NONRESIDENT
TRAINING
COURSE

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Naval Space

NAVEDTRA 14168A

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PREFACE

By enrolling in this self-study course, you have demonstrated a desire to improve yourself and the Navy. Remember, however, this self-study course is only one part of the total Navy training program. Practical experience, schools, selected reading, and your desire to succeed are also necessary to successfully round out a fully meaningful training program.

COURSE OVERVIEW: This Nonresident Training Course (NRTC) is a self-study course that will acquaint officers and enlisted personnel with the history of the Navy in space and current civil and military space organizations. The course also provides the student with a basic understanding of the space environment, orbital mechanics, launch and recovery systems, space systems architecture, the naval tactical use of space, and foreign space programs.

Chapter 4, Orbital Mechanics, contains the technical information required by the student to comprehend the forces required to orbit a spacecraft and sustain that orbit. To assist you with this chapter, there is a supplemental 35 1/2-minute video, entitled *Space Flight: The Application of Orbital Mechanic*s. The film, which was jointly produced by the Naval Space Command and the National Aeronautics and Space Administration, is available in all formats (3/4", VHS, Beta) and can be acquired through the Fleet Audiovisual Libraries. It is also available at no cost through the Defense Audiovisual Information System Product Identification Number *804859DN).*

THE COURSE: This self-study course is organized into subject matter areas, each containing learning objectives to help you determine what you should learn along with text and illustrations to help you understand the information. The subject matter reflects day-to-day requirements and experiences of personnel in the rating or skill area. It also reflects guidance provided by Enlisted Community Managers (ECMs) and other senior personnel, technical references, instructions, etc., and either the occupational or naval standards, which are listed in the *Manual of Navy Enlisted Manpower Personnel Classifications and Occupational Standards*, NAVPERS 18068.

VALUE: In completing this course, you will improve your military and professional knowledge. Importantly, it can also help you study for the Navy-wide advancement in rate examination. If you are studying and discover a reference in the text to another publication for further information, look it up.

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Sailor's Creed

"I am a United States Sailor.

I will support and defend the Constitution of the United States of America and I will obey the orders of those appointed over me.

I represent the fighting spirit of the Navy and those who have gone before me to defend freedom and democracy around the world.

I proudly serve my country's Navy combat team with honor, courage and commitment.

I am committed to excellence and the fair treatment of all."

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INSTRUCTIONS FOR TAKING THE COURSE

ASSIGNMENTS

The text pages that you are to study are listed at the beginning of each assignment. Study these pages carefully before attempting to answer the questions. Pay close attention to tables and illustrations and read the learning objectives. The learning objectives state what you should be able to do after studying the material. Answering the questions correctly helps you accomplish the objectives.

SELECTING YOUR ANSWERS

Read each question carefully, then select the BEST answer. You may refer freely to the text. The answers must be the result of your own work and decisions. You are prohibited from referring to or copying the answers of others and from giving answers to anyone else taking the course.

SUBMITTING YOUR ASSIGNMENTS

To have your assignments graded, you must be enrolled in the course with the Nonresident Training Course Administration Branch at the Naval Education and Training Professional Development and Technology Center (NETPDTC). Following enrollment, there are two ways of having your assignments graded: (1) use the Internet to submit your assignments as you complete them, or (2) send all the assignments at one time by mail to NETPDTC.

Grading on the Internet: Advantages to Internet grading are:

- you may submit your answers as soon as you complete an assignment, and
- you get your results faster; usually by the next working day (approximately 24 hours).

In addition to receiving grade results for each assignment, you will receive course completion confirmation once you have completed all the assignments. To submit your assignment answers via the Internet, go to:

http://courses.cnet.navy.mil

Grading by Mail: When you submit answer sheets by mail, send all of your assignments at one time. Do NOT submit individual answer sheets for grading. Mail all of your assignments in an envelope, which you either provide yourself or obtain from your nearest Educational Services Officer (ESO). Submit answer sheets to:

COMMANDING OFFICER
NETPDTC N331
6490 SAUFLEY FIELD ROAD
PENSACOLA FL 32559-5000

Answer Sheets: All courses include one "scannable" answer sheet for each assignment. These answer sheets are preprinted with your SSN, name, assignment number, and course number. Explanations for completing the answer sheets are on the answer sheet.

Do not use answer sheet reproductions: Use only the original answer sheets that we provide—reproductions will not work with our scanning equipment and cannot be processed.

Follow the instructions for marking your answers on the answer sheet. Be sure that blocks 1, 2, and 3 are filled in correctly. This information is necessary for your course to be properly processed and for you to receive credit for your work.

COMPLETION TIME

Courses must be completed within 12 months from the date of enrollment. This includes time required to resubmit failed assignments.

PASS/FAIL ASSIGNMENT PROCEDURES

If your overall course score is 3.2 or higher, you will pass the course and will not be required to resubmit assignments. Once your assignments have been graded you will receive course completion confirmation.

If you receive less than a 3.2 on any assignment and your overall course score is below 3.2, you will be given the opportunity to resubmit failed assignments. **You may resubmit failed assignments only once.** Internet students will receive notification when they have failed an assignment--they may then resubmit failed assignments on the web site. Internet students may view and print results for failed assignments from the web site. Students who submit by mail will receive a failing result letter and a new answer sheet for resubmission of each failed assignment.

COMPLETION CONFIRMATION

After successfully completing this course, you will receive a letter of completion.

ERRATA

Errata are used to correct minor errors or delete obsolete information in a course. Errata may also be used to provide instructions to the student. If a course has an errata, it will be included as the first page(s) after the front cover. Errata for all courses can be accessed and viewed/downloaded at:

http://www.advancement.cnet.navy.mil

STUDENT FEEDBACK QUESTIONS

We value your suggestions, questions, and criticisms on our courses. If you would like to communicate with us regarding this course, we encourage you, if possible, to use e-mail. If you write or fax, please use a copy of the Student Comment form that follows this page.

For subject matter questions:

E-mail: bwatson@nsc.navy.mil
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Address: COMMANDING OFFICER
NETPDTC N331
6490 SAUFLEY FIELD ROAD
PENSACOLA FL 32559-5000

NAVAL RESERVE RETIREMENT CREDIT

If you are a member of the Naval Reserve, you may earn retirement points for successfully completing this course, if authorized under current directives governing retirement of Naval Reserve personnel. For Naval Reserve retirement, this course is evaluated at 5 points. (Refer to *Administrative Procedures for Naval Reservists on Inactive Duty,* BUPERSINST 1001.39, for more information about retirement points.)

Student Comments

Course Title: Naval Space

NAVEDTRA: 14168A **Date**: _____

We need some information about you:

Rate/Rank and Name: _____ SSN: _____ Command/Unit _____

Street Address: _____ City: _____ State/FPO: _____ Zip _____

Your comments, suggestions, etc.:

Privacy Act Statement: Under authority of Title 5, USC 301, information regarding your military status is requested in processing your comments and in preparing a reply. This information will not be divulged without written authorization to anyone other than those within DOD for official use in determining performance.

NETPDTC 1550/41 (Rev 4-00)

CHAPTER 1

THE NAVY IN SPACE

“A globally-deployed Navy today needs space systems to make fleets out of ships. Today–and increasingly tomorrow–a seafaring nation must be a spacefaring nation."

Admiral James D. Watkins, USN
Chief of Naval Operations
October 1, 1983, at the Inauguration
of the Naval Space Command

INTRODUCTION

Space and space operations are not new concepts to the Navy. The U.S. Navy's involvement in space spans four decades. During this time, the U.S. Navy has been a leader in developing national space capabilities, pioneering many of the early programs from launching satellites to placing a man on the moon. This involvement is continuing at an accelerated pace with significant implications for future Naval operations.

In this chapter we will review the Navy's involvement in space from its early accomplishments through current programs and capabilities. Topics covered include:

- Global Requirements;
- History of Naval Research and Development;
- U.S. Naval Satellite Systems;
- U.S. Naval Contributions to the Manned Space Program.

GLOBAL REQUIREMENTS-A NAVAL HERITAGE

The U.S. Navy has evolved since colonial times into a truly "blue water navy," with responsibilities that span the globe. This global presence has spawned operational requirements for worldwide navigation, environmental monitoring, and communication capabilities. The ability to operate in a coordinated fashion across vast distances continues to be at the foreground of naval requirements.

By far the most exciting development has come in just the last few decades with the exploitation of the fourth military arena, the "high ground" of space. Being so dependent on long-range communications, weather forecasting, and navigation, it's easy to see why the Navy remains the primary tactical user of space assets. The Navy's longtime commitment to research and scientific problem solving led to such developments as radio, radar, satellites to provide global connectivity, and manned space flight. The Navy has earned its place in history as a pioneering service in the development and exploitation of space.

NAVIGATION AND THE EARLY MARINERS

Accurate navigation has been a continuing naval requirement. Since time immemorial, man has put to sea in ships. Early mariners stayed within sight of the coastline for fear of losing touch with the land. Trade and exploration were at the mercy of coastal breezes and contained dangers of tidal currents, rocks, and shoals. Ancient charts were rudimentary and not widely circulated. As the "known world" expanded, these limitations were pushed back by new navigational techniques but progress was slow.

Caravans navigated by stars across vast expanses of desert. They had the advantage of gauging their progress in terms of days and distance traveled without having to guess at the influence of currents and winds. They used geographic landmarks for

reference along the way. At sea, the Phoenicians, Greeks, Romans, Vikings, and South Sea Islanders also became masters at using the stars to aid in navigation. The stars were used to estimate latitude. Calculating longitude remained a problem because of the rotation of the Earth.

Science and Technology, a Naval Tradition

Much tradition of the United States Navy originated with the British Royal Navy. Part of this heritage is in the use of science and evolving technologies to solve operational problems. The Royal Navy recognized the need for precise navigation across the world's oceans. Determining latitude required only the Sun or the North Star, but calculating longitude required precision timekeeping.

Clocks of that day were too large, expensive, and cumbersome to be considered for shipboard use. Most were so inaccurate that they didn't even have a second hand, and accuracy of the minute hand was in question. In 1725, the Board of Longitude offered a prize of ten thousand pounds to sponsor the development of a chronometer that would be reliable for long voyages (from England to the West Indies and return), was small and rugged enough to take aboard the small sailing vessels of the day, and was accurate to 1° of longitude.

The British Royal Navy also recognized the need to produce charts of the known world and accurate tables of star motion for use by navigators. The Royal Naval Observatory at Greenwich, England, and later the U.S. Naval Observatory in Washington, D.C., became world-recognized authorities at precisely measuring and standardizing time and building accurate celestial tables. Celestial navigation is still widely used by ocean-going ships and long-range aircraft as a backup for more sophisticated electronic methods. Once these three enabling factors–accurate charts, celestial tables, and precision timekeeping–came together, accurate navigation was possible for the first time.

In the United Sates, research and development continued in these areas at an accelerated pace and more than forty years ago the Navy quickly realized that space is essential to naval operations. In response to the increasing dependence on space systems to conduct military operations and the rapidly growing need for expertise in this field, the Naval Postgraduate School established the Space Systems Academic Group. The Group's objective is to enable the graduate to develop the requirements, strategy, and doctrine necessary to plan and manage military space systems. To accomplish this objective, the program of study provides officers with a comprehensive operational and technical understanding of Navy Space Systems at the graduate level. Graduates acquire the practical and theoretical skills in space operations required to advance the combat effectiveness of our Naval force.