

Q: Why have I never heard of Systems Engineering?

Engineering?

A: Systems Engineering is a relatively young discipline, and has often grown into existing, established engineering departments at many universities. That's why you may not have seen the same number of departments or degrees exclusively devoted to Systems Engineering as you have electrical or mechanical engineering... but the disciplines we represent are in one or more departments at every major school.

Q: So why is Systems Engineering a separate department at the Naval Academy?

A: At USNA, the Systems Engineering department grew from the original Department of Ordnance, Gunnery and Steam, established in 1844. This department later evolved into the Weapons Department and most recently, the Weapons and Systems Engineering Department. The critical role of Systems Engineering in modern weapons systems, from AEGIS to the Tomahawk, is the reason that the department stands alone here at USNA. The amount of expertise in this crucial area that was present in this department when the Academy began its majors program made a Systems Engineering major an obvious choice, offering students a unique opportunity to focus on this exciting and important discipline and its applications well beyond the military realm.

Q: What is Systems Engineering?

A: Systems engineering is a modern discipline that arose from the fact that the complexity of the things that we make is ever-increasing. Most advanced devices made today are composed of many different technologies. As such, they can no longer be solely designed through a single engineering discipline, such as mechanical, electrical, or computer engineering. Systems engineering is a discipline that bridges traditional engineering areas to arrive at technological solutions for very difficult problems. Systems engineers don't typically design mechanical or electrical components; rather they understand how things work and how they can be controlled, independent of the technology that is being used. They come to these abilities by knowing the basics of traditional disciplines, like computer engineering, electrical engineering and mechanical engineering, and by having a thorough understanding of how collections of components can be controlled to accomplish a given task. The USNA Systems Engineering curriculum focuses mainly on the following aspects of complex system design: feedback control, system modeling and simulation, and embedded computing, with additional specialty areas in robotics and unmanned vehicles, information systems, environmental engineering and engineering management.

Q: OK.. who else has an accredited Systems Engineering major?

A: More schools than you might expect. Air Force and West Point both have Systems Engineering majors, but so do University of Arizona, University of Arkansas Little Rock, Case Western Reserve University, University of Florida, George Mason University, Georgia Tech, State University of New York at Binghamham, Oakland University, The Ohio State University, University of Pennsylvania, Rensselaer Polytechnic University, San Jose State University, Virginia Polytechnic Institute and State University, University of Virginia, Washington University, Wright State University and Youngstown State University. A majority of these programs were established between 1970 and 1990, as the modern engineering environment developed.

Q: What can I do with a Systems Engineering degree in the Navy or Marine Corps?

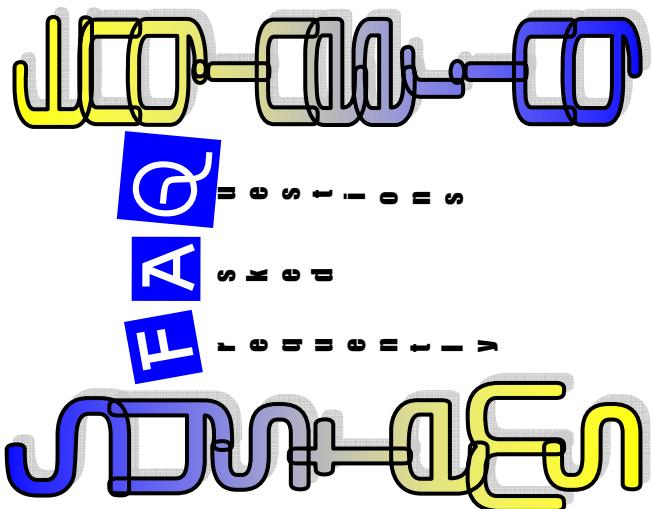
A: Whatever you want. While any warfare specialty is open to any midshipman regardless of degree, certain advanced career paths (such as test pilot) are limited to those with technical degrees. Technical degrees make nuclear power school much easier to get into and through. Further, a strong technical background is an asset on any modern battlefield, as our services move toward network-centric warfare using a variety of advanced platforms.

Q: Who hires Systems Engineers in the civilian world?

A: More companies than you might expect. Systems engineers hold high positions in a variety of cutting-edge companies and agencies, including NASA. Controls engineers are always in demand in industry, including power plants, chemical plants, manufacturing centers and anywhere that automation is a component of the mission. In the latest issues of trade magazines, it was easy to find advertised positions for Systems Engineers at companies such as Intel, Raytheon, Lockheed Martin, the Army Research Lab, the Jet Propulsion Laboratory, Applied Signal Technologies, Motorola, Inc., Freescale Semiconductor, Broadcom Corp. and many others.

Q: What opportunities for graduate study are available to Systems Engineers?

A: The interdisciplinary nature of our major prepares students for a wide variety of graduate programs. Top Systems Engineering students from the class of 2005 are attending Cambridge, Carnegie Mellon, MIT, Stanford, UC Berkeley, and UT Austin. While one student from the class of 2005 will be majoring in Chinese studies, most will be pursuing masters degrees in a technical areas like robotics or civil, electrical, mechanical, or aerospace engineering.



Q: How is Systems Engineering different from other engineering majors like computer, electrical or mechanical engineering?

A: Systems Engineers obviously need a basic foundation in all of those disciplines, but they are just a starting point. The science of feedback control is a separate academic discipline which students cover in a common five course sequence. Students then get to select focus areas, or tracks, in which they can apply the concepts they have learned (see list of courses at the end of this FAQ). From a practical perspective, every student gets experience in building and interfacing real systems, through course projects as well as a year-long senior-level capstone design project of their choosing. Past projects have included RC airplane autopilots, search and rescue robots, automatic guitar tuners, self righting kayaks, and rain-sensing windshield wipers.

Q: You mentioned computer, electrical, and mechanical engineering all go into Systems Engineering. Is Systems three times as hard as other engineering majors?

A: Of course not! All majors at USNA have approximately the same number of credit hours and approximately the same amount of work. Systems Engineers study how various sub-systems work together and learn how to *interface* computer, electrical, and mechanical sub-systems so that the plane flies, the brakes don't lock up, and the robot navigates in the desired manner. Systems Engineers don't do the jobs of three different engineers; they make sure the work done by those engineers results in a functional, integrated system. Systems Engineers didn't design the airframe for the F-18A, but without Systems Engineering that plane would not fly.

Q: Engineering sounds hard... I bet there's lots of homework. Who has time for all that along with everything else we do here?

A: Like any engineering major, Systems Engineers have their share of projects, homework, and lab reports, but no more so than any other major. Indeed, you'll find Systems Engineers on a variety of varsity sports teams, and 1/C Systems majors are frequently sporting a large collection of stripes on their shoulders. Selection of a major should be done on the basis of an honest assessment of your talents. It will always be easier to do well in a major that you enjoy studying and in courses that interest you.

Q: Does the System Engineering Major cap the number of students enrolled?
A: No, although Systems Engineering has been the largest engineering major at the Naval Academy for more than a decade, we have not capped our enrollment and we have no plans to do so in the future.

Q: Why is Systems Engineering so popular at the Naval Academy?

A: Two main reasons. First, Systems Engineering is very relevant to the technological needs of the Navy and to our nation. Systems Engineering is career-enhancing because you not only learn about how things work, you also focus that knowledge through a study of automatic control. In your military career, the most likely interaction you will have with an advanced weapons platform is through its control system. You will become a better operator as the result of this knowledge. The second main cause of Systems Engineering's popularity is that it is a flexible, versatile major appealing to a broad range of students and has outstanding facilities as well as a dedicated and talented faculty.

Q: What are the attributes of a typical successful Systems Engineering student?

A: As with all engineering majors a solid background in mathematics and physics is a must. Note that a 'solid background' does not require a '5' on the AP Calculus test or an 800 SAT math score... just basic capabilities garnered during the first year at USNA. Additionally, an innate curiosity about how things work and an interest in building physical devices are needed for success and fulfillment in the major. If you like the idea of working as part of an interdisciplinary team and learning something about other engineering disciplines, System Engineering is a great choice for you.

Q: I've heard that there is an Honors Systems Engineering Major. What's up with that?

A: Systems Engineering is the first of the Division I (Engineering) majors to design and offer an honors program. Students enroll in the Honors program in their 3/C year, after screening of grades and military performance. If interested, contact the program director (Assoc. Prof. Bishop, bishop@usna.edu).

Q: How can I find out about all of the majors here at USNA?
A: There are three separate opportunities. First, you have a chance to see all of the engineering majors at the Plebe Engineering Orientations during the Fall semester. In early January, there will be a Majors Open House, where you are given a brief on the majors program and an opportunity to speak with representatives of every department. After this event, you select up to four *non-binding* majors in preferred order, and are (often) invited to Open Houses dedicated to those majors. Plebes can also discuss major selection with their plebe academic advisor and upperclassmen in their academic year company.

Q: Sounds great! How do I sign up!?

A: Major selection occurs in March... make sure that you have fully researched all of your opportunities and carefully and honestly assessed your capabilities, interests and long-term goals. Then, if our major is right for you, just select Systems Engineering as your major according to the instructions you will be provided. You will be assigned a Systems Engineering advisor and be off on your academic program with many options available to you and an exciting experience ahead.

Systems Engineering Curriculum:

Systems Engineers take the standard Engineering Core (including calculus, physics, differential equations, naval weapons systems, electrical engineering I & II) plus:

Fundamental Engineering Courses:

Statics and Dynamics

Fluid Mechanics and Thermodynamics

Programming for Engineers

Engineering Mathematics

Required Systems Engineering Courses

Introduction to Systems Engineering

Modeling and Simulation

Linear Control Systems

Advanced Control Systems

Control Systems Design Laboratory

Engineering Design Methods

Applied Sensors and Actuators

Systems Design (project course)

Students also choose two 'tracks' of two related courses plus a fifth elective from the following lists:

Elective Systems Engineering Courses

Introduction to Robotic Systems

Advanced Topics in Robotics

Mobile Robot Design

Autonomous Vehicles

Introduction to Computer Vision

Digital Control Systems

Modern Control Systems

Digital Information Systems

Analog Information Systems

Introduction to Computer Engineering

Microcomputers in Control Applications

Operations Research

Emerging Technologies

Sample Electives from Other Departments

Ocean Environmental Engineering I & II, Electric Machines and Drives, Power Electronics, Strength of Materials, Mechanical Vibrations, Reactor Physics I & II, Nuclear Energy Conversion, Aerodynamics I & II, Spacecraft and Control (Aero), Astrodynamics I & II, Spacecraft Attitude Dynamics and Control, Space Operations