.

Prerequisites: ME-522(C) and ME-611(C) or the equivalent.

ME-632(B) Experimental Stress Analysis 2-2

The course outline includes: 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 in which the various facilities available in experimental stress analysis will be used.

Text: Introduction to Experimental Stress Analysis; Lee.

Prerequisite: ME-512(A) or Ae-204(A) and ME-601(C)

ME-700(C) Kinematics of Machinery 3-2

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: Mechanics of Machinery; Ham & Crane.

Prerequisite: MC-102(C)

ME-711(C) 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.

Text: Mechanics of Machinery; Ham & Crane.

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: Mechanical Vibrations; J.P. Den Hartog; Notes by E.K. Gatcombe.

Prerequisites: Ma-104(A), Mc-201(A), ME-711(C) and 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: Mechanical Vibrations; J. P. Den Hartog: Notes by E. K. Gatcombe.

Prerequisites: Ma-104(A), Mc-201(A), Ae-202(C)

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: Design of Machine Elements; Vallance: Notes by E.K. Gatcombe.

Prerequisites: Me-520(C) or equivalent, ME-700(C)

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, deflections, 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.

Reference: Design of Machine Members; Vallance.

Prerequisite: ME-700(C)

ME-830(C) Machine Design 4-2

Review of strength of materials, selection 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: Design of Machine Members; Vallance: Notes by E. K. Gatcombe.

Prerequisites: 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: Interchangeable Manufacturing; E. Buckingham.

Prerequisite: ME-811(C)

METALLURGY

Mt Courses

Mt-101(C) Production Metallurgy 2-0

This course serves as 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: Engineering Metallurgy (1938); Stoughton, Butts.

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, the blast furnace, its design and operation, blast furnace products. The various methods of steel production and the production of grey, white and malleable cast iron.

Text: Ferrous Production Metallurgy; Bray.

Prerequisite: Ch-101(C) or Ch-121(B).

Mt-103(C) Production of Non-Ferrous Metals 3-0

The subject matter of this course includes 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: Non-ferrous Production Metallurgy; Bray.

Prerequisite: Ch-101(C) or Ch-121(B).

Mt-201(C) Introductory Physical Metallurgy 3-2

This course serves as 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 characteristic 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, and (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: Principles of Physical Metallurgy; Coonan: Engineering Physical Metallurgy; Heyer.

Prerequisite: None.

Mt-202(C) Ferrous Physical Metallurgy 3-2

This course 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: Principles of Physical Metallurgy; Coonan. Engineering Physical Metallurgy; Heyer.

Prerequisite: Mt-201(C).

Mt-203(B) Physical Metallurgy (Special Topics) 2-2

This course is a continuation of material presented in Mt-201(C) and Mt-202(C). The subject matter covered includes discussions of casting and welding, developments in powder metallurgy, creep and fatigue of metals, material defects and non-destructive testing, light

alloys, and the special characteristics of alloys for electrical purposes, armor and armament, titanium and strategic materials.

Text: Engineering Physical Metallurgy; Heyer: Principles of Physical Metallurgy; Coonan: Metal Process Engineering; Woldman: Heat Treating Aluminum Alloys; Reynolds Metal Co.: Selected outside reading.

Prerequisite: Mt-202(C).

Mt-204(A) Physical Metallurgy 3-4

The material presented in this course includes a study of phase transformations in steel, isothermal decomposition reactions and products, decomposition on continuous cooling, factors involved in hardenability and methods of evaluating it, time, temperature, transformation, mechanical and heat treatment of steel, alloy steels, high strength cast irons and cast steels.

Text: Steel and Its Heat Treatment Vol. I - II - III; Bullens, 5th Ed.

Prerequisites: Mt-201(C), Mt-202(C).

Mt-205(A) Advanced Physical Metallurgy 3-4

The subject matter includes a discussion of equilibrium in alloy systems, structure of metals and alloys, phase transformations and diffusion.

Text: Structure of Metals; Barrett.

Prerequisites: Mt-202(C), Cr-271(B).

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: Structure of Metals; Barrett: Progress in Metal Physics; Chalmers.

Prerequisite: Mt-205(A).

Mt-301(A) High Temperature Materials 3-0

This course includes 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 rocket motors. A study of ceramics as possible materials for high temperature service is included and a consideration of corrosion and the status of strategic metals.

Prerequisites: Mt-201(C), Mt-202(C).

Mt-302(A) Alloy Steels 4-2

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: The Alloying Elements in Steel; E. C. Bain. References and reading assignments in other books and current literature.

Prerequisites: Mt-202(C), Mt-204(A).

Mt-303(A) Metallurgy Seminar 2-0

Papers from current technical journals will be reported and discussed by students.

Text: None.

Prerequisites: Mt-203(B), 204(A), or 205(A).

Mt-304(C) Radiography 2-2

This course covers the 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: Theoretical Structure Metallurgy; Cottrell.

Prerequisites: Mt-205(A), Ph-610(B), or 640(B).

ORDNANCE and GUNNERY

Or Courses

NEW WEAPON DEVELOPMENT

SL Lecture Courses

Or-120(C) Surface Fire Control 2-0

Fundamentals of the surface fire control problem, rangekeeper theory, director systems, synchros, fire control errors and correctors, battery alignment, basic mechanisms, shore bombardment.

Text: OP 1701 - Surface Fire Control; NavPers 16116B-Naval Ord & Gunnery; OP 1140 - Basic F.C. Mechanisms; OP 1068 - Rangekeeper Mk 8.

Prerequisite: None.

Or-131(C) Antiaircraft Fire Control 2-0

Fundamentals of the antiaircraft fire control problem, analytical solution of the antiaircraft fire control problem, basic mechanisms, rangekeeper and computer theory, units making up one antiaircraft fire control system, introduction to fire control errors and correctors.

Text: OP 1063 - Mk 6 Stable Element; NavPers 16116B - Naval Ord & Gunnery; OP 1064 - Mk 1 Computer.

Prerequisite: Or-120(C) or equivalent.

Or-132(C) Antiaircraft Fire Control 2-0

Review of the fundamentals of the antiaircraft fire control problem. Theory of gyro lead -computing systems. Basic electromechanical computing equipment. Distrubed-line-of-sight systems. Undisturbed-line-of-sight systems.

Text: NavPers 16116B-Naval Ord & Gunnery; OP 1098 - Mk-15 Gunsight; OP 1325 - Mk 20 Gunsight; OP 1097 - Mk 52 Director System; OP 1323 - Mk 57 GFCS; OP 1233 - Mk 63 GFCS.

Prerequisite: Or-131(C) or equivalent.

Or-141(C) Guided Missiles 2-0

Introduction to guided missiles and guidance systems. Survey of jet propulsion systems, launching problems, flight testing, simulators and damage potential. Organization for guided missile research and development. Study of one basic type guided missile. Guidance tactical problems and limitations of several guidance systems.

Text: Navy Department Classified publications.

Prerequisite: None.

Or-142(C) Guided Missile Guidance 2-0

This course is a continuation of Or-141(C). Survey of guidance systems and Bureau of Ordnance guided missiles. Units making up beam rider, command, and homing systems.

Text: Navy Department classified publications.

Prerequisite: Or-141(C) or equivalent.

Or-151(C) Underwater Ordnance 2-0

Moored and ground mines, contact and influence firing mechanisms, depth charges and other anit-submarine ordnance, steam, electric and chemical torpedoes, theory and design of torpedo control equipment, harbor defense, nets and booms.

Text: OP 888 - Mine Mk 6; OP 900 - Mine Mk 10; OP 901 - Mine Mk 12; OP 747 - Depth Charges Mk 6 & 7 OP; 950 - Torpedo Mk 13; OP 946 - Torpedo Mk 18; OP 663 - Torpedo Warheads & Exploders; NavPers 16116 B-Naval Ord & Gunnery; OP 636 A - Nets and Booms.

Prerequisite: None.

Or-152(C) Underwater Ordnance 2-0

Mathematical aspects of minefield planning, detailed design of influence firing mechanisms, design of mine accessories, moored and ground mine sweeping and location, harbor defense. Influence depth charges. Torpedo data computers.

Text: OP 1452 - Mine Accessories; OP 681 - Firing Mechanism M-11; OP 1799 - Firing Mechanism A-5; OP 668 - Firing Mechanism M-4; NOLR 1086 - Firing Mechanism A-6; USF 12 - Mine Warfare Instructions; OP 669 - Depth Charge Mk 14; OP 1056 - Torp. Data Computer Mk 3; OP 685 - Mine Mk 27.

Prerequisite: None.

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SL-101 New Weapon Development I 0-1
(Lecture)

This course consists of the first ten (10) lectures of a twenty (20) lecture series to be delivered by authorities in the field of new weapon 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.

Prerequisites: None.

SL-102 New Weapon Development II 0-1
(Lecture)

This course is a continuation of Course SL-101 and consists of the second ten (10) lectures of the twenty (20) lecture series described under SL-101.

Prerequisites: None.

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: Physical Mechanics; Lindsay.

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.

Text: Physical Mechanics; Lindsay; Introduction to Theoretical Physics; Page: Principles of Mechanics; Synge and Griffith.

Prerequisite: Ma-182(B) (may be taken concurrently).

Ph-142(B) Analytical Mechanics 4-0

Wave motion, fluid mechanics, constrained motion, Hamilton's principle, Lagrange's equations.

Prerequisites: Ph-141(B); Ma-183(B) (may be taken concurrently).

Ph-143(A) Advanced Mechanics 3-0

A continuation of Ph-142(B)

Prerequisite: Ph-142(B)

Ph-190(C) Introduction to Physics (Meteorology) 3-0

Elementary concepts and laws of statics and dynamics. Introduction to the statics and dynamics of fluids. Temperature, heat, radiation and kinetic theory. The gas laws. Rudiments of vector representation and notation.

Text: Introduction to Physics; Howe.

Prerequisite: None.

Ph-191(C) Review of General Physics (Meteorology) 4-0

A short review of statics and dynamics; a survey of temperature, heat, kinetic theory, radiation, electricity and magnetism, wave motion, and sound.

Text: Analytical Experimental Physics; Demon and Ference.

Prerequisite: Ph-190(C) or equivalent.

Ph-196(C) General Physics (Meteorology) 5-1

The course is a survey of the mechanics of solids and fluids, heat and kinetic theory, electricity and magnetism, wave motion, and sound.

Text: Analytical Experimental Physics; Lemon, Ference.

Prerequisite: None.

Ph-211(C) Optics 3-0

Reflection and refraction of light, lenses and lens aberrations, strips, optical systems, and dispersion.

Text: Physical Optics; Jenkins and White.

Prerequisites: 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. Related laboratory work is included.

Text: Physical Optics; Jenkins and White: Physical Mechanics; Lindsay.

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: Fundamentals of Optics; Jenkins and White, Second Edition.

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)

Ph-250(C) Geometrical and Physical Optics 3-2

Reflection and refraction of light, lenses, lens systems, dispersion, interference, diffraction.

Text: Fundamentals of Optics; Jenkins and White, Second Edition.

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 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: Principles of Electricity and Electromagnetism; Harnwell.

Prerequisite: 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.

Text: Principles of Electricity and Magnetism: Harnwell: NavShips 900,016: Lecture Notes.

Prerequisite: Ma-182(B) (may be taken concurrently).

Ph-342(B) Electricity and Magnetism 3-3

A continuation of Ph-341(C)

Vacuum tube circuits, oscillators, transients, multivibrators, pulse shaping circuits, non-ohmic circuits, photoelectric effects, electrostatics, dielectrics, conductors and electromagnetic effects of steady currents.

Text: Principles of Electricity and Magnetism; Harnwell: NavShips 900,016: Lecture notes.

Prerequisite: Ph-341(C)

Ph-343(B) Electricity and Magnetism 3-0

A continuation of Ph-342(B)

Electromagnetic theory including such topics as time varying electric currents, theory of magnetism, Maxwell's equations, electromagnetic waves in free space, in dielectrics and in conducting media, and elementary theory of gaseous conduction. Analytic and vector methods are used.

Text: Principles of Electricity and Magnetism: Harnwell: Lecture Notes.

Prerequisite: Ph-342(B)

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: Electromagnetism; Slater, Frank

Prerequisites: Ma-104(A), EE-272(C)

Ph-362(A) Electromagnetic Waves 3-0

A continuation of Ph-361(A)

Reflection and refraction of electromatic waves; wave guides; cavity resonators; electromagnetic radiation.

Text: Electromagnetism, Slater, Frank

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: Fundamentals of Acoustics; Kinsler, Frey.

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: Fundamentals of Acoustics; Kinsler, Frey

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: Fundamentals of Acoustics; Kinsler, Frey

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. Physics 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: Principles of Underwater Sound; NDRC Technical Summary.

Prerequisite: Ph-422(A)

Ph-424(A) Sonar Systems and Developments 2-3

Various types of sonar equipment and new developments are studied in the laboratory (Sonar Barge) and in the classroom.

Prerequisite: Ph-423(A) or PL-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 patterns, and operational characteristics of sonar equipment.

Text: Fundamentals of Acoustics; Kinsler, Frey: Principles of Underwater Sound; NDRC Technical Summary: Physics of Sound in Sea; NDRC Technical Summary.

Prerequisite: Ph-421(A).

Ph-426(B) Acoustics Laboratory 3-2

A laboratory course to accompany Ph-421(A). An experimental study of vibrating systems and acoustic radiations.

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 and etc.

Text: Fundamentals of Acoustics; Kinsler, Frey.

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. Physics 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: Principles of Underwater Sound; NDRC Technical Summary.

Prerequisite: Ph-427(B).

Ph-450(B) Underwater Acoustics 3-2

An analytic treatment and of the fundamentals of acoustics, with particular emphasis on sound radiation and transmission problems encountered in underwater acoustics:

Text: Fundamentals of Acoustics; Kinsler, Frey: Principles of Underwater Sound; NDRC Technical Summary.

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.
rem.

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.

Text: Kinectic Theory of Gases; Kennard: Introduction to Thermodynamics, Kinectic

Theory and Statistical Mechanics; Sears: 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, radio-activity, atomic structure, nuclear disintegration.

Text: Atomic Physics; Semat.

Prerequisites: 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.

Text: Atomic Physics; Semat: Introduction to Modern Physics; Richtmeyer and Kennard.

Prerequisite: Ph-311 or equivalent.

Ph-640(B) Atomic Physics 3-3

Same as in PH-631(B) above

Text: Same as Ph-631(B)

Prerequisite: Same as for PH-311(B)

Ph-721(A) Introduction to Quantum Mechanics. 4-0

This course is designed to familiarize the student with the postulates and other fundamental aspects of quantum mechanics. The wave mechanical treatment is applied to such problems as the free particle, particle in a potential well, potential barriers, cold cathode emission, increased emission from a coated filament, natural radioactivity, harmonic oscillator, free rotator, hydrogen atom, and the one-dimensional potential lattice for the solid state. The course terminates with a discussion of the relation of classical mechanics to quantum mechanics.

Text: Lecture notes.

Prerequisites: Ph-249(C), Ph-142(C), Ph-343(B), Ph-610(B) or the equivalent of the above with the consent of the instructor.

Ph-722(A) Physics of the Solid State 3-0

Properties of ionic crystals such as lattice energies, electrical conductivity, absorption, phosphoresence and fluorescence. The transistor. Properties of metals such as specific heats, electrical conductivity and magnetic susceptibility.

Text: Modern theory of Solids; Seitz.

Prerequisite: Ph-721(A) or equivalent.

Ph-731(A) Theoretical Physics

Topics in theoretical physics selected to meet the needs of the student.

Ph-732(A) Theoretical Physics

Topics in theoretical physics selected to meet the needs of the student.

PART IV

Groups Commencing Postgraduate Education Away from Postgraduate School, Annapolis, Md.

GROUPS COMMENCING POSTGRADUATE EDUCATION AWAY FROM THE POSTGRADUATE SCHOOL

	Group	University or School	Officer at Postgraduate School In Charge Of Curriculum
G	General	USNavScol (GenLine) Newport, R.I. and Monterey, Calif.	CAPT. J.S. DORSEY
ZCP	Cinematography	U. of Southern Calif.	CAPT. J.S. DORSEY
ZCR	Photography	Rochester Inst. of Technology	CAPT. J.S. DORSEY
ZG	Civil Engineering	Rensselaer Poly. Inst.	CAPT. J.S. DORSEY
ZHC	Law	Catholic University	CAPT. J.S. DORSEY
ZHW	Law	George Washington University	CAPT. J.S. DORSEY
ZHG	Law	Georgetown University	CAPT. J.S. DORSEY
ZI	Naval Intelligence	USNavScol, NavInt., Anacostia, D. C.	CAPT. J.S. DORSEY
ZK	Advanced Management	Harvard University	CAPT. R.W. CAVENAGH
ZKP	Advanced Management	University of Pittsburgh	CAPT. R.W. CAVENAGH
ZKC	Business Administration	Columbia Univ.	CAPT. J.S. DORSEY
ZKH	Business Administration	Harvard University	CAPT. J.S. DORSEY
ZKS	Business Administration	Stanford University	CAPT. J.S. DORSEY
ZL	Petroleum Engineering	University of Pittsburgh	CAPT. R.W. CAVENAGH
ZM	Textile Engineering	Georgia Inst. of Tech.	CAPT. J.S. DORSEY
ZNB	Naval Construction and Engineering	Mass. Inst. of Tech. Webb Institute	CAPT. R.W. CAVENAGH CAPT. R.W. CAVENAGH
ZO	Oceanography	Scripps Institute	CAPT. J.S. DORSEY
ZPO	Personnel Admin. & Training	Ohio State U.	CAPT. J.S. DORSEY
ZPS	Personnel Admin. & Training	Stanford U.	CAPT. J.S. DORSEY
ZS	Comptrollership	George Washington U.	CAPT. J.S. DORSEY
ZT	Management & Industrial Eng.	Rensselaer Poly. Inst.	CAPT. R.W. CAVENAGH
ZU	Religion	Various	CAPT. J.S. DORSEY

GENERAL LINE

One year of instruction at the U. S. Naval School (General Line) Newport, R.I. or the U. S. Naval School (General Line) Monterey, Calif. which is designed to bring transferee officers as nearly as practicable to the level of their USNA contemporaries by filling gaps in their naval education and in their junior officer experience, which may have resulted from spe-

cialized assignments. The course includes engineering, navigation, military and international law, ordnance and gunnery, seamanship, tactics, logistics, intelligence, organization, and administration. The catalogue of the school in question should be consulted for details.

CINEMATOGRAPHY

A one-year course in Cinematography given to selected officers with previous experience in this field at the University of Southern California to prepare them for assignments in connection with the production of training films and motion picture reports.

PHOTOGRAPHY

A two-year course at the Rochester Institute of Technology to prepare selected officers with previous experience in this field for technical duties involving photography.

CIVIL ENGINEERING (ADVANCED)

Fourteen months of postgraduate instruction at Rensselaer Polytechnic Institute, Troy, New York, normally leading to a degree of Master of Civil Engineering. Officers selected for this course will normally be CEC officers of the ranks of LT and LTJG who have a degree in Civil Engineering and have completed three years of commissioned service.

CIVIL ENGINEERING (QUALIFICATION)

Seventeen months of instruction at Rensselaer Polytechnic Institute, Troy, New York, normally leading to a degree of Bachelor of Science in Civil Engineering. Officers selected for this course will normally be line transferees to the Civil Engineer Corps who do not have a degree in Civil Engineering and CEC officers in the ranks of LT, LTJG, and ENS who do not have a degree in Civil Engineering.

LAW

Three years of graduate work for selected officers of the Navy in the Law School of George Washington University, Georgetown University, or Catholic University which qualifies them for the practice of law. Studies at the Law School are supplemented with work in the Office of the Judge Advocate General of the U. S. Navy.

NAVAL INTELLIGENCE

Six to twenty seven months of instruction at the U. S. Naval School, Naval Intelligence, Anacostia, D. C. to train selected officers in all phases of intelligence and qualify them in foreign languages. Students study an integrated course in strategic, operational (including air), and counter-intelligence for six months. A period of from four and one-half to twenty-two months is then devoted to the study of a foreign language (the length of time is determined by the difficulty of the language studied).

ADVANCED MANAGEMENT

A thirteen-week course conducted twice each year, convening in February and September, by the Graduate School of Business Administration, Harvard University, or an eight-week course, convening in the fall and spring, as announced by the University of Pittsburgh.

The method of instruction is by means of research studies involving inquiries of several companies or perhaps an industry, and case studies collected from specific business organizations.

The study program for both schools is divided about equally among the following subjects.

(a) Administrative Practices
(b) Cost and Financial Administration
(c) Production Management
(d) Marketing Management
(e) Problems in Labor Relations

At present this course is made available to only a few selected naval officers of the rank of Commander or above and departmental quotas are determined by the Bureau of Naval Personnel.

BUSINESS ADMINISTRATION

A two-year course of postgraduate instruction conducted at the Harvard Graduate School of Business Administration, the Stanford University Graduate School of Business, and at Columbia University, to develop the ability in officers to analyze business organizations, 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.

PETROLEUM ENGINEERING

A one year course at the University of Pittsburgh followed by one year in industry, to prepare two senior officers a year for duties with the Munitions Board or for similar assignments.

TEXTILE ENGINEERING

Two years of graduate work for selected officers of the Supply Corps at the Georgia Institute of Technology to prepare them for assignments involving manufacture, procurement, receipt, storage and issue of textiles and clothing. Provided the student officer has adequate educational background this curriculum normally leads to a Master's degree.

NAVAL CONSTRUCTION AND ENGINEERING

A three-year course at Massachusetts Institute of Technology at Cambridge, Massachusetts and at Webb Institute of Naval Architecture at Glen Cove, New York, successful completion of which normally leads to qualification for designation of Engineering Duty Officer.

OCEANOGRAPHY

A one-year course at Scripps Institute of Oceanography which prepares officers for assignment to billets requiring specialized knowledge in the field of oceanography. Provided the student officer has adequate educational background this curriculum normally leads to a Master's degree.

PERSONNEL ADMINISTRATION AND TRAINING

A twelve-month course carried on at Ohio State and Stanford Universities to prepare officers for assignment in personnel administration or supervision and administration of training activities. The course majors in personnel psychology and sociology supported by job analysis, personnel test and measurements, record studies, personnel management, and principles of training and education. Provided the student officer has an adequate educational background this curriculum normally leads to a Master's degree.

COMPTROLLERSHIP

A one-year course at George Washington University which prepares selected officers for supervisory and planning positions in comptroller-type billets throughout the Navy. Provided the student officer has adequate educational background this curriculum normally leads to a Master's degree.

MANAGEMENT AND INDUSTRIAL ENGINEERING CURRICULUM

One academic year of postgraduate education at Rensselaer Polytechnic Institute, Troy, New York. For details consult the catalogue in question.

Latest BuPers. Circular Letter on applications for postgraduate instruction should be consulted to determine eligibility.

This course leads to a degree of Bachelor of Management Engineering.

RELIGION

A one-year course which provides postgraduate instruction in religion and closely allied subjects for selected officers of the Chaplain Corps. Courses are of necessity individually tailored to fit the previous background and denominational training of each officer. The following schools normally participate:

Harvard Divinity School
Pacific School of Religion
Fordham University
Union Theological Seminary
Chicago Theological Seminary

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