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Welcome to the Department of Electrical Engineering and Computer Science, where great people learn how to do great things with technology!

The U.S. Army succeeds by exploiting cutting-edge technology better than any other army in the world. Today, the rise in importance of the Cyber Domain of warfare is fundamentally changing the nature and opportunities of Army leadership. Our courses provide a foundation critical for leadership in this Army of the twenty-first century. We also prepare our cadets for admission to top graduate schools and enable them to embrace the challenge of life-long learning. ABET accreditation keeps our electrical engineering, computer science, and information technology majors at the forefront of undergraduate education in America.

Cadets who major in our programs select from a rich collection of exciting subjects, including software design, robotics, cyber security, electronics, information systems, telecommunications, computer networks, and systems integration.

Our senior project program for each major is second to none. Interdisciplinary teams design and build systems that consistently win national competitions and meet real needs of customers throughout the Army, DoD, and for National agencies.

For majors in other departments, the Cyber Engineering Sequence introduces cadets to the secure design, implementation, and defense of information systems. The Electrical Engineering Core Engineering Sequence emphasizes the study of electronic and robotic systems with enormous future implications for the Army.

Learn about the technologies that underlie the world where you live and the Army where you will lead the world’s best soldiers! Prepare yourself for the future by selecting an EECS major or sequence!

Our department is committed to the best possible education for cadets at West Point. We ensure that our courses are current, comprehensive, challenging, and exciting. Our modern undergraduate laboratories are excellent. Graduates of our nationally accredited programs rank with those of the best schools in the country.

Come join us. We’ll be happy to see you!

Barry L. Shoop, Ph.D., P.E.
Colonel, Professor USMA
Head of the Department
United States Military Academy

The Academy provides a broad undergraduate education leading to the Bachelor of Science degree and ensures that each graduate can meet the physical, military, intellectual, and ethical challenges that a U.S. soldier and leader may face.

Mission

USMA Mission: To educate, train, and inspire the Corps of Cadets so that each graduate is a commissioned leader of character committed to the values of Duty, Honor, Country and prepared for a career of professional excellence and service to the Nation as an officer in the United States Army.

Academic Program

The United States Military Academy envisions that graduates will be . . . commissioned leaders of character who, in preparation for the intellectual and ethical responsibilities of officership, are broadly educated, professionally skilled, morally, ethically and physically fit, and are committed to continued growth and development both as Army officers and as American citizens.

Goals:

The Overarching Academic Program Goal: Graduates integrate knowledge and skills from a variety of disciplines and respond appropriately to opportunities and challenges in a changing world.

The seven Academic Program goals are as follows:

- Communication: Graduates communicate effectively with all audiences.
- Critical Thinking & Creativity: Graduates think critically and creatively.
- Lifelong Learning: Graduates demonstrate the capability and desire to pursue progressive and continued intellectual development.
- Ethical Reasoning: Graduates recognize ethical issues and apply ethical perspectives and concepts in decision making.
- Science, Technology, Engineering, and Mathematics: Graduates apply science, technology, engineering, and mathematics concepts and processes to solve complex problems.
- Humanities and Social Sciences: Graduates apply concepts from the humanities and social sciences to understand and analyze the human condition.
- Disciplinary Depth: Graduates integrate and apply knowledge and methodological approaches gained through in-depth study of an academic discipline.
Each cadet completes a broad core curriculum that covers the humanities, social sciences, basic and applied sciences, and engineering. Most of the Academy’s curriculum objectives are accomplished through 30 core courses distributed among math, science, engineering, humanities, social sciences, and information technology. Taking at least 10 electives in a chosen field satisfies the requirement for study in depth. Including the core curriculum, each cadet has the opportunity to pursue a 40 to 44 course program that leads to a major in a discipline supported by one of the thirteen academic departments.

The Department of Electrical Engineering and Computer Science supports the Academy’s intellectual outcome and academic study-in-depth program goals by providing cadets a broad foundation in electrical engineering, computer science, or information technology. Our department’s mission is to educate and inspire cadets to be leaders of character, prepared to think critically and apply engineering and technology expertise as Army Officers. In order to accomplish this mission, we have adopted the following goals.

**Department of Electrical Engineering & Computer Science goals:**

- Our graduates possess knowledge of state-of-the-art engineering and technology that meets Army needs; they are able to master and apply new technologies throughout a career of service.
- Our teaching makes cadets responsible for their own development in an environment of exceptional resources, guidance, and encouragement to succeed.
- Our programs are nationally accredited and highly regarded within the community of college education.
- Our faculty and staff are a diverse team of professionals, each making his or her personal best contribution to our mission and valuing the contributions of others.
- Our climate prizes initiative, innovation, and accomplishment for the department team, underpinned by enthusiasm for learning in all our disciplines.
- Our centers of excellence integrate externally resourced, Army-relevant research and outreach projects with cadet education and faculty professional development.
- Our organization is kind and fair to people, assigning work equitably, honoring preference, rewarding excellence, and enabling continued professional success.
- Our support activities provide a practically constraint-free environment for accomplishing the mission.

Through these departmental goals, the Electrical Engineering, Computer Science and Information Technology programs provide a basic technical understanding of modern society, develop creative problem-solving techniques, provide an understanding of the engineering thought process, instill a solid technical background for further study within the disciplines, and enhance communication skills.
The United States Military Academy provides cadets the opportunity to participate in summer training, enabling them to apply the academic skills learned in the classroom. The Department of Electrical Engineering and Computer Science sponsors the academic individual advanced development (AIAD) program for cadets interested in majoring or taking a sequence in Electrical Engineering, Computer Science and Information Technology. Cadets conduct world-wide research in Army, Department of Defense, National, and other government or civilian laboratories under the direct supervision of a research scientist or engineer.

Recent participants in the program include:

<table>
<thead>
<tr>
<th>National Security Agency</th>
<th>Army Research Labs</th>
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<tr>
<td>National Reconnaissance Office</td>
<td>US Cyber Command</td>
</tr>
<tr>
<td>MIT Lincoln Laboratory</td>
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<td>Boeing</td>
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<tr>
<td>Def. Adv. Research Projects Agency</td>
<td>FBI</td>
</tr>
</tbody>
</table>

Areas of research include:

- Signal processing and analysis
- Distributed databases
- High speed parallel computing
- Microcontrollers
- Simulation and virtual reality
- Control systems
- Network analysis
- Satellites
- Optical engineering
- Robotics
- Artificial intelligence
- Cybersecurity
Research Opportunities

The **Photonics Research Center** (PRC) studies applications of light-based technologies to solve Army/DoD problems. From advanced night vision systems to help soldiers “see in the dark” to laser based communications to opto-electronic signal processing, the PRC conducts basic and applied research in the area of lasers and photonics. The center is interdisciplinary and a consortium of the Electrical Engineering & Computer Science, Physics and Chemistry Departments. The PRC brings together a unique combination of personnel including Ph.D. faculty, rotating military faculty, and enthusiastic cadets from the three departments. Established in 1987, the research center has a world-class research program and is recognized by the National Research Council as an approved postdoctoral research site. EE&CS research projects include investigation of silicon optoelectronic circuits; fabrication and characterization of optical and optoelectronic devices; photonic analog-to-digital conversion; optical digital image half toning; and all optical fiber switching. The research programs and student projects use an assortment of commercial high and low power, tunable lasers. The Photonics Research Center also collaborates with Army research and development programs and conducts research in support of specific Army requirements. In its support role, the PRC provides direct technical support to the Army Research Office, Army Research Laboratory, Edgewood Chemical and Biological Command, U.S. Army Special Operations Command, National Reconnaissance Office, National Security Agency, Defense Threat Reduction Agency, Ballistic Missile Defense Office, Natick RDT&E Center, Program Executive Offices, National Missile Defense Program, Ground Based Radar System, and the Department of Energy. The PRC receives external funding from several agencies such as the Army Research Office and the Defense Advanced Research Projects Agency.

The **Cyber Research Center**’s primary mission is to support the USMA educational mission through curriculum development, research, and outreach to Army, DoD, and federal agencies. The primary focus areas for the center are the acquisition, use, management, and protection of information. To address the many challenges that our Army and Nation face in these areas, the CRC brings together a unique combination of personnel including senior faculty at the Ph.D. level, rotating military faculty with Masters degrees, and enthusiastic and highly motivated undergraduate cadets. Current research areas for the CRC include: cyber warfare, information security, online privacy, usable security, and security data visualization. As the nation's first undergraduate institution recognized as an NSA Center of Excellence in Information Assurance Education a major emphasis of the center is the annual, NSA-sponsored, Cyber Defense Exercise. Sponsors of CRC research programs include the National Security Agency, US Cyber Command, Army Cyber Command, the Department of Defense Information Assurance Program, the National Reconnaissance Office, and Army Program Managers. In addition to research, outreach work, the CRC is
involved in teaching Computer Science and Information Technology courses at USMA, organizing academic workshops and conferences, and sponsoring the cadet run West Point chapter of the ACM Special Interest Group for Security, Audit, and Control (SIGSAC – the information warfare club) as well as C3T (Cadet Competitive Cyber Team).

The **Robotics Research Center** was established in Fall 2017 and is the Academy’s resource for expertise and academic scholarship in the field of robotics that enables interdisciplinary cooperation and concentrates Academy-wide research efforts in robotic systems. The center supports margin-of-excellence educational, scholarship, and extracurricular activities focused on autonomous systems to educate and inspire leaders of character who are prepared to think critically, innovate, and apply robotic systems in the Army. The center is also a host for a drone racing team where cadets may compete while learning the field of robotics.
Laboratory Facilities

The Department of Electrical Engineering and Computer Science has many resources to provide a high caliber of instruction to cadets. The department maintains facilities that provide everything from general support to specialized instruction.

Computer Laboratories

General Purpose Computing Labs. Nine laboratories are used primarily for IT105 and CY305. IT105 is the core introductory information technology course taken by all freshmen; CY305 is the core course taken by all juniors who are not majoring in engineering or CS. Common software utilization in these courses includes the Microsoft Office suite of office productivity tools, Python programming tools and development environment, and a host of network access tools including web browsers. Instruction that occurs in these laboratories utilizes both wired and wireless networks and students receive and submit assignments electronically.

Special Purpose Computing Labs. Three laboratories are typically used for courses taken by both majors and non-majors in the Information Technology Program and the Computer Science Program. Common software utilization includes Eclipse, JUnit, Scalac, Wingman Python IDE, IDLE Python GUI, Ruby and its Rails framework, and the X-ming X-server package to interface with the department’s Red Hat Enterprise Linux servers and resources.

Cyber Engineering Network Labs. The two Cyber Engineering Laboratories each contain 42 Cisco 2900 series routers, 42 Cisco 3560 Switches, 21 MacMini servers and 21 HP server class desktop computers. From individual desks in the room, students can configure their own router, switch, and server combination to apply concepts covered in networking courses. The hardware is all part of an “air-gapped” network that provides maximum learning potential in a risk-free environment. The room also has wired and wireless access to the department and Academy networks to support classroom activities that require standard networked resources.
Linux Lab. One laboratory contains 22 workstations running Red Hat Linux with Gigabit Ethernet connections to department file and computer servers.

Advanced Studies Lab. The Advanced Studies Laboratory (ASL) is configured on demand for specific student and faculty research projects. It has twenty-four network ports and equipment to meet various requirements including Macintosh computers, UNIX systems, and a multimedia station. Support technicians can configure workstations in the ASL to interface with the rich server resources available within the department according to the individual needs of students and faculty.

Information Warfare Analysis and Research (IWAR) Laboratory / Cyber Defense Exercise Lab / Classroom XXI. This laboratory is part of an Army-wide distance education initiative. The laboratory is equipped with video cameras throughout the room, including one at each of the 18 student workstations. Classroom activity can be recorded and/or broadcast to other similarly enabled classrooms on various Army installations.

This laboratory also hosts the CS482 Cyber Security course for IT & CS majors and is used for various faculty and student research projects. Student teams learn about information assurance concepts and conduct practical exercises in the laboratory on a LAN which is not connected to the departmental LAN and is not connected to the Internet to prevent accidental damage to production resources.

A wide variety of servers and workstations support this laboratory; each student team participating in the course is assigned a desk that includes a workstation running Windows 10 and a KVM switch that allows them to connect to a server on the isolated LAN. Those servers, running Windows Server Web or Standard edition, host independent virtual machines for other operating systems including Red Hat Linux. Using these different environments, students learn to defend against and conduct attacks on a “victim” network composed of servers, workstations, and network components of various architectures and operating systems.

Other computer science and information technology elective courses are also taught in this laboratory using the workstations with a standard laboratory image. Accordingly, the laboratory has wired and wireless access to the department and Academy networks to support classroom activities that require available networked resources. Students use the KVM switch to alternate between machines that interface with the standard network and the information assurance LAN.

This laboratory also houses many servers and workstations that are not connected to the departmental LAN or to the Internet. The machines can be specially configured to support student projects or faculty research that may not be appropriate for the department’s network. Projects include running and analyzing malware and performing detailed network analysis.
Servers. Numerous servers provide infrastructure services including database servers, file servers, web servers, license servers, a print server, administrative servers for scanning, and patching and monitoring departmental assets. The server environment is self contained with climate control, humidity control, an uninterrupted power supply, and a Sensaphone device for contacting support personnel in emergency situations. Principal server resources include the following:

- Four Linux servers including 1 Dell PowerEdge R510 and 3 Dell PowerEdge 710 models
- Three VMware ESXi servers Dell PowerEdge R730 models, supporting 20 Windows 2012 R2 and 8 Red Hat virtual servers.
  - Together these servers host 5 SharePoint Servers, 3 Microsoft SQL servers, 6 file servers and multiple EECS required applications servers.
- A Storage Area Network with a capacity of approximately 60 terabytes
- One Dell ML6000 Tape Library with 64 terabytes of storage that is physically separated for catastrophe management.

Server resources are separated into three categories: student development, production environment, and administrative support so that the data and applications from the categories do not overlap on the same physical device. This separation provides maximum flexibility to students and teachers while minimizing the risk of data loss or exposure to malicious users. The department uses the distributed file system and server proxies to present a logically connected, intuitive interface to the students and faculty so that the physical separation is transparent.

The EECS Department has taken significant steps to improve technical support to its programs through a private cloud. The EECS Cloud will provide a pool of configurable computing resources to be shared by staff and faculty as well as cadets. It is based on the VMware vSphere Enterprise Plus suite of tools, comprised of three servers providing fault tolerance and a EMC SAN, all on a 10GB Ethernet network. The EECS Cloud creates a high availability environment with access to virtualized servers and storage in its initial rollout, and will eventually include applications and networks.

Our motivations are typical for organizations which are transitioning from a high server density, direct attached storage environment to cloud services. Among them are rapid provisioning of resources, flexibility, and cost savings. Rapid provisioning of servers with minimal management overhead will allow department members to more effectively engage in varied teaching and research initiatives. The uncertainty of future equipment needs, and the ability to meet those needs in a timely fashion, is mitigated with our ability to efficiently provision server and storage resources. Lower costs in infrastructure (power, HVAC, and potentially service technicians) will also result from a reduction in the number of physical machines supporting our programs.
Electrical Engineering Laboratories

The electrical engineering laboratories at West Point are among the best undergraduate electrical engineering laboratories in the country. They contain state-of-the-art equipment with a total value in excess of $10 million and provide ready access to modern engineering hardware tools such as Agilent instruments and software tools such as Cadence PSPICE; NI LabView & MultiSim; NETWARS & OPNET; Mathworks MATLAB & SimuLink; Altera Quartus II; and Agilent IC-CAP, BenchVue & LogicWare.

Electronics Laboratory I & II. These laboratories provide opportunities in low-to-mid frequency electronic circuit design and analysis. They also offer the student the capability to design, build, and test microelectronic devices: diodes, field effect and bipolar junction transistors, and integrated differential and discrete operational amplifiers. These labs are used in the Introduction to Electrical Engineering, Basic Electrical Engineering, Introduction to Electronics, and Electronics Design courses.

Digital Logic and Computer Architecture Laboratory. This lab also serves as a classroom and is fully equipped with digital trainers, workstations, and software capable of programming digital systems, such as Field Programmable Gate Arrays (FPGAs), single-board computers, and microcontrollers. Students in Digital Computer Logic, Computer Architecture, and Embedded Systems use this lab.

Control Systems Laboratory. This laboratory provides facilities to support hardware design and experimentation experience for feedback controls system study. This lab supports the Dynamic Modeling and Control course.
Network and Communications Laboratory. Provides facility and equipment to support communications circuit and network design and analysis. Provides capability and support for audio, video and data analog communication, digital communication, network communication, digital signal processing, software defined radio, and radio frequency communications in the HF, VHF and UHF bands. Automatic measurement instrumentation with the following general capabilities: network analysis up to 26.5 GHz; noise figure; spectrum analysis to 50 GHz. This lab supports the communications systems courses.

Robotics Research Center (RRC). The RRC consists of three laboratories and an administrative office, all of which are conveniently located within Thayer Hall. Its mission is to provide cadets an unparalleled educational opportunity to design, build, and operate a wide variety of ground and aerial robotic platforms so that they are better prepared to lead in an Army more reliant on unmanned systems.

Aerial Robotics Laboratory. This lab supports the research, development and testing of robotic systems. With a mezzanine and high ceiling, the laboratory is well-suited for the testing of aerial drones. The lab is equipped with measurement and testing tools including a camera based visual tracking system and a global positioning system simulator. Students in the Robotics depth thread depth option and senior design projects use this lab.

Mechatronics and Embedded Systems Laboratory. This lab provides cadets with the ability to design, build, and test mechatronic and embedded systems. The lab contains workstations, digital oscilloscopes, dynamometers, microcontrollers, single-board computers, robots, actuators, and an array of sensors. The accessibility of these components offer cadets an unparalleled ability to explore the programming and interfacing of electronics inherent with the fields of robotics, mechatronics, and embedded systems. Students in the Robotics depth thread depth option and senior design projects use this lab.

Robotics Capstone and Independent Study Laboratory. Provides facility and equipment to support robotic system engineering. Provides advanced capability to support undergraduate design and research projects in robotics. Students working on senior capstone projects and independent research studies use this lab.

Space Operations Laboratory. This lab provides cadets with the ability to design, build, and test electronic circuits that are designed for operations in space. Students have access to a clean room for system development and an environmental chamber that allows system testing under various temperature and humidity conditions. Students working on senior design projects use this lab.

Photonics Engineering Laboratory. This lab contains lasers, oscilloscopes, spectrum analyzers, and other equipment for the generation of optical signals and their transmission through free space and fiber optic cables. The equipment provides cadets with hands-on demonstrations of the fundamentals of geometrical optics, lasers, LEDs, photodetectors, holography, and fiber optic communication
systems. This lab is primarily used by the Photonics Engineering and Fiber Optic Communications courses as well as by students working on senior design and independent study projects.

**Power Engineering Laboratory.** This laboratory contains integrated workstations for the study of AC and DC power fundamentals: generation, transmission, transformation, utilization, and systems. This lab also includes a test station for the characterization of small DC motors consisting of a 160A DC power supply, dynamometer, and torque/speed controller. Students in the Electric Power Engineering and Mechatronics courses and students working on senior design projects use this lab.

**Engineering Support Laboratories.** These labs include facilities for photolithography, computer aided machining and general engineering support. They provide cadets and faculty the ability to design and construct enclosures for projects, create mockups and models of electronic devices, and design, layout and fabricate printed circuit boards. The staff of experienced machinists and electronics technicians is available to advise and assist in these projects. These facilities are used extensively by cadets working on senior design and independent study projects.
The Electrical Engineering Program

Electrical Engineering is the underlying discipline that enables many of the technological innovations in modern society. On the battlefield, these innovations directly support the warfighter. Our Army is fighting a global war on terror while also preparing for major conventional operations and cyber operations.

Army transformation and modularization is heavily invested in advanced technology to lighten the force while increasing its lethality and survivability. The general categories of technological innovations include computer, communications, and network technologies for cyber operations, unmanned vehicle and robotic technologies to reduce battlefield exposure, laser and advanced optical systems, advanced and distributed sensors to provide improved multispectral sensing, global positioning and guidance systems for precision strike capability, electric and hybrid power systems for propulsion and weapons - just to name a few. Electrical Engineering is the enabling discipline for these and many other technological innovations.

The Army needs technically competent leaders in all branches and at all echelons who understand the underlying concepts and can effectively employ these new technologies. Leaders will have to understand and exploit all the tools at their disposal in an increasingly complex battlefield environment.

The courses you will take in our electrical engineering curriculum are directly applicable to the Army you will lead. You have a unique opportunity to define your future through your course of study at West Point. Becoming an electrical engineer is challenging; being an electrical engineer is both challenging and rewarding. We look forward to including you as a member of our team! Don’t take my word for it. Here are some emails from graduates. CPT Barry has returned to USMA as an EECS faculty member.

“I believe that I have discussed the benefits of my EE education with you before after my first deployment. In my second one (Afghanistan this time), I used those skills even more…I designed and built the entire power grid on the COP...We set up our own AFN so that we could watch TV. Aligning that dish took some math and at least a rudimentary understanding of how satellite signals work. It helps to be able to look at simple circuit boards and determine what they might have been used for. While it is an uncommon tactic for the enemy to use, it does happen”

-Nicholas Barry, CPT, EN, Commander HHC, 40th EN BN,HAVOC!, Class of 2006

“I branched armor and ... in Mar 2010 I reported to my unit, 2nd Cavalry Regiment (Stryker BCT), in Vilseck, Germany, and in June I deployed to Afghanistan as a Scout Platoon Leader, almost exactly 1 year after I graduated. ... The engineering mind set and problem-solving attitude was definitely instrumental in helping me get through my 1 year deployment as a PL.”

-Hang Li, Armor, Class of 2009

Lisa A. Shay, Ph.D./PE
Colonel, Signal Corps
Associate Professor
Electrical Engineering Program Director
Opportunities in Electrical Engineering

Electrical Engineers design and build many of the warfighting systems that enable the Army to dominate present and future battlefields. These include autonomous and robotic systems, optical and radio communications systems, cyber-physical systems, and power systems. Every branch of the Army is dependent upon the technology that electrical engineers create and implement.

Electrical Engineering students at USMA apply creativity, analytical skills, and state-of-the-art computer and instrumentation tools to the study of electrical, electronic, and computer systems. Hands-on laboratory and computer experience, teamwork, and exciting interdisciplinary capstone projects are hallmarks of the Electrical Engineering Program. Our courses are current and relevant. Our laboratory facilities are among the best in the world. Our faculty is unique among EE faculty in that they are leaders of soldiers, experts in their discipline, and world-class teachers.

Electrical Engineering students study digital logic, electronics, circuits, computer architecture, signals and systems, electromagnetic fields, electric power, and participate in a 2-semester design project that helps solve real-world problems relevant to our Army such as designing and building an automatic mortar fuze setter, aerial or ground robotic systems, or a small satellite; developing and testing control and security algorithms for a smart grid; or managing a power grid on a FOB. Cadets can concentrate in robotics, communications, cyber engineering, alternative energy, or opto-electronics.

Electrical Engineering is one of the most challenging, and therefore rewarding, majors at the Academy. To successfully meet the challenge, cadets should have a sincere interest in the discipline, good time management skills, a thirst to know how things work, and the desire to apply math and science skills to real world problems. The Electrical Engineering Major is accredited by the Engineering Accreditation Commission of ABET, http://www.abet.org.

We also offer a 3-Course Engineering Sequence that exposes cadets to the technology employed in the Army with a focus on Robotics and Robotic Systems.

Soldier at Fort Benning testing the cadet capstone project referred to as ‘Demon Eye’ which won the Best Project Award in 2017. The device uses a laser along with other sensors and processing to rapidly provide precise positioning information on enemy targets.
Our outcomes describe specifically what you will be able to do upon completion of the Electrical Engineering major. Our objectives describe what you will be able to do as you meet the challenges 5-7 years after graduation.

**Student Outcomes.** Upon graduation, cadets who major in electrical engineering can:

- Apply knowledge of mathematics, probability, statistics, physical science, engineering, and computer science to the solution of problems
- Identify, formulate, and solve electrical engineering problems
- Apply techniques, simulations, information and computing technology, and disciplinary knowledge in solving engineering problems
- Design and conduct experiments to collect, analyze, and interpret data with modern engineering tools and techniques
- Communicate solutions clearly, both orally and in writing
- Work effectively in diverse teams
- Apply professional and ethical considerations to engineering problems.
- Incorporate understanding and knowledge of societal, global and other contemporary issues in the development of engineering solutions that meet realistic constraints
- Demonstrate the ability to learn on their own

**Program Educational Objectives.** Five to seven years after graduation, cadets who major in Electrical Engineering will have been successful Army officers who have:

- Applied their engineering, management, and leadership skills in service of their country
- Demonstrated intellectual growth through self-study, continuing education, and professional development in the Army
- Provided technical leadership and disciplinary knowledge as Army Officers with a broad understanding of the potential ethical and societal impacts of technology
- Applied engineering methodology and creativity to Army problems while effectively communicating across mediums and cultures
# Electrical Engineering Major
## Class of 2021
### Code EEN1

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<thead>
<tr>
<th>Fourth Class</th>
<th>Third Class</th>
<th>Second Class</th>
<th>First Class</th>
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<tbody>
<tr>
<td>MA103</td>
<td>MA104</td>
<td>MA205</td>
<td>EE302</td>
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<tr>
<td>CH101</td>
<td>PH205</td>
<td>EE360</td>
<td>MA364</td>
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<td>HI103</td>
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<td>LX203</td>
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<tr>
<td>EN101</td>
<td>EN102</td>
<td>SS201</td>
<td>SS202</td>
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**Required Courses:**

**Core Electrical Engineering Courses**

- EE302 Intro to Electrical Engineering 2
- EE360 Digital Logic w/Embed Sys 1 2
- EE362 Intro to Electronics 1
- EE375 Computer Architecture 1 2
- EE377 Electrical Power Engineering 1 2
- EE381 Signals and Systems 1
- EE383 Electromagnetic Fields 2
- EE400 EE Professional Considerations 2
- EE462 Electronic Design 2
- XE401 Integrative System Design I 1
- XE402 Integrative System Design II 2
- MA205 Calculus 2 1 2
- MA364 Engineering Math 1 2

**Breadth Course**

- MC311 Thermal-Fluid Systems I 1 2

**Choose 1 of 5 Depth Options:**

### OptoElectronics

- EE486 Solid State Electronics 2
- EE483 Photonics Engineering 2
- EE480 Optical Fiber Communications 1

### Communications

- EE477 Digital Communication Systems 2
- EE482 Wireless Comm Systems Engr 2
- EE480 Optical Fiber Communications 1

### Alternative Energy

- EE486 Solid State Electronics 2
- XE472 Dynamic Modeling and Control 1 2
- XE442 Alternative Energy Engineering 1

**Elective Courses:**

**Robotics**

- EE477 Digital Communications Systems 2
- EE487 Embedded Systems Development 2
- XE472 Dynamic Modeling & Controls 1 2
- XE475 Mechatronics 1

**Cyber Engineering**

- CY300 Programming Fundamentals 1 2
- CY350 Net. Engr. & Management 1 2
- CY450 Cyber Security Engineering 1 2
- EE477 Digital Communication Systems 2

**Choose 1 EECS Elective:**

Except for the Robotics or Cyber Engineering Depth Options since they already have a directed elective

- CY300 Programming Fundamentals 1 2
- CS393 Database Systems 1 2
- EE477 Digital Communication Systems 2
- EE480 Optical Fiber Communications 1
- EE482 Wireless Comm Systems Engr 2
- EE483 Photonics Engineering 2
- EE485 Special Topic in EE* 1 2
- EE486 Solid State Electronics 2
- EE487 Embedded Systems Develop. 2
- EE489 Advanced Individual Study 1 2
- EE489A Advanced Individual Study 1 2
- EE490 EE Summer Research 3-7
- XE442 Alternative Energy Engineering 1
- XE472 Dynamic Modeling & Controls 1 2
- XE475 Mechatronics 1
- XE492 Disruptive Innovations 1 2

*topics will vary from term to term
Electrical Engineering Major (EEN1)

Complete the core curriculum.

Complete the twelve courses listed below:

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
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<tbody>
<tr>
<td>EE302</td>
<td>Introduction to Electrical Engineering</td>
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<tr>
<td>EE360</td>
<td>Digital Logic with Embedded Systems</td>
</tr>
<tr>
<td>EE362</td>
<td>Introduction to Electronics</td>
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<tr>
<td>EE375</td>
<td>Computer Architecture with Microprocessors</td>
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<tr>
<td>EE377</td>
<td>Electrical Power Engineering</td>
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<td>EE381</td>
<td>Signals and Systems</td>
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<td>EE383</td>
<td>Electromagnetic Fields and Waves</td>
</tr>
<tr>
<td>EE462</td>
<td>Electronic Design</td>
</tr>
<tr>
<td>XE401</td>
<td>Integrative System Design I</td>
</tr>
<tr>
<td>XE402</td>
<td>Integrative System Design II</td>
</tr>
<tr>
<td>MA205</td>
<td>Calculus 2</td>
</tr>
<tr>
<td>MA364</td>
<td>Engineering Mathematics</td>
</tr>
</tbody>
</table>

Take the Electrical Engineering Seminar in the second term of the First Class year:

EE 400     EE Professional Considerations

Complete one of the depth options listed below:*  

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>EE487</td>
<td>Embedded Systems Develop.</td>
</tr>
<tr>
<td>XE472</td>
<td>Dynamic Modeling and Control</td>
</tr>
<tr>
<td>XE475</td>
<td>Mechatronics</td>
</tr>
<tr>
<td>EE477</td>
<td>Digital Communication Systems</td>
</tr>
<tr>
<td>EE486</td>
<td>Solid-State Electronics</td>
</tr>
<tr>
<td>EE483</td>
<td>Photonics Engineering</td>
</tr>
<tr>
<td>EE480</td>
<td>Optical Fiber Communications</td>
</tr>
<tr>
<td>EE477</td>
<td>Digital Communication Systems</td>
</tr>
<tr>
<td>EE477</td>
<td>Digital Communication Systems</td>
</tr>
</tbody>
</table>

* Cyber Engineering and Robotics are four-course depth options

Complete one breadth course listed below:

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>MC311</td>
<td>Thermal-Fluid Systems - I</td>
</tr>
</tbody>
</table>

Complete one elective as approved by the Head of the Department from the list below:

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>XE442</td>
<td>Alternative Energy Engineering</td>
</tr>
<tr>
<td>XE472</td>
<td>Dynamic Modeling &amp; Control</td>
</tr>
<tr>
<td>XE475</td>
<td>Mechatronics</td>
</tr>
<tr>
<td>XE492</td>
<td>Disruptive Innovations</td>
</tr>
<tr>
<td>EE477</td>
<td>Digital Communication Systems</td>
</tr>
<tr>
<td>EE480</td>
<td>Optical Fiber Communications</td>
</tr>
<tr>
<td>EE482</td>
<td>Wireless Communication Systems Engineering</td>
</tr>
<tr>
<td>EE483</td>
<td>Photonics Engineering</td>
</tr>
<tr>
<td>EE485</td>
<td>Special Topics in EE</td>
</tr>
<tr>
<td>EE486</td>
<td>Solid-State Electronics</td>
</tr>
<tr>
<td>EE487</td>
<td>Embedded Systems Development</td>
</tr>
<tr>
<td>EE489</td>
<td>Advanced Individual Study in Electrical Engineering</td>
</tr>
<tr>
<td>CY300</td>
<td>Programming Fundamentals</td>
</tr>
<tr>
<td>CS393</td>
<td>Database Systems</td>
</tr>
</tbody>
</table>
Electrical Engineering Honors Major

The Electrical Engineering Honors Major offers cadets the opportunity for additional depth of study in Electrical Engineering. It is expected that cadets graduating from the Electrical Engineering Honors Major will be among the highest achieving majors in Electrical Engineering, will be recognized as participating in the Honors Program of the Department of Electrical Engineering and Computer Science, and will have “Electrical Engineering Honors Major” annotated on their official USMA transcript.

In order to qualify for the Electrical Engineering Honors Major, cadets will be required to meet grade-point thresholds, complete an additional course and participate in either an undergraduate research experience or report on their engineering design experience. The research or design experience will include writing a research or engineering paper suitable for submission to a conference or engineering design competition. Research-focused programs will typically include enrollment in EE489: Advanced Individual Study in Electrical Engineering (or its variants, EE489A or EE490) or in XE492: Disruptive Innovations. The engineering design experience can result from participation in XE401: Integrative System Design I and XE402: Integrative System Design II.

For those cadets who enroll in EE489 or XE492 to satisfy this requirement, the course grade is also based on the honors major research paper. For those cadets who use the XE401 – XE402 engineering design series instead, the engineering paper should be based on activities completed within the two classes, but beyond their normal coursework.

Requirements

- A cadet majoring in Electrical Engineering will normally petition for entry into the Electrical Engineering Honors Major at the beginning of the spring term of the Second Class year.
- Successful completion of the Electrical Engineering Honors Major requires:
  - Successful completion of the Academy Core Curriculum with a minimum 3.0 grade point average.
  - Successful completion of courses required for the Electrical Engineering major with a minimum 3.5 grade point average.
  - Successful completion of an additional course from the list of approved electives for the EEN1 major. This course could be used to fulfill the research or engineering requirement.
  - Successful completion of a research or engineering paper requirement.

*IEEE-HKN, the Electrical Engineering Honor Society, 2016 Induction with 2016 IEEE President COL Barry Shoop and 2016 HKN President S.K. Ramesh*

- The undergraduate research or engineering experience for the Electrical Engineering Honors Major consists of a written research or engineering paper should be of a depth
and quality suitable for publication in an undergraduate conference proceeding.

- The research or engineering project will be affiliated with a 400-level Electrical Engineering course, traditionally EE489, XE492, or the XE401 and XE402 capstone design experience. The research may build on an existing project completed in the course, or may be a new project inspired by the course. In either case, the research project may be completed during a subsequent semester, but must be completed before graduation.

- The research or engineering project must reflect individual effort, although it may build on an existing group project, especially in the context of XE401 and XE402.

- The research project must be conducted under the supervision and mentorship of a member of the faculty. The topic and mentor must be approved by the Electrical Engineering Program Director before the beginning of the graduating term.

- The final report must be approved by both the faculty mentor and the Electrical Engineering Program Director.

The Redhawk capstone team won second place in the department’s 2017 project’s day award luncheon. The team investigated ways to geolocate radio frequency (RF) transmitters using miniaturized antennas and computers mounted on unmanned vehicles. Pictured from left to right are: Dr. Suzanne Matthews, Cadets Rachel Kim (CS), Hannah Grosso (EE), Kyle Broughton (EE), Jeffrey Schanz (CS), and Orion Boylston (EE).
We also offer a **3-Course Engineering Sequence** that exposes cadets to the technology employed in the Army focused on Robotics and Robotic Systems. These three courses are listed below and described in detail in the course descriptions included at the end of this booklet.

<table>
<thead>
<tr>
<th>Required Courses</th>
<th>Prerequisites</th>
<th>Term</th>
</tr>
</thead>
<tbody>
<tr>
<td>EE300 Fundamentals of Digital Logic</td>
<td>NONE</td>
<td>1</td>
</tr>
<tr>
<td>EE350 Basic Electrical Engineering</td>
<td>PH205, MA104</td>
<td>2</td>
</tr>
<tr>
<td>EE450 Military Robotic Systems</td>
<td>(EE300 or EE360) and (EE350 or EE301 or EE302)</td>
<td>1</td>
</tr>
</tbody>
</table>

Below is a typical course plan for a cadet who selects the **3-Course Robotics Engineering Sequence**:

<table>
<thead>
<tr>
<th>Fourth Class</th>
<th>Third Class</th>
<th>Second Class</th>
<th>First Class</th>
</tr>
</thead>
<tbody>
<tr>
<td>MA103</td>
<td>MA104</td>
<td>MA206</td>
<td>EE300</td>
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<td>PH205</td>
<td>Science</td>
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</tr>
<tr>
<td>HI105</td>
<td>HI108X</td>
<td>LX203</td>
<td>EE450</td>
</tr>
<tr>
<td>PL100</td>
<td>IT105</td>
<td>PY201</td>
<td>major</td>
</tr>
<tr>
<td>EN101</td>
<td>EN102</td>
<td>SS201</td>
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</tr>
<tr>
<td></td>
<td></td>
<td>SS202</td>
<td>major</td>
</tr>
</tbody>
</table>

*Ribbon Cutting Ceremony for the Robotics Research Center (RRC) in 2017: LTC Christopher Korpela (RRC Director), Dr. Robert Sadowski (Army Chief Roboticist), BG Cindy Jebb (USMA Dean), and COL Barry Shoop (EECS Department Head).*

20
The Computer Science Program


The past ten years have repeatedly demonstrated the value of technology and information throughout a range of operational environments. The modern Army recognizes the value of ensuring appropriate information is available to our soldiers no matter where they might operate. Army Strategic Planning Guidance 2012 states “The Army will invest in its ability to operate in the cyberspace domain... The Army continues reviewing models to recruit, train, and retain cyber professionals. The Army must have a pipeline for both the next generation of cyber professionals as well as address Army cyber military and civilian personnel requirements.”

Decisive victory today is predicated by Army leaders who think critically and apply technology across the full spectrum of operations.

President Barack Obama stated “Today we can see the cyber threat to the networks upon which so much of our modern American lives depend. We have the opportunity—and the responsibility—to take action now and stay a step ahead of our adversaries.” Data and information storage, processing, security, and networking are increasingly pervasive throughout our society. Those who immerse themselves in the Computer Science Major will develop an understanding of the underlying fundamental principles in areas such as software development, programming languages, computer networks, and information assurance. The Computer Science Major is accredited by the Computing Accreditation Commission of ABET, www.abet.org.

The Computer Science Program also offers a Cyber Engineering 3-course engineering sequence to students pursuing degrees in other academic departments to provide insight into how computing relates to their disciplines. Just as computing technologies have been found to assist most Army missions, a fundamental understanding of basic computing themes and concepts can enhance experiences in virtually all academic areas.

We are continually updating our courses, our computing equipment, and our software tools to prepare those willing to seize the exciting opportunities that lie ahead. If you envision yourself leading soldiers in the world’s most technologically advanced Army, then the Computer Science Program wants you. See any member of our department faculty to request an academic counselor who can discuss alternatives with you, or come speak directly with me—it’s your move.

Christa M. Chewar, Ph.D.
Colonel, Signal Corps
Computer Science Program Director
Computer Science is not just about writing computer programs or building computers! Nor is it just about the tools used to carry out computation. Computer Science is the study of the theoretical foundations of information and computation, and of practical techniques for their implementation and application in computer systems. Consequently, Computer Science continues to permeate the application of nearly all other science and engineering disciplines and play an increasing role as these disciplines are integrated to solve increasingly complex problems.

The fundamental question underlying all of computing is: what computational processes can be efficiently automated and implemented? In fact, the solution of many computer science problems may not even require the use of computers—just pencil and paper. Moreover, cadets who study Computer Science acquire extensive critical thinking skills as they study the very nature of computing to determine which problems are (or are not) computable. If you are interested in problem solving and technology, numerous opportunities, in a variety of computing technology fields, await your exploration and contributions!

For cadets who pursue a major in another area but who want a unified set of “hands-on” experiences with computing technologies, the Cyber Engineering 3-course engineering sequence may be an ideal choice. Here introductory courses in programming, network engineering, and management allow later study of and practical experience in protecting a network from intrusions.

Together with the Information Technology Program, we also offer four individual service courses in computing beyond IT105 and CY305 to help you effectively use information technologies now and in the future.

- **CS393, Database Systems** gives cadets the necessary information technology skills to design, build, and test relational database systems.
- **IT383, User Interface Development** provides a practical, hands-on exposure to concepts and strategies for designing good human interfaces to computer systems as well as the tools and techniques for implementing them.
- **IT460, Cyber Operations** takes a high-level approach to the tactics, techniques and procedures involved with computer network attack and defense, while also addressing the politics, ethics, and strategies of information warfare.
- **IT394, Distributed Applications Development** teaches cadets how to build distributed web applications.

IT460 builds on knowledge gained in IT105, CS393 and IT383 each build on CY305 and CY300, and a cadet may take IT394 after successfully completing CS393.
The Computer Science major prepares you for your career in the Army and a lifetime of dealing with rapid advances in computing technologies. Our outcomes listed below describe more specifically what you will be able to do upon completion of the Computer Science major.

Upon graduation, cadets who major in computer science will have met the following outcomes:

A. Analyze a complex computing problem and to apply principles of computing and other relevant disciplines to identify solutions.
B. Design, implement, and evaluate a computing-based solution to meet a given set of computing requirements in the context of the program’s discipline.
C. Communicate effectively in a variety of professional contexts.
D. Recognize professional responsibilities and make informed judgments in computing practice based on legal and ethical principles.
E. Function effectively as a member or leader of a team engaged in activities appropriate to the program’s discipline.
F. Apply computer science theory and software development fundamentals to produce computing-based solutions. [CS]

Our program will prepare you to deal with the constant evolution of computing technologies as you assume progressively greater responsibilities in your career in the Army. The Program Educational Objectives for Computer Science are that, five to seven years after graduation, cadets who major in Computer Science will have, as successful Army officers:

A. Initiated and completed tasks that identify aspects of a complex situation that can be enhanced by using computing technology.
B. Applied computing knowledge and skills while using an engineering process individually or in diverse teams to develop computing technology applications.
C. Used effective communication to explain new computing technology to war fighters in support of current and emerging Army war fighting doctrine.
D. Grown professionally through self-study, continuing education, and professional development.
Computer Science is a 41 course major, with 18 courses being CS-related. Curriculum is designed to remain relevant long after graduation. The major includes the Cyber Engineering Sequence and an advanced version of the CY305 Cyber Foundations Core Course. Double majors and Semester Abroad Programs can be possible.

<table>
<thead>
<tr>
<th>Plebe Year</th>
<th>Yearling Year</th>
<th>Cow Year</th>
<th>Firstie Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>MA103</td>
<td>MA104</td>
<td>MA206</td>
<td>SS201</td>
</tr>
<tr>
<td>EV203/</td>
<td>CH101/</td>
<td>PH205/</td>
<td>CH102/</td>
</tr>
<tr>
<td>PH105</td>
<td>EV203</td>
<td>SS202</td>
<td>CY350/</td>
</tr>
<tr>
<td>SS307</td>
<td></td>
<td></td>
<td>CS484</td>
</tr>
<tr>
<td>EN101</td>
<td>EN102</td>
<td>LX203</td>
<td>LX204</td>
</tr>
<tr>
<td>IT105</td>
<td>PL100</td>
<td>CY300</td>
<td>CS384</td>
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<td>HI105</td>
<td>HI108</td>
<td>CY355</td>
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<td>Math elective</td>
<td>CS474</td>
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<td>CS elective</td>
</tr>
<tr>
<td>EE360</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

CS majors complete many projects and have exciting opportunities with AIADs, cadet clubs and other activities. The year-long capstone design project, culminating on Projects Day, is one exciting experience all CS majors undertake. CS cadets work in teams of 4-7 that include cadets in other majors.

The CS Honors major is very achievable by high-performing cadets (>3.5 in-major and 3.0 in Core courses), requiring only 1 extra course and a small Honors project. Most class year groups in recent memory have cadets publishing academic research and successfully competing for scholarships.
Computer Science Major (Code CSC1)

Complete the 24-course core curriculum, which includes:

- CY355   Cyber Foundations – Computing

Complete the following 13 courses, which are Required Courses:

- CY300   Programming Fundamentals
- CS380   Computer Organization
- CS384   Data Structures
- CS385   Design & Analysis of Algorithms
- CS400   Computer Science Seminar
- CS403   Software Testing & Development
- CS474   Fundamentals of Computer Theory
- CS478   Programming Languages
- CS481   Operating Systems
- EE360   Digital Logic w/ Embedded Systems
- MA372   Introduction to Discrete Math
- XE401   Integrative System Design I
- XE402   Integrative System Design II

Complete one course from the Math Electives (Complementary Support Course) group:

- MA205/255   Calculus II
- MA371   Linear Algebra
- MA376   Applied Statistics
- MA383   Foundations of Math
- MA385   Chaos and Fractals
- MA386   Introduction to Numerical Analysis
- MA388   Sabermetrics
- MA391   Mathematical Modeling
- MA394   Fundamentals of Network Science
- MA461   Graph Theory and Networks
- MA462   Combinatorics
- MA464   Applied Algebra w/ Cryptology
- MA466   Abstract Algebra
- MA476   Mathematical Statistics

Complete one course from the Networking Group:

- CS484   Computer Networks
- CY350   Network Engineering & Management

Complete two additional courses from the Computer Science Electives group:

- CS393   Database Systems
- CS394   Distributed Application Engineering
- CS473   Computer Graphics
- CS482   Cyber Security Engineering
- CS483   Digital Forensics
- CS484   Computer Networks
- CS485   Special Topics in CS
- CS486   Artificial Intelligence
- CS489   Advanced Individual Study in Computer Science
- CY350   Network Engineering & Management
- EE487   Embedded Systems Development
- IT383   User Interface Development
- XE492   Disruptive Innovations
Honors Program in Computer Science
Class of ‘21

The Computer Science Honors Program offers cadets the opportunity for additional depth of study in Computer Science, which earns the annotation of “Computer Science Honors Program” on their official USMA transcript. A cadet majoring in Computer Science can declare entry into the Computer Science Honors Program starting in Second Class year. Entry. Continuation in the program requires the grade point averages listed below.

Successful completion of the Computer Science Honors Program requires:

1) **Completion of all Computer Science Major requirements**

2) **Completion of one Computer Science Honors Elective**, which cannot be double-counted with electives used to meet the CS Major requirements.

   - CS394 Distributed Application Engineering
   - CS473 Computer Graphics
   - CS483 Digital Forensics
   - CS484 Computer Networks
   - CS485 Special Topics in Computer Science
   - CS486 Artificial Intelligence
   - CS489 Advanced Independent Study in CS
   - CS490 CS Summer Research
   - EE487 Embedded Systems Development
   - XE492 Disruptive Innovations

3) **Completion of the Research Requirement.**
   - Consists of both a written document and an oral presentation of a depth and quality suitable for submission to a professional conference.
   - The research will normally be accomplished as an extension of a project begun in the CS Honors Elective. The research must reflect individual effort, although it may build on an existing group project (especially the context of XE401/402).
   - Neither the project/research work nor the resulting paper and presentation need be completed during the same semester they are begun, but must be complete by the end of the TEE period of semester 8.
   - The project/research must be conducted under the supervision/mentorship of a member of the faculty, normally the instructor of the corresponding course.
   - The final written document and oral presentation must be approved by both the research mentor and the Computer Science Program Director.

4) **Grade Requirements.** Attain an APSC of at least 3.0 in the core curriculum and an APSC of at least 3.5 in the major. Please note that CY300, CY355, CY350/CS484, and XE401 are counted as core courses.
Cyber Engineering Core Engineering Sequence
Class of 2021

For cadets who pursue a major in another area but who want a unified set of “hands-on” experiences with computing technologies, the Cyber Engineering 3-course engineering sequence may be an ideal choice.

- CY300, Programming Fundamentals
- CY350, Network Engineering & Management
- CY450, Cyber Security Engineering

We also offer four individual service courses in computing beyond the 3-course engineering sequence, CY105 and CY305 to help you effectively use information technologies now and in the future.

- CS393, Database Systems
- IT383, User Interface Development
- IT460, Cyber Operations
- IT394, Distributed Applications Development

Typical

<table>
<thead>
<tr>
<th>Fourth Class</th>
<th>Third Class</th>
<th>Second Class</th>
<th>First Class</th>
</tr>
</thead>
<tbody>
<tr>
<td>MA103 MA104</td>
<td>MA205 MA206</td>
<td>CY300 CY350</td>
<td>CY450 Major</td>
</tr>
<tr>
<td>CH101 CH102</td>
<td>PH203 PH204</td>
<td>CY305 PL300</td>
<td>Major Major</td>
</tr>
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<td>HI103 HI104</td>
<td>LX203 LX204</td>
<td>Major Major</td>
<td>Major Major</td>
</tr>
<tr>
<td>PL100 IT105</td>
<td>PY201 EV203</td>
<td>SS307 EN302</td>
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</tr>
<tr>
<td>EN101 EN102</td>
<td>SS201 SS202</td>
<td>HI301 HI302</td>
<td>Major LW403</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Optional CS/IT Elective</td>
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</table>

Required Courses:

<table>
<thead>
<tr>
<th>Course</th>
<th>Prerequisites</th>
<th>Term</th>
</tr>
</thead>
<tbody>
<tr>
<td>CY300</td>
<td>Programming Fundamentals IT105</td>
<td>1 2</td>
</tr>
<tr>
<td>CY350</td>
<td>Network Engineering &amp; Management CY305, CY300</td>
<td>1 2</td>
</tr>
<tr>
<td>CY450</td>
<td>Cyber Security Engineering CY350</td>
<td>1 2</td>
</tr>
</tbody>
</table>

“Cyber is a critical mission area for the Army and the nation. Cyber capabilities must be effective enablers of our combat forces. I am
humbled and excited about the opportunity to serve with our tremendous men and women as we develop the cyberspace domain and a world-class cyber force.”

LTG(R) Rhett A. Hernandez
Former Commander, US Army Cyber Command

“I am currently stationed in Baghdad, Iraq on the final month of a 15 month deployment. ... As it turns out, the programming opportunities in Iraq are plentiful ... I developed a client application that is a front-end to a SQL Server ... The end state is that this application is now the only method of operational reporting for my battalion.”

1LT Brian Olson, ’05 CS Major, Camp Slayer, Iraq

“I am currently in Iraq with 1st BSTB, 1st BCT, 82d Airborne Division ... There are a lot of IED's. I have found that "Macros" ... are extremely useful. ... I am easily able to apply programming concepts to a lot of what is required of me... I have automated the tedious tasks of my job, making it easier for me and my fellow officers to track the fight.”

2LT Joe Weston, ’06 CS Major, Camp Adder, Iraq
Information Technology is the most hands-on and applied branch of the computing discipline.

"IT programs exist to produce graduates who possess the right combination of knowledge and practical, hands-on expertise to take care of both an organization’s Information Technology infrastructure and the people who use it. IT specialists assume responsibility for selecting hardware and software products appropriate for an organization, integrating those products with organizational needs and infrastructure, and installing, customizing, and maintaining those applications for the organization’s computer users. Examples of these responsibilities include the installation of networks; network administration and security; the design of web pages; the development of multimedia resources; the installation of communication components; the oversight of email systems; and the planning and management of the technology lifecycle by which an organization’s technology is maintained, upgraded, and replaced."

-- Association for Computing Machinery Computing Curricula 2005 Report
The program educational objectives of the Information Technology Program are that five to seven years after graduation, cadets who major in Information Technology will have been successful Army officers who have:

- Identified and exploited opportunities to improve Army operations by applying best practices in Information Technology.
- Effectively communicated Information Technology to a range of audiences.
- Grown professionally through self-study, continuing education, and professional development.

The student outcomes for the program are that the Information Technology Program enables students to attain, by the time of graduation the ability to:

1. Analyze a complex computing problem and to apply principles of computing and other relevant disciplines to identify solutions.
2. Design, implement, and evaluate a computing-based solution to meet a given set of computing requirements in the context of the program’s discipline.
3. Communicate effectively in a variety of professional contexts.
4. Recognize professional responsibilities and make informed judgments in computing practice based on legal and ethical principles.
5. Function effectively as a member or leader of a team engaged in activities appropriate to the program’s discipline.
6. Identify and analyze user needs and to take them into account in the selection, creation, integration, evaluation, and administration of computing-based systems. [IT]

Tanya T. Estes, Ph.D.
Lieutenant Colonel, Aviation
Information Technology Program Director

The Information Technology Major consists of four threads shown at the left that build on the USMA core program. Each of the four threads consists of 2 or more courses and culminate in a year-long Integrative Experience.

| Fundamental Skills | Integrate software to build tools that  
|                    | • explore and manipulate the local file system and the network,  
|                    | • communicate with network services such as web servers and database servers, and  
|                    | • communicate with other tools  
| System Integration | • Strong information management skills relevant to junior officers.  
|                    | • Database design using Unified Modeling Language and web-based servers.  
|                    | • Web site development in an n-tier environment.  
| Network Integration| • Design and manage multiple computers connected by a network.  
|                    | • Defend information resources, networks, and services from attack and compromise.  
|                    | • Learn how to defend against Red Team attackers in a Cyber Defense Exercise.  
| IT Application Studies | • Choose an Information Technology application area to study (such as geographic information systems or remote sensing)  
| Integrative Experience | • A year long project in the First Class year using Information Technology to solve a real problem for a real client.  

### Information Technology Major
#### Class of 2021
- Code ITE1
- Sample 8TAP

<table>
<thead>
<tr>
<th>Fourth Class</th>
<th>Third Class</th>
<th>Second Class</th>
<th>First Class</th>
</tr>
</thead>
<tbody>
<tr>
<td>MA103</td>
<td>MA104</td>
<td>SS201</td>
<td>PY201</td>
</tr>
<tr>
<td>EV203/</td>
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<td>SS202/</td>
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<td>CH101/</td>
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<tr>
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<td>PL100</td>
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<td>IT383</td>
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<td>EN101</td>
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</table>

* IT APP refers to a cadet-selected IT Application Study such as remote sensing, geographic information systems, terrorism and others.

* CH275 (Biology) may be replaced with CH102 (General Chemistry II) or PH206 (Physics II) based on cadet interest.
Information Technology Major
Class of 2021
Code ITE1
Graduation Requirements

- Complete the core curriculum.
  CY355 Cyber Foundations – Computing

- Complete the Fundamental Skills Thread:
  CY300 Programming Fundamentals
  IT384 Network System Programming
  EM411 Project Management
  IT460 Cyber Policy, Strategy & Operations
  EE360 Digital Logic w/ Embedded Systems

- Complete the System Integration Depth Thread:
  CS393 Database Systems
  IT394 Distributed Application Development
  IT383 User Interface Development

- Complete the Network Integration Depth Thread:
  CY350 Network Engineering & Management
  IT392 Network Services Management
  CY450 Cyber Security Engineering

- Complete an IT Application Depth (one of the following sets):
  EV398 Geographic Information Systems
  EV498 Advanced Geographic Information Systems
  EV377 Remote Sensing
  EV477 Advanced Remote Sensing
  SS464 Homeland Security
  SS465 Terrorism: New Challenges
  DS345 Military Innovation
  DS385 Sustaining the Force

  (select 2 of the 3 below to form this thread):
  PL250 Neurocognitive Foundations of Behavior
  PL392 Cognitive Psychology
  PL394 Anthropometrics & Biomechanics

- Complete the Integrative Capstone Experience and IT Seminar
  XE401 Integrative System Design I
  XE402 Integrative System Design II
  IT400 IT Professional Considerations
A cadet majoring in Information Technology will normally declare entry into the Information Technology (IT) Honors Program at the beginning of the spring term of the Second Class year. This requires a 3.0 cumulative grade point average in the Academy Core Curriculum at the time of entry.

Successful completion of the IT Honors Program requires:

(a) Successful completion of the IT major with a 3.5 academic performance score (APS).
(b) Successful completion of the Academy Core Curriculum with a 3.0 APS average.
(c) Successful completion of the research requirement consisting of enrollment in a 3.0 credit IT independent study course (IT493) or XE492 (Disruptive Innovations) that is not otherwise part of the IT major requirements. The independent study course will include completion of both a written report and an oral presentation. The report and presentation should be of a depth and quality suitable for professional publication.
(d) Successful completion of one more additional course, bringing the total number of unique courses upon graduation to 42. Suggested courses include:

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
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<tbody>
<tr>
<td>XE492</td>
<td>Disruptive Innovations</td>
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<tr>
<td>PY326</td>
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<tr>
<td>CS481</td>
<td>Operating Systems</td>
</tr>
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<td>CS403</td>
<td>Object Oriented Concepts</td>
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<td>CS384</td>
<td>Data Structures</td>
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<tr>
<td>CS380</td>
<td>Computer Organization</td>
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<tr>
<td>SM484</td>
<td>System Dynamics Simulation</td>
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</table>

*Other courses may be approved per the discretion of the IT Program Director.

For calculation of the GPA, CY355, CY300, CY350, and CY450 will be included as part of the Academy Core Curriculum mentioned in (b) above. The IT major mentioned in (a) is the remaining 12 courses of the IT academic major.
Electronic and Information Technology Systems

Opportunities in EITS ...

EITS -- a focus on innovative ways to use technology.

Topics such as:
- Defending computer networks
- Building robotic devices
- Building web-enabled databases
- Building remote sensor networks

It can be any one of these or some combination of them.

It gives you choices.

In fact, EITS is more like a framework that allows you to build your own major.
**EITS Choices . . .**

The EITS major is all about flexibility. By an appropriate choice of 3-course threads, the EITS major can become very specialized in a topic that interests you. Alternatively, you can choose a broader selection of threads that introduces you to many topics without becoming a specialist.

To design your EITS program, you

- Complete the 24-course USMA core program (which includes either CY355 or CY305),
- XE401 Integrative System Design I
- EE360 Digital Logic w/ Embedded Sys
- Select one of three:
  - CS400 CS Professional Considerations
  - IT400 IT Professional Considerations
  - EE400 EE Professional Considerations
- Select either
  - the Cyber Engineering sequence
  - the Robotics Engineering sequence,
- Select two of the 25 three-course threads and four additional courses as required to ensure the 8TAP has 40 total unique academic courses.

**For more information about EITS . . .**

Contact:

Dr. Leonowich-Graham  
EITS Academic Counselor  
Thayer Hall room 117, x5011  
Peggy.Leonowich-Graham@usma.edu
EITS Major

Class of 2021
Code EIT0

- 24-Course Core Curriculum (which includes CY355 or CY305)
- Complete
  XE401 Integrative System Design I
  EE360 Digital Logic w/ Embedded Sys
- CHOOSE ONE OF THREE:
  CS400 CS Professional Considerations
  IT400 IT Professional Considerations
  EE400 EE Professional Considerations
- CHOOSE ONE OF TWO:
  Either
  EE300 Fundamentals of Digital Logic
  EE350 Basic Electrical Engineering
  EE450 Military Robotic Systems
  Or
  CY300 Programming Fundamentals
  CY350 Network Engineering & Management
  CY450 Cyber Security Engineering
- CHOOSE TWO OF 25 Three-Course Threads found on the next two pages
  - The “other” engineering sequence, the one not chosen above, may be chosen as a thread.
  - Select four additional courses to ensure the 8TAP has 40 total unique academic courses.
<table>
<thead>
<tr>
<th>THREADS</th>
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<tbody>
<tr>
<td>Network Systems</td>
<td>CY350 Network Engr &amp; Management</td>
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<td>CS484 Computer Networks</td>
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<td>Cyber Defense</td>
<td>IT384 Network Systems Programming</td>
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<td>CY450 Cyber Security Engineering</td>
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<td>IT460 Cyber Policy, Strategy &amp; Operations</td>
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<td>IT Programming</td>
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<td>IT394 Distributed Application Dvlp</td>
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<td>Communications</td>
<td>EE477 Digital Communications Systems</td>
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<td>EE480 Optical Fiber Communications</td>
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<td>EE482 Wireless Communications Sys Eng</td>
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<td>Circuits</td>
<td>EE302 Intro to Electrical Engineering</td>
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<td>EE362 Intro to Electronics</td>
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<td>EE462 Electronic Design</td>
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<td>Robotics</td>
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<td>XE472 Dynamic Modeling &amp; Control</td>
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<td>XE475 Mechatronics</td>
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<td>Sensing</td>
<td>MA364 Engineering Mathematics</td>
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<td>EE383 Electromagnetic Fields and Waves</td>
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<td>EV377 Remote Sensing</td>
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<td>EE486 Solid State Electronics</td>
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<td>XE442 Alternative Energy Engineering</td>
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<tr>
<td>Power</td>
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<td>Foundations of Computing</td>
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<td>CS474 Fundamentals of Computer Theory</td>
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| Foundations of Formal Systems | MA372 Introduction to Discrete Math  
CS474 Fundamentals of Computer Theory  
CS478 Programming Languages |
|-----------------------------|--------------------------------------------------------------------------------|
| Homeland Security           | IT460 Cyber Policy, Strategy & Operations  
SS464 Homeland Security  
SS465 Terrorism: New Challenges |
| Computer Engineering        | EE375 Computer Architecture w/ Micro  
EE487 Embedded Systems Development  
EE477 Communications Systems |
| Digital Forensics           | CS380 Computer Organization  
CS481 Operating Systems  
CS483 Digital Forensics |
| Mobile App Development      | CS393 Database Systems  
CS403 Software Testing & Development  
CS394 Distributed Applications Engr |
| GIS Thread                  | EM411 Project Management  
EV398 Geographic Information Systems  
EV498 Adv Geographic Information Systems |
| Remote Sensing Thread       | EM411 Project Management  
EV377 Remote Sensing  
EV477 Advanced Remote Sensing |
| Military Thread             | EM411 Project Management  
DS345 Military Innovation  
DS385 Strategic Decision Making |
| Human Interaction Thread    | PL250 Neurocognitive Foundations of Behavior  
PL392 Cognitive Psychology  
PL394 Anthropometrics & Biomechanics |

**ADDITIONAL ELECTIVES:**

XE402 Integrative System Design II  
XE492 Disruptive Innovations  
EE381 Signals and Systems  
MA365 Adv Math for Engrs/Scientists  
MC311 Thermal-Fluid Systems I
Recommended EE-EITS Focus Areas

**ROBOTICS**

XE401 Integrative System Design I  
EE360 Digital Logic w/ Embedded Systems  
EE400 EE Professional Considerations

Robotics Engineering  
EE300 Fundamentals of Digital Logic  
EE350 Basic Electrical Engineering  
EE450 Military Robotic Systems

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**COMPUTER ENGINEERING**

XE401 Integrative System Design I  
EE360 Digital Logic w/ Embedded Systems  
EE400 EE Professional Considerations

Robotics Engineering  
EE300 Fundamentals of Digital Logic  
EE350 Basic Electrical Engineering  
EE450 Military Robotic Systems

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Recommended CS/IT-EITS Focus Areas

**CYBER DEFENSE**

XE401 Integrative System Design I  
EE360 Digital Logic w/ Embedded Systems  
IT400 IT Professional Considerations  

Cyber Engineering Sequence  
CY300 Programming Fundamentals  
CY350 Network Engineering & Management  
CY450 Cyber Security Engineering

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<td>Homeland Security</td>
<td>IT460 Cyber Policy, Strategy &amp; Operations</td>
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<td>SS465 Terrorism: New Challenges</td>
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**PROGRAMMING**

XE401 Integrative System Design I  
EE360 Digital Logic w/ Embedded Systems  
CS400 CS Professional Considerations  

Cyber Engineering Sequence  
CY300 Programming Fundamentals  
CY350 Network Engineering & Management  
CY450 Cyber Security Engineering

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<td>CS481 Operating Systems</td>
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<td>CS483 Digital Forensics</td>
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</table>
Computer Science Course Descriptions

**CS380  Computer Organization**
3.0 Credit Hours (BS=0.0, ET=3.0, MA=0.0); Prerequisite: CY300 and EE360; Disqualifier: EE375

This course provides an introduction to computer organization and architecture. Emphasis is placed on understanding the implications of computer hardware, the operating system, and compilation system, on the performance and security of written code. Students learn basic C programming and the IA32 assembly language. Topics covered include basic computer organization, reverse engineering, buffer overflow, pipelining, the memory hierarchy, code optimization, and process creation. Students also gain exposure to topics in concurrency and parallel computing through the POSIX API. In addition to theory, students gain practical real-world experience using tools for profiling and debugging, including Valgrind and GDB. By the end of this programming intensive course, students will understand how the fundamental principles of computer organization impact their ability to write efficient code.

**CS384  Data Structures**
3.0 Credits (BS=0.0, ET=3.0, MA=0.0); Prerequisite: CY300

This course is designed to build on the cadet's basic programming knowledge. Major emphasis is placed on object-based design, programming methodology, algorithms and algorithm analysis, data structures, and abstract data types as tools for the analysis, design, and implementation of software modules to meet specified requirements. Cadets will learn and employ several well-known algorithms and data structures. Techniques of searching, sorting, recursion, and hashing will be examined. Data structures such as sets, heaps, linked lists, stacks, queues, and trees will be covered. A block-structured programming language reflecting comprehensive support for good software engineering principles will be the foundation of application-oriented exercises. Cadets will design software solutions by employing problem decomposition and selecting the appropriate algorithms and abstract data types.

**CS385  Design and Analysis of Algorithms**
3.0 Credits (BS=0.0, ET=0.0, MA=0.0); Prerequisites: CS384 and MA372

This course studies analysis of algorithms and the relevance of analysis to the design of efficient computer algorithms. Algorithmic approaches covered include greedy, divide and conquer, and dynamic programming. Topics include sorting, searching, graph algorithms, and disjoint set structure.


**CS393 Database Systems**
3.0 Credit Hours (BS=0.0, ET=3.0, MA=0.0); Prerequisite: CY300 or CY305

This course addresses the analysis, design and implementation of relational database applications. The structured query language (SQL) is covered in depth along with standard problem domain and data modeling techniques. Implementation techniques and considerations are discussed and practiced extensively. Key concepts include analysis and design using a standardized notation such as the unified modeling language (UML), data model to logical schema conversion techniques, normalization, client-server architectures and web-based access to database systems (e.g. XML). Additional advanced topics covered include system security, transaction processing, data recovery techniques, and maintaining state for mobile devices. Design projects focus on implementing the key course concepts using state-of-the-art multi-user database software.

**CS394 Distributed Application Engineering**
3.0 Credit Hours (BS=0.0, ET=0.0, MA=0.0); Co requisite: CS403; Disqualifier: IT394

Building on the foundations of algorithm implementation, data representation, web development, and basic networking, this course focuses on the principles of constructing a modern distributed application. Cadets study the principles, construction, and interaction of user interface, network, web server, and database components to produce an effective distributed application. Cadets will learn new tools and skills working as a team to analyze, design, and implement a system that solves a given problem.

**CS400 Professional Considerations**
3.0 Credit Hour (BS=0.0, ET=0.0, MA=0.0); Corequisite: XE401

This course addresses the professional considerations of Computer Scientists, primarily focusing on non-technical considerations and the development of communication skills. Coursework includes significant emphasis on written work that is based on relevant reading assignments, class discussions, individual research, distinguished guest speakers, and personal reflection. Content will address current, emerging, and relevant topics in the computing profession. Students will develop the ability to recognize professional responsibilities and make informed judgments in computing practice based on legal and ethical principles. They will also learn to identify and discuss local and global impacts of computing solutions on individuals, organizations, and society. Students will demonstrate the ability to communicate effectively in writing in a variety of professional contexts, including an iterative writing experience.

**CS403 Software Testing & Development**
3.0 Credit Hours (BS=0.0, ET=0.0, MA=0.0); Prerequisite: CS384 and CS350

This course builds on the fundamental programming skills from prerequisite courses to explore advanced concepts used in modern object oriented software design to create software that is robust, reusable, and extensible in varying problem domains. Cadets gain confidence in their abilities to model, implement, and test solutions to demanding programming problems.

**CS473 Computer Graphics**
3.0 Credit Hours (BS=0.0, ET=0.0, MA=0.0); Prerequisite: CS384, MA205 and PH201/251

This course concerns computer programs that draw two- and three-dimensional objects on computer output devices and receive input from users through graphical input.
devices. Cadets implement interactive programs through a commonly available graphical application programmers’ interface (API). They learn about graphical hardware devices and the elegant algorithms that underlie the API, including elementary computational geometry, homogeneous transformations, parametric forms, clipping, shading, color, and surface rendering. These concepts are all illustrated with examples of military data visualization including two-dimensional maps and three-dimensional battle simulation and terrain visualization.

CS474 Fundamentals of Computer Theory
3.0 Credit Hours (BS=0.0, ET=0.0, MA=0.0); Co-requisite: CS385
Grounds the cadet in the essentials of theory of computation: formal languages, automata, and computability theory. Frames computation in the context of the Chomsky hierarchy, the polynomial and exponential time hierarchies, and the decidability hierarchy. Explores fundamental limits on computation: what problems can never be solved, what problems can be solved but are intractable, and the class NP of problems that are thought to be intractable, but for which no proof of intractability exists to date.

CS478 Programming Languages
3.0 Credit Hours (BS=0.0, ET=0.0, MA=0.0); Prerequisite: CS384
Concepts of high-level programming language design are explored in detail. Cadets will examine the fundamental issues of programming language design and use this knowledge as a framework for comparison of different high-level languages. Cadets will study concepts from some or all of the imperative, functional, object-oriented, concurrent, and logic programming language paradigms.

CS481 Operating Systems
3.0 Credit Hours (BS=0.0, ET=3.0, MA=0.0); Prerequisite: CS380, CS403
The operating system controls the computer itself and provides a useful interface for users and application programs. The operating system controls all the computer resources: processors, main storage, secondary storage, I/O devices, and files. It determines which programs will be in memory at any given time and the order in which programs will run. The operating system should resolve conflicts between processes, attempt to optimize the performance of the computer, allow the computer to communicate with other computers, and maintain a record of actions performed as it goes about its system tasks. This course investigates the basic design issues encountered in order to produce an operating system that can address the above problems in an efficient manner. These concepts are reinforced by a series of programming projects that include both design and implementation.

CS483 Digital Forensics
3.0 Credit Hours (BS=0.0, ET=3.0, MA=0.0); Prerequisite: CS380 and CS481
Digital Forensics will explore the evidence left behind when malicious activity occurs on an information system. The material in this course will build on your knowledge of Operating Systems, file formats, file system structure, computer architecture, and networking. The course begins with an overview of these areas, then examines how to find and extract digital evidence. During the course, you will be challenged with three projects (subjects to be chosen by you) and in class challenges that will allow you to demonstrate your understanding of the material.

CS484 Computer Networks
3.0 Credit Hours (BS=0.0, ET=3.0, MA=0.0); Prerequisites: CS384 or CY350
This course provides cadets with an introduction to computer networks by breaking the subject into comprehensible parts and building a survey of the state of the art. The goal of the course is to provide each cadet with basic concepts necessary to understand the design and operation of computer networks. Taking a layered approach, it examines the internet with an emphasis on the TCP/IP protocol suite. Additionally, basic principles including multiplexing, switching, flow control, and error control are covered. Internetworking and its application to both local and wide area networks are also investigated. The course offers an understanding of the current status and future directions of technology and how technology relates to standards.

CS485  Special Topics in Computer Science
3.0 Credit Hours (BS=0.0, ET=0.0, MA=0.0); Prerequisite: Permission of the department head

This course provides in-depth study of a special topic in computer science not offered elsewhere in the USMA curriculum. Course content will be based on the special expertise of the visiting professor or a senior computer science faculty member.

CS486  Artificial Intelligence
3.0 Credit Hours (BS=0.0, ET=0.0, MA=0.0); Prerequisite: CS384 and (EE360 or EE300)

The course provides an introduction to the field of Artificial Intelligence (AI). Cadets will develop an appreciation for the domain of AI and an understanding of the current interest and research in the field. The historical ideas and techniques of AI and the resulting set of concepts will be covered. Classic programs will be covered as well as underlying theory. Topics include a history of computer problem solving, heuristic search techniques, knowledge representation, knowledge engineering, predicate calculus, and expert and/or rule based systems. Advanced topics that may be covered include intelligent agents, genetic algorithms, neural networks, fuzzy logic, robotics, vision, natural language processing, learning, and the programming languages of AI. The course will emphasize the practical application of artificial intelligence to industry and business as well as DOD.

CS488  Language-Based Simulation and Modeling
3.0 Credit Hours (BS=0.0, ET=0.0, MA=0.0); Prerequisite: CS403 and CS477

This course applies nearly all previous study of computer science to a specific problem domain essential to the Army – simulation technology. Cadets will learn the fundamental principles of event-based simulation, language based representation of simulation models, and how models are implemented efficiently. Finally, they will learn how simulations are assessed and validated to determine their usefulness. A series of progressive implementation put learned concepts into practice.

CS489  Advanced Individual Study in Computer Science
3.0 Credit Hours (BS=0.0, ET=0.0, MA=0.0); Prerequisite: Permission of the Department Head

The detailed syllabus of this elective will be tailored to the specific project and to qualifications of the cadet. The research or study program will be proposed by the cadet or selected from those proposed by the department. The cadet will formalize a proposal, design a viable research plan, and conduct research under the guidance and supervision of a faculty advisor. The Head of the Department will approve cadet projects. Lessons and labs will be established by consultation between cadet and advisor.

CS489A  Advanced Individual Study in Computer Science
3.0 Credit Hours (BS=0.0, ET=0.0, MA=0.0); Prerequisite: Permission of the Department Head
Same as CS489.

**CS490**  **Computer Science Summer Research**  
3.0 Credit Hours (BS=0.0, ET=0.0, MA=0.0); Prerequisite: Permission of the Department Head

This course is designed to familiarize the cadet with advanced techniques for independent research in computer science. The course will normally require research, development, and implementation of a novel idea or concept. An oral presentation and a written project report will be completed under the supervision of a USMA faculty member who serves as project advisor. The course requires three full weeks of study, completed in conjunction with the Academic Individual Advanced Development Program. Scope, depth, and material covered will meet the requirements of a three-credit course in computer science.

**CS490A**  **Computer Science Summer Research**  
2.0 Credit Hours (BS=0.0, ET=0.0, MA=0.0); Prerequisite: Permission of the Department Head

Same as CS490. The course requires three weeks of study, completed in conjunction with the Academic Individual Advanced Development Program. Scope, depth, and material covered will be equivalent to two credits of course work in computer science.

**CS490B**  **Computer Science Summer Research**  
1.0 Credit Hours (BS=0.0, ET=0.0, MA=0.0); Prerequisite: Permission of the Department Head

Same as CS490. The course requires three weeks of study, completed in conjunction with the Academic Individual Advanced Development Program. Scope, depth, and material covered will be equivalent to one credit of course work in computer science.
XE401 Integrative System Design I
3.5 Credit Hours (BS=0.0, ET=3.5, MA=0.0); Prerequisite: CS403 or EE362 or IT394

This course is a team-based capstone design experience in electrical engineering, computer science and information technology. It provides an integrative experience, presenting each cadet team with a professionally relevant, open-ended situation including professional, ethical, social, security, legal, economic, and political dimensions, where an engineering approach has strong potential to produce benefits. Under the guidance of a faculty advisor for each project team, cadets develop client-focused products, applying the principles of design and implementation to effect an optimal outcome for the circumstances presented to the team by creating a product or service that meets requirements and constraints negotiated with the client.

XE402 Integrative System Design II
3.5 Credit Hours (BS=0.0, ET=3.5, MA=0.0); Prerequisite: First Class standing in an academic major offered by the Department of Electrical Engineering and Computer Science.

This course is a team-based capstone design experience in electrical engineering, computer science and information technology. It provides an integrative experience, presenting each cadet team with a professionally relevant, open-ended situation including professional, ethical, social, security, legal, economic, and political dimensions, where an engineering approach has strong potential to produce benefits. Under the guidance of a faculty advisor for each project team, cadets develop client-focused products, applying the principles of design and implementation to effect an optimal outcome for the circumstances presented to the team by creating a product or service that meets requirements and constraints negotiated with the client.
### EE300  Fundamentals of Digital Computer Logic
3.0 Credit Hours (BS=0.0, ET=3.0, MA=0.0); Prerequisite: None. Disqualifier: EE360.

This is a course for non-electrical engineering majors that covers the analysis, design, simulation, and construction of digital logic circuits and systems. The material in this course provides the necessary tools to design digital hardware circuits such as clocks and security devices, as well as computer hardware. The course begins with the study of binary and hexadecimal number systems, Boolean algebra, and their application to the design of combinational logic circuits. The first half of the course focuses on combinational logic designs. The second half of the course emphasizes sequential logic circuits like memory systems, counters, and shift registers. Laboratory work reinforces the course material by requiring cadets to design and implement basic digital circuits. Throughout the course, the focus is on how the various digital hardware devices are used to perform the internal operations of a computer.

### EE301  Fundamentals of Electrical Engineering
3.5 Credit Hours (BS=0.0, ET=3.5, MA=0.0); Prerequisites: MA205 and PH202 or equivalents. Disqualifiers: EE350, EE302.

This first course in electrical engineering for the non-electrical engineering major provides a solid foundation in basic circuit theory and analysis, power in circuits and electric power systems, and analog electronics. Lectures, laboratory work, classroom demonstrations and discussions showing practical applications emphasize and illustrate the fundamental theories and concepts presented in the course. Engineering design is reflected in laboratory work and minor design problems.

### EE302  Introduction to Electrical Engineering
3.5 Credit Hours (BS=0.0, ET=3.5, MA=0.0); Co-requisites: MA205 and PH202 or equivalents. Disqualifiers: EE350, EE301.

This first course in electrical engineering provides a solid introduction to electric circuit theory. Fundamental principles and network theorems are developed using DC resistive circuits. The complete responses of RC, RL, and RLC circuits are obtained using classical and Laplace-transform techniques to solve the related differential equations. Electrical system transfer functions, time-domain and frequency-domain relationships, stability, frequency response, steady-state ac analysis, and power are also studied. Laboratory work, practical applications, and classroom demonstrations emphasize and illustrate the fundamentals presented in the course.

### EE350  Basic Electrical Engineering
3.0 Credit Hours (BS=0.0, ET=3.0, MA=0.0); Prerequisites: MA104 and PH205 or equivalents. Disqualifiers: EE301, EE302.

This is a course for non-electrical engineering majors that provides a foundation in basic circuit theory and analysis, power in circuits and electric power systems, and analog electronics. Lectures, laboratory work, classroom demonstrations and discussions showing practical applications illustrate the fundamental theories and concepts presented in the course. Engineering science is reflected in laboratory work.
EE360  Digital Logic with Embedded Systems
3.5 Credit Hours (BS=0.0, ET=3.5, MA=0.0); Prerequisite: IT105 or equivalent.
Disqualifier: EE300.

This course covers the analysis, design, simulation, and construction of digital logic circuits and embedded systems. The material in this course provides the necessary tools to design digital hardware circuits based on design techniques such as Karnaugh maps and Finite State Machines. The course begins with the study of binary and hexadecimal number systems, Boolean algebra, and their application to the design of combinational logic circuits. The first half of the course focuses on designs using medium-scale integration (MSI) circuits, and Field Programmable Gate Arrays (FPGAs) to implement combinational logic functions. The second half of the course emphasizes sequential logic circuits. Laboratory work in this half of the course focuses on using very high speed integrated circuit hardware description language (VHDL) to simulate digital systems and to program those systems in hardware. As a final project, cadet teams design, build, and test a digital logic system.

EE362  Introduction to Electronics
3.5 Credit Hours (BS=0.0, ET=3.5, MA=0.0); Prerequisite: EE302/EE301

This course continues cadet education in electrical engineering through the study of basic electronic devices and circuits. It begins with an introduction to semiconductor physics. It then covers the operation of the pn-junction diode and the metal-oxide semiconductor field-effect transistor (MOSFET) in DC, large-signal, and small-signal regimes. The course emphasizes single-stage amplifier design. The course concludes with an introduction to bipolar junction transistors (BJT) and the design, analysis, simulation and testing of a two-stage audio amplifier. Six laboratory exercises and computer-aided design and analysis using modern circuit simulation software supplement the lectures with practical analysis, design, construction, and testing.

EE375  Computer Architecture with Microprocessors
3.0 Credit Hours (BS=0.0, ET=3.0, MA=0.0); Prerequisite: EE360

This course provides an introduction to computer architecture and organization using modern microprocessors. It builds on digital logic theory and embedded systems to develop more complex systems. Emphasis is placed on hands-on understanding of the basics of computer system organization, design, and operation. This includes the use of Register Transfer Language (RTL) to describe the movement of data in the computer and assembly language programming to control the system at a higher level. Additionally, students are introduced to modern engineering design tools through several labs using VHDL (VHSIC Hardware Description Language) to design, simulate, and program a simple processor. Other topics such as microprogram control, RISC architectures, arithmetic processing, input/output, and memory design are introduced.

EE377  Electric Power Engineering
3.0 Credit Hours (BS=0.0, ET=3.0, MA=0.0); Prerequisite: EE301 or EE302

This course provides a study of the fundamentals in two areas of electric power engineering: electromechanical energy conversion and electric power systems. Steady-state behavior in single-phase and balanced three-phase power circuits is emphasized. The concept of per unit analysis is introduced and used throughout the course. Transformers, AC & DC machines, transmission lines, power systems, power electronic devices and renewable energy sources are studied. Laboratory exercises demonstrate the electrical,
mechanical, and physical characteristics of several of the systems studied. The cadet will apply analysis, design, build, and/or test techniques to a power related project.

**EE381 Signals and Systems**  
3.5 Credit Hours (BS=0.0, ET=3.5, MA=0.0); Prerequisite: EE301/EE302; Corequisites: MA206, MA364/MA365.  
This course provides a general study of linear system theory and signal representation techniques as preparation for continued study in communications, control, and electronic systems. Topics include the resolution of continuous time signals and discrete time sequences into their images as frequency functions using Fourier series and transforms. The study includes singularity functions, convolution, convergence properties, and transform properties. The Laplace transform and its inverse provide a method for determining the system function for systems described by differential equations, while the z-transform and its inverse provide a method of analysis for difference equations. The course includes a brief study of communication system principles to include sampling and a study of analog and digital (both finite and infinite impulse response) filter design. In addition to exposing students to the engineering software program MATLAB, laboratory periods provide opportunities for instructor-assisted problem solving.

**EE383 Electromagnetic Fields and Waves**  
3.5 Credit Hours (BS=0.0, ET=3.5, MA=0.0); Prerequisites: PH206/PH256; Corequisite: MA365  
This course is an introduction to electromagnetic fields, which are the foundation of electrical engineering. The course begins with transmission line analysis using circuit models and reviews the mathematical tools (vector algebra and calculus) that are used to describe electromagnetic phenomena. Maxwell’s equations are solved to describe time-harmonic fields under various boundary conditions and at interfaces between dissimilar media. Additional topics include the applications of electromagnetic field theory to transmission lines, antennas and waveguides, and the role of electromagnetics in science, technology and society. Laboratory periods provide opportunities for instructor-assisted problem solving. Additionally, Cadets complete a computer project on finding the numerical solutions to Maxwell’s equations.

**EE400 EE Professional Considerations**  
3.0 Credit Hours (BS=0.0, ET=3.0, MA=0.0); Prerequisite: XE401; Corequisite: XE402  
This course addresses the concerns of professional electrical engineers such as engineering ethics, economics, licensing, manufacturability, sustainability, reliability, safety, and design methodologies. It includes Fundamentals of Engineering Exam preparation and supports the USMA writing program as a Writing in the Major course. The course includes all first class cadets majoring in electrical engineering. Guest lecturers from military, industrial, and academic communities will present some of the material.

**EE450 Military Robotic Systems**  
3.0 Credit Hours (BS=0.0, ET=3.0, MA=0.0); Prerequisites: EE300 and EE350  
This is the capstone course of a three course series of courses designed to introduce non-electrical engineering majors to the fundamentals of electrical engineering. These key concepts are then used to interface various sensors and actuators with a simple microprocessor using experiments that demonstrate some basic applications of microprocessor control of a simple robot. Finally, cadets design a robot to autonomously navigate a simple maze that simulates some practical military robotics applications.
EE462  Electronic Design
3.5 Credit Hours (BS=0.0, ET=3.5, MA=0.0); Prerequisites: EE360 and EE362

This course focuses on the design, simulation, building, and testing of a wide variety of application-oriented circuits based upon the bipolar junction transistor (BJT) and operational amplifier (OPAMP). Applications of the BJT include current sources, active loads, differential amplifiers, and power amplifiers. OPAMP applications include active filters, oscillators, and comparators. Themes common to both the BJT and OPAMP include frequency response and feedback. The classroom material is supplemented with six labs, computer-aided simulations using modern circuit simulation software and a comprehensive design project.

EE477  Digital Communications Systems
3.0 Credit Hours (BS=0.0, ET=3.0, MA=0.0); Prerequisites: EE362, MA206, and EE381

This course examines modern digital communications networks, with particular emphasis on wired networks at the physical layer and the TCP/IP network model above the physical layer. The study of digital communications systems includes waveform sampling, time multiplexing, line coding, digital modulation, and clock recovery techniques. Time and frequency domain analysis are the basis for study of bandwidth considerations, filtering, and channel and communication system modeling. Network topology, traffic representation, and link capacity assignment schemes are analyzed. Cost and time delay optimization for centralized and distributed networks are investigated. Queuing theory is presented with application to buffer modeling, buffer design considerations, and throughput constraints. Basic network design algorithms and flow control schemes are also covered. A communications system project brings these concepts to reality.

EE480  Optical Fiber Communications
3.0 Credit Hours (BS=0.0, ET=3.0, MA=0.0); Prerequisite: EE383/XE383

The study of fiber optics provides insight into the enabling technology of the global Internet and modern day telecommunications. This course develops understanding of the devices and key components that comprise a fiber based optical communications system. Students will develop an understanding of the fundamental properties of silica based fibers and the principal components required to exploit this medium. Topical coverage of the fiber medium includes modal fields, attenuation, and dispersion for both single mode and multimode fibers. Several device types will be studied to include transmitters, receivers, multiplexers, amplifiers, specialty optical fibers, and selected state-of-the-art components. Software tools and measurement equipment will be used to characterize fiber and device properties. The course culminates with students designing, building, and characterizing a fiber optic communications link.

EE482  Wireless Communication Systems Engineering
3.0 Credit Hours (BS=0.0, ET=3.0, MA=0.0); Prerequisite: EE381; Corequisite: EE383.

This course provides an introduction to wireless systems engineering with applications to voice and data networks. Description of well known systems such as cell phones, pagers, and wireless LAN's is presented along with the design considerations for deployment of wireless networks. Wireless radio channel modeling along with common impairments such as multipath fading are introduced and modulation techniques well suited to the wireless applications are presented. Receivers for the various modulation schemes are analyzed in terms of performance and the trade-offs offered by source and channel coding are presented. Multiple access techniques used in wireless applications are introduced and the design of networks described. The course concludes with an analysis and description of deployed systems along with their standards and services provided.
EE483  Photonics Engineering
3.0 Credit Hours (BS=0.0, ET=3.0, MA=0.0); Corequisites: EE362 and either EE383 or PH382.

This course is an introduction to optoelectronic devices and systems. It begins with a review of the fundamental electromagnetic field theory, quantum mechanics, and solid state electronics that characterize optoelectronic device behavior. The course then addresses essential concepts from geometrical and physical (wave) optics. Building upon these fundamental principles, the course addresses the operating principles and design considerations of photoemitters (lasers and LEDs), photodetectors, optical waveguides and signal modulators. Finally, the cadet incorporates the individual devices in the design, building and testing of a fiber optic data link.

EE485  Special Topics in Electrical Engineering
3.0 Credit Hours (BS=0.0, ET=3.0, MA=0.0); Prerequisite: Permission of senior faculty member or visiting professor

This course provides an in-depth study of special topics in electrical engineering not offered elsewhere in the USMA curriculum. Course content will be based on expertise of a senior electrical engineering faculty member or a Visiting Professor.

EE486  Solid State Electronics
3.0 Credit Hours (BS=0.0, ET=3.0, MA=0.0); Prerequisite: EE362

The course covers device physics, operating principles and applications of diodes, bipolar junction transistors, and field effect transistors (FET). It begins with basic properties of crystalline solids, energy diagrams, and thermal physics. P-N junction diodes are the first semiconducting device explored with further study into MOS capacitor and MOSFET based digital circuits. The course normally covers layout of complementary metal oxide semiconductor (CMOS) gates on an integrated circuit chip. Throughout the course, a number of modern electronic devices are introduced including digital memories, charge coupled devices, solar cells, photodiodes, and light emitting diodes. The laboratories are focused on integrated circuit design and layout, device characterization, and simulation using computer aided design (CAD) tools.

One of two photonics labs in the department
EE487 Embedded Systems Development
3.0 Credit Hours (BS=0.0, ET=3.0, MA=0.0); Prerequisite: EE375 or equivalents

This course teaches students how to employ microcontrollers in the design of an embedded system. Cadets are introduced to the C programming language, which is the foundation for programming embedded systems. Students conduct a detailed study of common microcontroller peripheral devices with emphasis on their application to real-time control design. Cadets practice top-down design of both hardware and software components of moderately complex digital systems throughout the semester. Cadets are exposed to addressing, serial and parallel input and output, timing, interrupts, A-to-D and D-to-A conversion. Additionally, real-time operating systems will be introduced through the use of programmable devices and soft-processors. The cadets will learn the basics of implementing an operating system on an embedded device and linking peripherals to the processor via the operating system.

EE489 Advanced Individual Study In Electrical Engineering
3.0 Credit Hours (BS=0.0, ET=0.0, MA=0.0); Prerequisites: EE362 and permission of the Department Head.

Course requirements will be tailored to the needs and qualifications of the individual cadet. The course will normally involve a project requiring research, experimentation, and the submission of a report under the guidance of a departmental advisor. Alternatively, study may take the form of a tutorial course covering material not available in the regular elective course offerings.

EE489A Advanced Individual Study In Electrical Engineering
3.0 Credit Hours (BS=0.0, ET=0.0, MA=0.0); Prerequisites: EE362 and permission of the Department Head.
Same as EE489.

EE490 Electrical Engineering Summer Research
3.0 Credit Hours (BS=0.0, ET=0.0, MA=0.0); Prerequisite: EE362 and permission of the Department Head.

This course is designed to familiarize the cadet with advanced techniques for independent research in electrical engineering. The course will normally require research, development, and experimental implementation of a novel idea or concept. An oral presentation and a written project report will be completed under the supervision of a USMA faculty member who serves as project advisor. The course requires three full weeks of study, completed in conjunction with the Academic Individual Advanced Development Program. Scope, depth, and material covered will meet the requirements of a three-credit course in electrical engineering.

EE490A Electrical Engineering Summer Research
2.0 Credit Hours (BS=0.0, ET=0.0, MA=0.0); Prerequisite: EE362 and Department Head permission.

This course is designed to familiarize the cadet with advanced techniques for independent research in electrical engineering. The course will normally require research, development, and implementation of a novel idea or concept. An oral presentation and a written project report will be completed under the supervision of a usma faculty member who serves as project advisor. The course requires three weeks of study, completed in conjunction with the academic individual advanced development program. Scope, depth, and material covered will be equivalent to two credits of course work in electrical engineering.
EE490B  Electrical Engineering Summer Research  
1.0 Credit Hours (BS=0.0, ET=0.0, MA=0.0); Prerequisite: EE362 and Department Head permission. 

This course is designed to familiarize the cadet with advanced techniques for independent research in electrical engineering. The course will normally require research, development, and experimental implementation of a novel idea or concept. An oral presentation and a written project report will be completed under the supervision of a USMA faculty member who serves as project advisor. The course requires three weeks of study, completed in conjunction with the academic individual advanced development program. Scope, depth, and material covered will be equivalent to one credit of course work in electrical engineering.

XE383 Electromagnetic Waves  
3.0 Credit Hours (BS=3.0, ET=0.0, MA=0.0); Prerequisites: MA364; Disqualifier: EE383  

This course is an introduction to electromagnetic waves, which are the foundation of electrical engineering and applied physics. The course begins with transmission line analysis using circuit models and reviews the mathematical tools (vector algebra and calculus) that are used to describe electromagnetic phenomena. Maxwell's equations are solved to describe time-harmonic fields under various boundary conditions and at interfaces between dissimilar media. Additional topics include the applications of electromagnetic wave theory to transmission lines, antennas and waveguides, as well as the role of electromagnetics in science, technology and society. Laboratory exercises are conducted to experimentally characterize transmission lines and antennas, and to provide instructor-assisted problem solving sessions. Additionally, Cadets complete a computer project on finding the numerical solutions to Maxwell's equations.

XE401 Integrative System Design I  
3.5 Credit Hours (BS=0.0, ET=3.5, MA=0.0); Prerequisite: CS403 or EE362 or IT394  

This course is a team-based capstone design experience in electrical engineering, computer science and information technology. It provides an integrative experience, presenting each cadet team with a professionally relevant, open-ended situation including professional, ethical, social, security, legal, economic, and political dimensions, where an engineering approach has strong potential to produce benefits. Under the guidance of a faculty advisor for each project team, cadets develop client-focused products, applying the principles of design and implementation to effect an optimal outcome for the circumstances presented to the team by creating a product or service that meets requirements and constraints negotiated with the client.

XE402 Integrative System Design II  
3.5 Credit Hours (BS=0.0, ET=3.5, MA=0.0); Prerequisite: First Class standing in an academic major offered by the Department of Electrical Engineering and Computer Science  

This course is a team-based capstone design experience in electrical engineering, computer science and information technology. It provides an integrative experience, presenting each cadet team with a professionally relevant, open-ended situation including professional, ethical, social, security, legal, economic, and political dimensions, where an engineering approach has strong potential to produce benefits. Under the guidance of a
faculty advisor for each project team, cadets develop client-focused products, applying the principles of design and implementation to effect an optimal outcome for the circumstances presented to the team by creating a product or service that meets requirements and constraints negotiated with the client.

**XE442 Alternative Energy Engineering**
3.0 Credit Hours (BS=0.0, ET=3.0, MA=0.0); Prerequisite: EE301 or EE302

This course provides a study of the fundamentals of alternative energy generation, storage, integration and efficient use. Solar power (both solar thermal and photovoltaic), wind power, hydro power, fuel cells and other sources of energy are covered. Focus is placed on energy conversion, modeling alternative energy sources, and integration of these sources into the power grid. The technical, economic, and political challenges associated with these alternative energies is covered in depth.

**XE472 Dynamic Modeling and Control**
3.0 Credit Hours (BS=0.0, ET=3.0, MA=0.0); Prerequisite: EE301 or EE302

This course covers dynamic modeling and control of linear systems. The course provides an overview of classical control theory as the foundation for control applications in electrical, mechanical, and aeronautical systems. Topics here include system modeling using Laplace transform, frequency domain, and state variable methods. Mathematical models are developed for electrical, mechanical, aeronautical, chemical and other physical control systems. Control systems analysis and design techniques are studied within the context of how each system is physically controlled in practice. Laboratory exercises include feedback design and system identification. Computer design exercises include dynamic modeling and control of various engineering systems.

**XE475 Mechatronics**
3.5 Credit Hours (BS=0.0, ET=3.5, MA=0.0); Corequisite: XE472

XE 475 is a comprehensive introductory course in the field of mechatronics. Mechatronics is the crossroads in engineering where mechanical engineering, electrical engineering, computer science, and controls engineering meet to create new and exciting real-world systems. Knowledge of mechanical and electrical components, controls theory, and design are integrated to solve actual physical design applications.
The course begins by developing the background understanding of what disruptive technology is and a historical context about successes and failures of social, cultural, and religious acceptance of technological innovation. To develop this framework, students read several texts underlying the innovator's dilemma, how scientific revolutions are structured, and cultural distinctions found between the sciences and humanities. For each class meeting, students read current scientific and technical literature and come prepared to discuss current events related to technological innovation. Each student researches potential disruptive technologies and prepares a compelling argument of why the specific technologies are disruptive so they can defend their choice and rationale. Cadets also interact with national level innovators throughout academia, industry, and government.
**Information Technology Course Descriptions**

**CY300  Programming Fundamentals**
3.0 Credit Hours (BS=0.0, ET=2.5, MA=0.0); Prerequisite: IT105/155 or validation  
This is the foundational programming course for CS and IT majors, as well as the first course for the cyber engineering sequence. Cadets learn fundamental computing concepts that will allow them to design, build and test small to medium programs using a high-level programming language. Key concepts include applying appropriate aspects of a structured problem solving process, applying a standardized design notation such as the Unified Modeling Language (UML) to communicate their design, and iteratively testing their program.

**CY305  Cyber Foundations**
3.0 Credit Hours (BS=0.0, ET=1.5, MA=0.0); Prerequisite: IT105/155; Disqualifier: IT305, CY355  
This course builds on the foundations of Information Technology (IT) acquired during the first two years of cadet experiences to ensure graduates have the capacity and confidence to employ information technology—hardware, software, and networks—to empower people and organizations to acquire, manage, communicate and defend information, solve problems, and adapt to change. It provides a deeper understanding of sensor and communications technologies; computer processing, storage, and networks; cyberspace operations, planning and management; interaction of IT components; IT-enabled decision making; and the evolving legal and ethical framework surrounding use of IT and operating in the cyber domain. Information Assurance issues are addressed throughout the course. Cadets complete projects throughout the course using specified information systems to meet given requirements.

**CY350  Network Engineering & Management**
3.0 Credit Hours (BS=0.0, ET=3.0, MA=0.0); Prerequisite: IT105/IT155 or CY300/CY305; Corequisite: CY300; Disqualifier: IT350  
This course addresses the analysis, design, building, and testing of modern computer networks. Network implementation techniques and considerations are discussed and practiced extensively. Key concepts include analysis and design using standardized network models, protocols and practices such as the Open Systems Interconnect (OSI) network model, subnetting, static/dynamic routing, switching, and access control. Practical skills implementing network designs are also reinforced through a number of hands-on laboratory exercises using commodity network hardware.

**CY355  Cyber Foundations - Computing**
3.0 Credit Hours (BS=0.5, ET=1.5, MA=0.0); Prerequisites: IT105/155; Disqualifier: IT305, CY305  
Special requirements: CY355 is designed primarily for CS and IT majors and Cyber minors. Enrollment by other cadets with permission of the Department Head.  
Provides a more in-depth study of computing for cadets who have demonstrated ability beyond the level of CY305. The course covers material presented in CY305 at an accelerated pace to provide cadets additional opportunities for application and hands-on experience with cyber principles and concepts such as encryption and machine learning, with less emphasis on networking.

**CY450  Cyber Security Engineering**
3.0 Credit Hours (BS=0.0, ET=3.0, MA=0.0); Prerequisite: CS484 or CY350  
The focus for this course is to design, build and test secure networked computer
systems. Topics covered include operating system and network security, secure network architecture, and offensive and defensive information operations. Practical exercises that give students hands-on experience with current network security tools and techniques complement a series of laboratory exercises that have small groups of cadets secure their own small network. In a culminating exercise, cadets design, build and test defensive measures to protect a production network from intrusions.

**IT105 Introduction to Computing and Information Technology**
3.0 Credit Hours (BS=0.0, ET=0.5, MA=0.0); Prerequisite: None. Disqualifier: IT155.

Designed to meet the needs of the core curriculum, this fundamental course provides an introduction to the principles behind the use, function, and operation of digital computers and information technology. The course presents program design and construction techniques, with consideration given to principles of software engineering. Cadets use a PC-based, integrated program development environment and sophisticated application software. Problem solving using the computer as a tool is a central theme throughout the course as cadets employ a design methodology to solve problems efficiently and logically. Emphasis is placed on learning how to learn and individual discovery. Cadets are introduced to the Internet, and the use of the World Wide Web, other information technology tools, and information security.

**IT155 Advanced Introduction to Computing and Information Technology**
3.0 Credit Hours (BS=0.0, ET=0.5, MA=0.0); Prerequisite: Placement by performance in IT105.

IT155 provides a more advanced study of computers, information technology and programming for cadets who have demonstrated ability beyond the level of the IT105 course. The course studies advanced microcomputer technology and advanced programming techniques. All graded material is identical to that in IT105.

**IT383 User Interface Development**
3.0 Credit Hours (BS=0.0, ET=3.0, MA=0.0); Prerequisite: CY300

This course provides a practical introduction to user interface development and usability engineering of interactive applications. The disciplines of Human-Computer Interaction (HCI) and Software Engineering guide these endeavors, but our focus here is more applied than theoretical. Major emphasis is on the principles and techniques for human-centered design and implementation of graphical user interfaces (GUIs) within a software development lifecycle. Cadets will extend their knowledge of programming in a high-level language by learning how to use an interface builder to create a fully functional GUI. Cadets will learn and practice human-centered problem analysis techniques and usability testing methodologies to ensure that their interfaces are usable. A hypothetico-deductive approach to design is emphasized throughout their development efforts. Fundamentals taught in this course will prepare cadets for more advanced software development, development of physical devices, or a deeper theoretical look at HCI topics.

**IT384 Network System Programming**
3.0 Credit Hours (BS=0.0, ET=3.0, MA=0.0); Prerequisite: CY300

This course applies fundamental programming skills to automate interactions with a computer, a local operating system, or the Internet and so use and manage resources and services. Examples of the resources and services that the programming in this course will address include file systems, web servers, mail servers, database servers, image and audio files, compressed and encrypted files and files used in common office environments (documents, presentations, spreadsheets).
IT392  Network Services Management
3.0 Credit Hours (BS=0.0, ET=3.0, MA=0.0); Prerequisite: CY350
Cadets study network services in terms of design, implementation, maintenance and security of computer servers. The learning process in this course builds on IT382 and assumes a functional network with basic connectivity. This course first covers the design and selection of hardware and software to provide network services based on identified user requirements. Cadets then learn to support the Army Enterprise through the implementation and maintenance of network services, including naming, addressing, resource management, voice over IP, and web services. Security is a pervasive theme throughout the course. While this course focuses on the practical aspect of network services, it also gives cadets a foundational understanding of the theories behind those services.

IT394  Distributed Applications Development
3.0 Credit Hours (BS=0.0, ET=0.0, MA=0.0); Prerequisite: CS393
Building on the foundations of algorithm implementation, data representation, web development, and basic networking, this course focuses on the principles of constructing a modern distributed application. Cadets study the principles, construction, and interaction of user interface, network, web server, and database components to produce an effective distributed application. Cadets will learn new tools and skills working as a team to analyze, design, and implement a system that solves a given problem.

IT400  IT Professional Considerations
3.0 Credit Hours (BS=0.0, ET=3.0, MA=0.0); Prerequisite: XE401; Corequisite: XE402
This course addresses the professional considerations of Information Technologists, primarily focusing on non-technical considerations and the development of communication skills. Coursework includes significant emphasis on written work that is based on relevant reading assignments, class discussions, individual research, distinguished guest speakers, and personal reflection. Content will address current, emerging, and relevant topics in the computing profession. Students will develop the ability to recognize professional responsibilities and make informed judgments in computing practice based on legal and ethical principles. They will also learn to identify and discuss local and global impacts of computing solutions on individuals, organizations, and society. Students will demonstrate the ability to communicate effectively in writing in a variety of professional contexts, including an iterative writing experience.

IT460  Cyber Policy, Strategy & Operations
3.0 Credit Hours (BS=0.0, ET=1.5, MA=0.0); Prerequisite: IT105/IT155 or Validation and SS307/SS357 or Validation
This course addresses the entire spectrum of Information Warfare from the political, legal, and ethical aspects to the technology and techniques of cyber attack. The Political Science and Computer Science faculty jointly teach this course. The course covers how digitization has changed the world and the national security environment of the United States. Students also learn how attack and defense are conducted in cyberspace through classroom discussion and hands-on exercises in the IWAR Laboratory. The course culminates with a group project in which cadets are given a real scenario and possible U.S. objectives and then develop and brief an information operation plan.
IT485  Special Topic in Information Technology
3.0 Credit Hours (BS=0.0, ET=0.0, MA=0.0); Prerequisite: Permission of the Department Head

This course provides in-depth study of a special topic in information technology not offered elsewhere in the USMA curriculum. Course content will be based on the special expertise of the visiting professor or a senior information technology faculty member.

IT491/IT492/IT493  IT Independent Study
1.0 or 2.0 or 3.0 credits (BS=0.0, ET=0.0, MA=0.0); Prerequisite: Permission of the Department Head

This elective will be tailored to the specific project and to qualifications of the cadet. The research, study program, or special project will be proposed by the cadet or selected from those proposed by the department. The cadet will formalize a proposal, develop a viable research plan, and conduct project design under the guidance and supervision of a faculty advisor. The Head of the Department will approve cadet projects and designate 1, 2, or 3 credits. Lessons and labs established through consultation between cadet and advisor.

XE401     Integrative System Design I
3.5 Credit Hours (BS=0.0, ET=3.5, MA=0.0); Prerequisite: CS403 or EE362 or IT394

This course is a team-based capstone design experience in electrical engineering, computer science and information technology. It provides an integrative experience, presenting each cadet team with a professionally relevant, open-ended situation including professional, ethical, social, security, legal, economic, and political dimensions, where an engineering approach has strong potential to produce benefits. Under the guidance of a faculty advisor for each project team, cadets develop client-focused products, applying the principles of design and implementation to effect an optimal outcome for the circumstances presented to the team by creating a product or service that meets requirements and constraints negotiated with the client.

XE402     Integrative System Design II
3.5 Credit Hours (BS=0.0, ET=3.5, MA=0.0); Prerequisite: First Class standing in an academic major offered by the Department of Electrical Engineering and Computer Science.

This course is a team-based capstone design experience in electrical engineering, computer science and information technology. It provides an integrative experience, presenting each cadet team with a professionally relevant, open-ended situation including professional, ethical, social, security, legal, economic, and political dimensions, where an engineering approach has strong potential to produce benefits. Under the guidance of a faculty advisor for each project team, cadets develop client-focused products, applying the principles of design and implementation to effect an optimal outcome for the circumstances presented to the team by creating a product or service that meets requirements and constraints negotiated with the client.
COL Barry L. Shoop  
Professor, U.S. Military Academy  
Head of Department

B.S., Electrical Engineering, The Pennsylvania State University, 1980  
M.S., Electrical Engineering, U.S. Naval Postgraduate School, 1986  
M.A., National Security and Strategic Studies, U.S. Naval War College, 2002  
Ph.D., Electrical Engineering, Stanford University, 1992

COL Shoop is a Signal Corps officer selected as Professor, USMA in 2007. His military assignments include Science Advisor to the Director and Chief Scientist of the Joint IED Defeat Organization, Chief of the Afghanistan Military Academy Implementation Support Team, Senior Electronics Engineer at the U.S. Army Foreign Science and Technology Center, and Electronics Engineer for the Defense Satellite Communication System Earth Terminal. At West Point, he has served as the Electrical Engineering Program Director and the Director of the Photonics Research Center. COL Shoop is a graduate of CGSC and the U.S. Naval War College. His research interests include optical information processing, neural networks, and smart pixel technology. He is the Vice President for Member and Geographic Activities of the Institute of Electrical and Electronics Engineers (IEEE) and a member of the Board of Directors of the IEEE. COL Shoop is a Fellow of the Optical Society of America and the International Society of Optical Engineers, as well as a Senior Member of the IEEE.
COL James J. Raftery, Jr.
Signal Corps / Acquisition Corps
Deputy Department Head

B.S., Electrical Engineering, Washington University in St. Louis, 1988
M.S., Electrical Engineering, University of Missouri - Columbia, 1996
Master of Strategic Studies, United States Army War College, 2011
Ph.D., Electrical Engineering, University of Illinois at Urbana-Champaign, 2005

COL Jim Raftery is a Professor and Deputy Head of the Department. As a Signal Corps officer he commanded the 261st Signal Company in Hanau, Germany. As a 15-year member of the Army Acquisition Corps, he served as Product Manager Information Warfare at Ft. Meade, Maryland. He completed a one year operational experience with the Cyber Nation Mission Force at Ft. Meade in summer 2016. He holds the academic rank of Associate Professor. His research interests include semiconductor lasers, optoelectronics, power and energy, and cyberspace operations.
Dr. Jean R. S. Blair  
Professor of Computer Science  
B.S., Economics, Allegheny College, 1981  
B.S., Computer Science, Allegheny College, 1981  
M.S., Computer Science, University of Pittsburgh, 1984  
Ph.D., Computer Science, University of Pittsburgh, 1986  

Jean R. S. Blair was the Vice Dean at the United States Military Academy (USMA) from 2010-2017. Prior to becoming the Vice Dean, she served as the director of the Computer Science Program for six years and as the director of the Information Systems Engineering program for four years. She spent academic years 2001-2002 and 2009-2010 on sabbatical at the University in Bergen, Norway, where she served as a visiting professor and senior research scientist. She became a Professor of Computer Science at West Point in 2001. Before joining the USMA faculty in 1994, Blair spent eight years on the faculty at the University of Tennessee and also worked at Oak Ridge National Laboratory as a research scientist.

Dr. Katherine Duncan  
Visiting Professor, CERDEC  
B.E., Computer Engineering/Electrical Engineering Minor, Stevens Institute of Technology  
M.E., Electrical Engineering/Optics Certificate Minor, Stevens Institute of Technology  
Ph.D., Applied Physics, New Jersey Institute of Technology Dissertation  
Ph.D., Computer Science, University of Pittsburgh, 1986  

Dr. Kate Duncan received a B.E. in Computer Engineering and M.E. in Electrical Engineering from Stevens Institute of Technology and a Ph.D. in Applied Physics from New Jersey Institute of Technology. She joined CERDEC in 2009, where she has been engaged in the development of novel nanomaterials for the next-generation communication systems. Synthesis, deposition, material, and electrical characterization have been her research focus. This has resulted in her group being among the first to successfully deposit novel nanomaterial via ink-jet printing for RF/power applications. She developed a direct-write laboratory enhancing the Army's in-house prototyping capabilities and plans to introduce the capabilities to the USMA cadets.
COL (Ret) John R. James, Ph.D., P.E.

Associate Professor

B.S., USMA, 1967
M.S., Electrical Engineering, University of California, Berkeley, 1973
Ph.D., Electrical Engineering, Rensselaer Polytechnic Institute, 1986
Registered Professional Engineer, Virginia, 1976

Dr. James' previous military assignments include Platoon Leader/Battery Commander, 5th Bn, 6th Arty, 32nd AADCOM in Germany, District Senior Advisor, Republic of Vietnam, Battery Commander / Chief Division Airspace Management Element, 2/59 ADA, 1st Armored Division, Inst. / Asst. Prof / Assoc. Prof, Dept of EE, USMA, and Director Artificial Intelligence Center, TRADOC. Dr. James' technical interests are in network science, artificial intelligence, software tools for real-time control, and information assurance. He is a former Associate Editor for the IEEE Control Systems Magazine, former member of the Board of Governors of the IEEE Control System Society (CSS), and former Chairman of the CSS Technical Committee for Computer-Aided Control System Design (CACSD). Dr. James has held the Adam Chair in Information Technology since 2000 and was the first Director of the USMA Network Science Center, serving in that capacity from April of 2007 until February of 2009. He served as the Computer Science mentor at the National Military Academy of Afghanistan (NMMA) from February to July of 2009.

Dr. Wenli Huang

Professor of Electrical Engineering

B.S., Physics, Beijing University, China, 1990
Ph.D., Electrical Engineering, University of Connecticut, 1995

Dr. Huang previously worked as an Assistant Professor at Bucknell University for three years, where she taught courses in electronics, circuits theory, optoelectronics, optical fiber communications, and digital design labs. She also served as a Visiting Assistant Professor at Trinity College at Hartford, Connecticut from Fall 1995 to Spring 1997. Her research interests include design, modeling, and fabrication of semiconductor optoelectronic devices with a focus on nanostructure wide-gap semiconductor lasers and modulators.
Mr. Kyle King
National Security Agency (NSA) Fellow
M.S., Information Technology, University of Maryland University College, Europe, 2011
B.S., Computer Science, University of Idaho, 2006
B.S., Applied Mathematics, University of Idaho, 2006
Mr. King attended the University of Idaho as a Scholarship for Service Fellow, where he published papers on building computer laboratories suitable for teaching computer exploitation. Mr. King took a job in Maryland as a protocol analyst. Mr. King spent five years working in England where he studied and taught at the University of Maryland University College, Europe. He received a Master's in Information Technology. Before coming to West Point, Mr. King worked at the Aerospace Data Facility in Aurora, Colorado as a Senior Data Science writing big data analytics and supporting data science initiatives. Mr. King's research interests are in data science, network understanding, and network visualization.

COL Christa Chewar
Signal Corps
Associate Professor
B.S., Computer Science, USMA, 1995
M.B.A., Webster University, 2001
M.S., Computer Science, Virginia Tech, 2003
Ph.D., Computer Science, Virginia Tech, 2005
LTC Chewar was commissioned as a Signal Corps officer, and is now serving as an Academy Professor and Computer Science Program Director. She has served in tactical and strategic signal units, a basic training company, on a DoD-level software acquisition program, and with the Regional Computer Emergency Response Team in Iraq. Her military assignments include platoon leader, logistics officer, plans officer, company commander. She has served overseas in Germany, Hungary, and the Czech Republic during Operation Joint Endeavor, as well as in Iraq during Operation Enduring Freedom. LTC Chewar is a graduate of the Command and General Staff College, the Combined Arms Services Staff School, Signal Officers Advanced Course, and Signal Officers Basic Course. Her academic interests include human-computer interaction, programming, web frameworks, and software testing.
LTC Tanya T. Estes
Aviation
Associate Professor
B.S. Mechanical Engineering (Aerospace), USMA, 1995
M.S. Computer Science, North Carolina State University, 2004
Ph.D. Human-Centered Computing, Georgia Institute of Technology, 2012

LTC Estes is an Aviation Officer, having served as an AH-64A Apache Instructor Pilot and is currently the Information Technology Program Director. Her previous assignments include Battalion Intelligence Officer, 3-229th Aviation Regiment, Ft. Bragg, NC; Company Commander, HHC, 1-14th Aviation Regiment; Assistant Professor, USMA; Operations Officer, 164th Theater Airfield Operations Group, and Operations Officer, Air Traffic Services Command, Ft. Rucker, AL. She was deployed during Operation Joint Endeavor to Bosnia-Herzegovina and Operation Iraqi Freedom as the Airfield Operations Officer for Udairi Army Airfield. LTC Estes is a graduate of the Army’s Command and General Staff College, AH-64A Instructor Pilot Course, Aviation Captain's Career Course, Initial Entry Rotary Wing Course, Aviation Officer Basic Course, Master Fitness Trainer Course, Air Assault School and Airborne School. Her research interests include haptics, spinal cord injury rehabilitation, and human-computer interaction.

Maj (USA, Ret) Peter D. Hanlon
Associate Professor
B.S., Engineering, University of Central Florida, 1985
M.S., Electrical Engineering, Air Force Institute of Technology, 1992
Ph.D., Electrical Engineering, Air Force Institute of Technology, 1996

Dr. Hanlon is a civilian professor in the EE&CS Department, after retiring from the Air Force. He was a Research and Development Engineer specializing in guidance and control systems for aircraft, munitions, and space systems. His previous military assignments include service in Massachusetts, Ohio, and Florida. Just before coming to USMA, he served as Chief of the Weapons Lethality and Vulnerability Branch that was responsible for developing computer models to assess the effectiveness of inventory and conceptual weapons against various high value targets. His academic interests include aircraft and missile failure detection, guidance and tracking algorithms, and software development.
Dr. Suzanne J. Matthews  
Associate Professor  
B.S., Computer Science, Rensselaer Polytechnic Institute, 2006  
M.S., Computer Science, Rensselaer Polytechnic Institute, 2008  
Ph.D., Computer Science, Texas A&M University, 2012  
Dr. Matthews is an assistant professor in the Department of Electrical Engineering & Computer Science. She was a research assistant for three years in the Department of Computer Science & Engineering at Texas A&M University. During the last year of her Ph.D., she was recognized as a Texas A&M University Dissertation Fellow. Prior to her Ph.D. program, Dr. Matthews held teaching and research assistantships at Rensselaer Polytechnic Institute. For academic year 2007-2008, she was recognized as a Rensselaer Master Teaching Fellow for her performance as a teaching assistant. During the summer of 2006, she received a CRA-W Distributed Mentoring Program (DMP) summer research grant. She is a member of the Association of Computing Machinery (ACM), the Institute of Electrical and Electronics Engineers (IEEE), and the honor societies of Upsilon Pi Epsilon (UPE) and Phi Kappa Phi. Her research interests include high performance phylogenetic algorithms, computational biology, experimental algorithms, data analysis, parallel computing, domain-level compression and version control systems.

Dr. Christopher Okasaki  
Associate Professor  
B.S., Mathematics, Harvey Mudd College, 1989  
M.S., Computer Science, Carnegie Mellon University, 1993  
Ph.D., Computer Science, Carnegie Mellon University, 1996  
Dr. Okasaki spent three years at Columbia University as an Assistant Professor of Computer Science, where he taught courses in programming languages and advanced data structures. He has also worked as a visiting researcher at the University of Glasgow, and as a consultant for an Internet startup company, developing a compiler for their agent control language. His primary research interests are programming languages and algorithms. He is especially interested in the combination of these two areas, considering questions of how the details of a programming language affect the implementation and efficiency of algorithms.
COL Lisa A. Shay  
*Signal Corps*  
*Associate Professor*

B.S., Electrical Engineering, USMA, 1989  
M.S., EE, Cambridge University, 1991  
M.A. National Security and Strategic Studies, U.S. Naval War College, 2011  
Ph.D., EE, Rensselaer Polytechnic Institute, 2002

COL Shay is an Academy Professor and director of the Electrical Engineering Program. COL Shay’s previous military assignments include Operations Officer, Division Signal Office, 5th Infantry Division; Platoon Leader and S-1, 142nd Signal Battalion; Brigade Automation Officer, 7th Signal Brigade; and Commander, C Company, 44th Signal Battalion. She deployed to Operation Joint Endeavor with the 7th Signal Brigade in support of the NATO peacekeeping efforts in Bosnia-Herzegovina. She is a graduate of the Signal Officer Basic and Advanced Courses, the Combined Arms & Services Staff School, the Command and General Staff College, the Naval War College and Airborne School. She is a Marshall Scholar. Her academic interests include, distributed sensor networks, robotics, and power systems.

Dr. Aaron St. Leger  
*Associate Professor*

B.S., Electrical Engineering, Drexel University, 2003  
M.S., Electrical Engineering, Drexel University, 2005  
Ph.D., Electrical Engineering, Drexel University, 2008

Dr. St. Leger’s expertise is in electric power systems. His research interests include power system modeling, computation, operation and control. His research has focused on faster than real time computation via analog techniques and power transmission line modeling.
LTC Thomas Babbitt
Infantry
Assistant Professor
Ph.D., Computer Science, Rensselaer Polytechnic Institute, 2016
M.S., Computer Science, Rensselaer Polytechnic Institute, 2009
B.S., Computer Science, United States Military Academy, 1999

LTC Tom Babbitt served in Iraq as a Stryker Rifle Company Commander, in Kuwait as the Future Operations and Plans OIC in the Southwest Asia Cyber Center (SWACC), and an operational deployment to Bosnia-Herzegovina as an Infantry Battalion Support Platoon Leader. As an infantry officer, LTC Babbitt served as a Rifle Platoon Leader, Rifle Company Executive Officer, Support Platoon Leader, Assistant Battalion S3, and Stryker Rifle Company Commander. As an FA53 Information Systems Management Officer, he served on USARAK G6 staff, EECS as an Instructor and Assistant Professor, and in the SWACC. LTC Babbitt is a graduate of the Command and General Staff College, Combined Arms and Staff School, Infantry Captains Career Course, Infantry Officer Basic Course, Airborne and Air Assault School. His academic interests include Network Protocols, Network Security, and Cyber Policy.

Dr. Thomas S. Cook COL (R)
Armor
Assistant Professor
B.S., History, Brockport State University, 1987
M.S., Computer Science, Naval Postgraduate School, 1999 M.S., Industrial Engineering, University of Louisville, 2003
Ph.D., Software Engineering, Naval Postgraduate School, 2008

Dr. Cook was commissioned Armor and later joined the Army Acquisition Corp. His Armor assignments include Platoon Leader and Executive Officer, 3rd Infantry Division; Platoon Leader, VII Corps Canadian Army Trophy Team, 1st Armored Division; Company Commander, 1st Infantry Division; and Chief, Crew Gunnery Doctrine, United States Army Armor Center. In the Acquisition Corp he has served as Assistant Program Manager in the Office of the Secretary of Defense for Command, Control, Communications, and Intelligence; Executive Assistant to the Deputy Director for Integration and Product Leader, Battle Manager, Missile Defense Agency. He deployed with the 1st Armored Division to Saudi Arabia and Kuwait during Operations Desert Shield and Desert Storm. He retired from active duty on 1 October, 2016 after 28 years and 9 months of active federal service. Academic interests include software engineering, real-time systems, information assurance, and computer science education.
Dr. Kevin Grazier  
Assistant Professor

B.S. Computer Science, Purdue University, 1983  
B.S. Physics, Oakland University, 1987  
M.S. Physics, Purdue University, 1990  
B.S. Geology Purdue University, 1992  
M.S. Geophysics and Space Physics, University of California, Los Angeles, 1996  
Ph.D. Geophysics and Space Physics, University of California, Los Angeles, 1997  

Dr. Kevin Grazier earned his Ph.D. at UCLA performing large-scale long-term computational simulations of early Solar System dynamics and evolution--research which he continues today. For fifteen years, Grazier worked at NASA's Jet Propulsion Laboratory on the Cassini/Huygens Mission to Saturn and Titan as both a science planning engineer and Investigation Scientist on the imaging science subsystem instrument. Grazier wrote mission planning and analysis software that won both JPL- and NASA-wide awards.

LTC David Harvie  
Field Artillery  
Assistant Professor

B.S., Computer Science, United States Military Academy, 1996  
M.S., Computer Science, North Carolina State University, 2006  
Ph.D., Computer Science, University of Kansas, 2015  

LTC Harvie is a Field Artillery Officer. His previous military assignments include Company Fire Support Officer (FSO), Battery Fire Direction Officer (FDO), Battery Executive Officer, and Battalion FDO in 3-319th AFAR, 82nd Airborne Division; Battalion Maintenance Officer, Battalion Assistant S3, and Battery Commander in 1-39th FA (MLRS), 3rd Infantry Division; Assistant Professor in the Department of Electrical Engineering and Computer Science, USMA; Iraqi Army Advisor and Brigade FSO in 1st Brigade, 82nd Airborne Division. LTC Harvie has deployed to Kosovo (1999) and twice to Iraq (2003 and 2009). LTC Harvie's military education and training include: Field Artillery Officer Basic Course, Field Artillery Captains Career Course, Combined Arms Staff Services School, Intermediate Level Education, Air Assault School, Airborne School, Ranger School, Jumpmaster School, and Joint Firepower Course.
LTC Kirk Ingold  
*Military Intelligence*  
*Assistant Professor*  

B.S., Electrical Engineering, USMA, 1996  
M.S., Electrical Engineering, Stanford University, 2006  
Ph.D., Electrical Engineering, Stanford University, 2015  

LTC Ingold was commissioned as a Military Intelligence Officer from the United States Military Academy. He became a Functional Area 24 – Telecommunications Officer in 2008. His previous military assignments include Assistant Battalion and Battalion Intelligence Officer, 1st Battalion, 501st Parachute Infantry Regiment (PIR) at Fort Richardson, AK; Assistant Brigade and Brigade Intelligence Officer, 18th Aviation Brigade; Brigade Adjutant, 525th Military Intelligence Brigade and Company Commander, HHD, 525th MI Brigade at Fort Bragg, NC; and Deputy Director, Theater Network Operations and Security Center (TNOSC) – Kuwait at Camp Arifjan, Kuwait. His academic interests include non-linear optics and optical parametric oscillators for frequency comb applications in the mid-infrared, high energy laser applications, and optoelectronic semiconductor devices.

LTC Christopher Korpela  
*Corps of Engineers*  
*Assistant Professor*  

B.S., Electrical Engineering, USMA, 1996  
M.S., Electrical Engineering, University of Colorado, 2006  
Ph.D., Electrical Engineering, Drexel University, 2014  

LTC Korpela is an Academy Professor serving as the Deputy Director of the Electrical Engineering Program. His previous military assignments include: Tank Platoon Leader, Scout Platoon Leader, Troop Executive Officer, Squadron Adjutant, and Squadron Assistant Operations Officer in 1st Squadron, 3rd Armored Cavalry Regiment. During a brief break in service, he worked in the civilian sector as a hardware engineer for National Semiconductor Corporation. He deployed as the Headquarters Commander for the 439th Engineer Battalion (USAR) while attached to 2nd Brigade, 82nd Airborne Division in Baghdad, Iraq, in support of Operation Iraqi Freedom. In 2010, he served as the 2nd Infantry Division Network Engineer at Camp Red Cloud, South Korea. During the summer of 2015, he deployed with the 82nd Airborne Division in support of Operation Inherent Resolve. LTC Korpela is a graduate of the Armor Officer Basic Course, Engineer Captains Career Course, Combined Arms and Services Staff School, Command and General Staff College, Ranger School, Airborne School, and Air Assault School. His research interests include robotics, aerial manipulation, and embedded systems.
CPT(P) Michael Kranch

Cyber Warfare
Assistant Professor

B.S., Computer Science, United States Military Academy, 2008
M.S.E., Computer Science, Princeton University, 2015

CPT Michael Kranch enlisted in the Army in 2001 and was commissioned upon graduation from the United States Military Academy in 2008. His previous assignments include Battalion S6, Detachment Commander, Executive Officer and Platoon Leader. He has deployed twice to Afghanistan (OEF II and OEF XII) as well as to Haiti as part of operation Unified Response. His military education includes the Signal Captain’s Career Course, Signal Officers Basic Course, Airborne School and Explosive Ordnance Disposal School.

LTC Michael Lanham

Cyber Warfare
Assistant Professor

B.S., Computer Engineering, North Carolina State University, 1992
B.S., Computer Science, North Carolina State University, 1992
M.S., Computer Science, University of Florida, 2002
M.S., Computation, Organizations, and Society, Carnegie Mellon University, 2014

LTC Mike Lanham is an Academy Professor and Director of the Cyber Research Center. He became a Functional Area 53 - Information Systems Management office in 2003. He has served in numerous deployments to Macedonia, Bosnia-Herzegovina, Sierra Leone, Liberia, and Kuwait. His military assignments included duty with 2-15IN, 3rd ID(Mech) (Schweinfurt, Germany) and Special Operations Command Europe (Stuttgart, Germany) as well as with the 1st BDE and 1-327IN, 101st Airborne Division (Air Assault) (Fort Campbell, Kentucky). He has also served as faculty at USMA, in various staff positions with USSTRATCOM, Joint Functional Component Command (JFCC)-Integrated Missile Defense (IMD), JFCC-Network Warfare (JFCC-NW), USARCENT, and USASMDC/ARSTRAT/ARFORCYBER. His current research interests revolve around finishing his dissertation in "Rapid Mission Assurance Assessment via Socio-Technical Modeling and Simulation."
MAJ Dominic Larkin
Field Artillery
Assistant Professor
B.S., Computer Science, Troy State University, 2003
M.S., Computer Science, Georgia Institute of Technology, 2008
MAJ Larkin enlisted as an Infantryman and served with 3/75th Ranger Regiment, Ranger Training Brigade, and the 82nd Airborne Division before being selected to attend Officer Candidate School. After receiving his commission as a Field Artillery officer he served in 2-5th Field Artillery, 2-80th Field Artillery which later reflagged to 1-78th Field Artillery and the 101st Airborne Division. He is a graduate of the Army Command and General Staff College, the Field Artillery Advanced Course and Basic Course, Officer Candidate School, Airborne, Jumpmaster, Ranger, and Pathfinder Schools. MAJ Larkin deployed in support of Operation Just Cause in Panama, Operation Iraqi Freedom in Iraq and Operation Enduring Freedom in Afghanistan. His academic interests include computer science education, robotics, and cyber privacy, and cyber warfare.

Dr. Peggy J. Leonowich-Graham
Assistant Professor
B.S., Computer Science, University of New Haven, 1984
M.S., Systems Management, University of Southern California, 1989
D.C.S., Computer Science, Colorado Technical University, 2003
Dr. Leonowich-Graham was CIO of Pikes Peak Integrated Solutions in Colorado Springs. She led the software development of an electronic medical record system for mental health. Dr. Leonowich-Graham has over 14 years experience working for the Department of the Army in Information Technology positions. She was the Chief of the Information Management Department at Keller Army Community Hospital for 8 years. Prior to working for the government, she was a programmer for a pharmaceutical company. Her prior teaching experience was at Connecticut College and Big Bend Community College. She was also a cadet for two years at USMA. Dr. Leonowich-Graham’s research interest is data quality, and she currently serves on the Program Committee for the International Conference on Information Quality at MIT.
LTC Christopher Lowrance  
Military Intelligence  
Assistant Professor  
Ph.D., Computer Engineering, University of Louisville, 2016  
M.S., Electrical Engineering, George Washington University, 2008  
B.S., Electrical Engineering, Virginia Military Institute, 2000  
LTC Lowrance has served in multiple capacities, including operational deployments to Iraq and Kuwait, as a Signal Officer and Network Engineer. His past military duty positions include: Signal Platoon Leader, 32nd Signal Battalion, Darmstadt, Germany; Assistant Brigade S-3 Operations for the 22nd Signal Brigade while deployed in support of Operation Iraqi Freedom I; G-6 Signal Officer for V Corps Artillery, Schweinfurt, Germany; Company Commander of Delta Company, 551st Signal Battalion and Delta Company, 369th Signal Battalion, 15th Signal Brigade, Fort Gordon, Georgia; Chief of Enterprise Operations, Southwest Asia Cyber Center, Camp Arifjan, Kuwait. LTC Lowrance is a graduate of the Signal Officer Basic Course, Signal Captain's Career Course, and the Army Command and General Staff College. His academic interests include ad hoc networks, robotics, machine learning, and fuzzy control.

LTC Alexander S. Mentis  
Signal Corps  
Assistant Professor  
B.S., Computer Science, United States Military Academy, 1997  
M.S., Computer Science, University of Colorado Denver, 2007  
Ph.D., Computer Science, Auburn University, 2014  
LTC Mentis has served previously as a Signal Officer and Telecommunications Systems Engineer in several overseas assignments and operational deployments including S. Korea, Thailand, Egypt, Afghanistan, Iraq, and Bahrain. His past military duty positions include Signal Company Commander in the 1st Brigade Combat Team, 101st Airborne Division (Air Assault); S-6 at the brigade and battalion levels in the 101st Airborne and 25th Infantry Divisions; and Platoon Leader, Executive Officer, and S-4 in a variety of tactical signal units. He is a Distinguished Graduate of the Command and General Staff College and a graduate of the Air Assault School. His academic interests include agent-based modeling and simulation, metaheuristic optimization, artificial intelligence, network science, and computer science education.
MAJ W. Clay Moody
Cyber
Assistant Professor
Ph.D., Computer Science, Clemson University, 2015
M.S., Computer Networking, North Carolina State University, 2009
B.S., Computer Engineering, Clemson University, 1998
MAJ W. Clay Moody is an FA24 Information System Engineer Officer. He has served two tours in Iraq as a Cyber Defense Planner in the Expeditionary Cyber Support Element and as a Stryker Infantry Battalion Signal Officer. MAJ Moody also served as a Cyber Battle Captain and Cyber Capabilitier Engineering with US Cyber Command. Originally branched as a Signal Officer, MAJ Moody served as a Platoon Leader, Company Executive Officer, and Assistant Battalion S3 in the 57th Signal Battalion. He is a graduate of the Signal Officers Basic Course, Signal Captains Career Course, and CGSC ILE. His academic interest include cyber maneuver, parallel and distributed systems, networking, and security.

LTC Robert Ross
Cyber
Assistant Professor
B.S., Computer Science, Rowan University, 1998
M.S., Computer Science, Monmouth University, 2005
Ph.D. Candidate, Information Science, Naval Postgraduate School, pending
LTC Bob Ross is a newly transitioned Cyberwarfare officer. He was commissioned and served as a Field Artillery Officer for 18 years. He has two combat deployments to Iraq and an operational deployment to Kosovo. His military assignments include Brigade Fires and Effects Coordinator, Battalion S3, Stability Transition Team Operations Advisor, Battery Commander, Paladin Platoon Leader, and Company Fire Support Officer. LTC Ross is a graduate of resident CGSC. His academic interests include robotics, Linux systems administration, and computer networks.
CPT Matthew Sherburne
Cyber
Instructor
B.S., Electrical Engineering, United States Military Academy, 2007
M.S., Electrical Engineering, Virginia Tech, 2015
CPT Sherburne was commissioned as a Signal Officer from the United States Military Academy in 2007; in 2012 he was redesignated as a Telecommunications Systems Engineer (FA 24) Officer. He was recently selected for transition to become a Cyber Warfare Officer (17A). He served with the 82nd Airborne Division as a Platoon Leader and Infantry Battalion S-6 in support of Operation Enduring Freedom and Operation New Dawn. He has also served in support of the 82nd's Global Response Force. CPT Sherburne is a graduate of the FA24 Course, Signal Captain’s Career Course as the Distinguished Military Graduate, Signal Officer’s Basic Course, Airborne School, and Air Assault School. He is an Intern Engineer (IE) and Certified Information Systems Security Professional (CISSP). His academic interests include ad-hoc mesh networks, Internet of Things, and moving target defenses.

LTC Christopher Morrell
Signal Corps
Assistant Professor
B.S., Computer Science, United States Military Academy, 2000
M.S., Computer Science, Rensselaer Polytechnic Institute, 2008.
LTC Christopher Morrell is an FA26 Information Systems Engineer Officer. He has served a tour in Afghanistan as the Signal Detachment Commander for 2nd Battalion, 1st Special Forces Group (Airborne) and a tour in Kuwait as the Chief of Enterprise Engineering for 335th Signal Command (Theater) (Provisional). Originally branched as a Signal Officer, LTC Morrell has served as a Battalion S6 for 1-501st Parachute Infantry Regiment and a platoon leader in the 21st Signal Company. He is a graduate of the Signal Officer's Basic Course, Signal Captain's Career Course, Combined Arms Service Staff School, CGSC ILE, and the Jumpmaster School. His academic interests include cyber operations, networking, and computer security.
MAJ Nicholas Barry  
**Signal Corps**  
**Instructor**

B.S., Electrical Engineering, United States Military Academy, 2006

M.S., Engineering Management, University of Missouri Science and Technology, 2011

M.S., Electrical Engineering, Rensselaer Polytechnic Institute, 2015

CPT Nicholas Barry served in the 101st Airborne Division as a platoon leader, and executive officer, and in the 37th Engineer Battalion as the construction officer. He commanded Alpha Company, 40th Engineer battalion, 170th IBCT while deployed to Kunduz Province, Afghanistan and HHC, 40th Engineer Battalion in Germany. He also served as an OC/T for CIED training at First Army Division West. CPT Barry serves as an instructor in the Electrical Engineering and Computer Science Department at the United States Military Academy. CPT Barry's military education includes the Joint Engineer Operations Course, Airborne School, Air Assault School, Pathfinder Course, and the Sapper Leader Course. CPT Barry's research interests include energy efficiency, Military Micro-Grid Design, Analysis, and Development, the Integration of Renewable Energy Systems into Micro-Grids, and Photovoltaic Modeling.

MAJ Brian Boyles  
**Armor**  
**Instructor**

B.S., Computer Science, United States Military Academy, 2006

M.S., Computer Science, The University of Texas at Austin, 2015

CPT Brian Boyles was commissioned as an Armor officer from the United States Military Academy in 2006. He has served as a Tank Platoon Leader, Tank Company Executive Officer, Reconnaissance Troop Commander, Headquarters Troop Commander, as well as on battalion and squadron staff as an Assistant S-3. While serving as a platoon leader, he deployed to central Iraq with the 2nd Brigade, 1st Infantry Division from 2008-2009 in support of Operation Iraqi Freedom. CPT Boyles' military education includes the Basic Officer Leader's Course, Armor Officer Basic Course, Maneuver Captain's Career Course, and Airborne school.
CPT(P) John H. Chamberlin
Cyber
Instructor
B.S. Computer Science, United States Military Academy, 2008
M.S. Computer Science, University of Colorado at Boulder, 2006

CPT John Chamberlin received his commission from the United States Military Academy as an Aviation Officer on May 31st, 2008, and was assigned to Fort Hood, Texas. He has served two combat tours in Afghanistan as both an Assistant Operations Officer for the 1st Armored Division Combat Aviation Brigade and as a Company Commander with the Special Operations Aviation Regiment. Prior to commissioning, CPT Chamberlin served as an infantry soldier with the 82nd Airborne Division, where he participated in the 2003 invasion of Iraq. His military education includes the Basic Officer Leadership Course, the Aviation Officer's Basic Course, Initial Entry Rotary Wing Aviator's Course, the AH-64D Apache Longbow Qualification Course, Survival Evasion Resistance Escape (SERE) Course Level C, Aviation Captain's Career Course, the Unmanned Aviation Systems Commander's Course, Airborne School, and Air Assault School. His academic interests include offensive and defensive cyber warfare, network systems, and Computer Science education.

CPT(P) Jack Cooperman
Signal Corps
Instructor
B.S., Electrical Engineering, United States Military Academy, 2008
M.S.E., Electrical and Computer Engineering, University of Texas – Austin, 2017

CPT Cooperman served as the Assistant Operations Officer and as a Stryker Infantry Platoon Leader prior to deployment to Kandahar province, Afghanistan in June 2010. There, he served as a Stryker Infantry Platoon Leader and Squadron Maintenance Officer in support of Operation Enduring Freedom. CPT Cooperman graduated as the distinguished honor graduate from the Signal Captain's Career Course. After, CPT Cooperman commanded E Company, 53rd Signal Battalion (SATCON) in Fort Buckner, Okinawa, Japan from June 2013 to May 2015. E Company's Wideband SATCOM Operations Center provided payload, transmission, defensive space control for two constellations of military communications satellites in order to enable the operations of US Army, Navy, Air Force, Marine Corps, US Government, and allied partner nations throughout the PACOM AOR.
MAJ Corey Crosser
Signal Corps
Instructor

B.S., Computer Science, University of Houston, 2001
M.S., Computer Science, University of Texas at San Antonio, 2017
In 2007, MAJ Corey Crosser was assigned to the 304th Signal Battalion at Camp Stanley, South Korea. After a one year tour in South Korea, MAJ Crosser was assigned to the 335th Signal Command (Theater) in East Point, GA. During this assignment, he served as an S3 Operations Officer, Command Automations OIC, and Aide de Camp. In 2013, he transferred to Functional Area 26B (Information Systems Engineer), and was assigned to the 214th Fires Brigade at Fort Sill, OK. During this assignment, CPT Crosser served as the Brigade Information Management Officer.

CPT(P) Joshua Groen
Armor
Instructor

B.S., Electrical Engineering, Arizona State University, 2007
M.S., Electrical Engineering, University of Wisconsin, Madison, 2017
CPT Joshua Groen received his commission from the ROTC program at Arizona State University as an Armor Officer on December 15th, 2007 and was assigned to the 2nd Infantry Division at Camp Casey, Korea. There he served as a Platoon Leader and Executive Officer in Blackfoot Troop, 4th Squadron, 7th Cavalry Regiment. His next assignment was with the 25th Infantry Division in Anchorage, Alaska. There he served as a Platoon Leader in Apache Troop and as Executive Officer of Headquarters and Headquarters Troop, 1st Squadron, 40th Cavalry Regiment (ABN), deploying in support of Operation Enduring Freedom to Khost Province, Afghanistan from NOV 2011-JUN 2012. In 2012 CPT Groen voluntarily transferred to Functional Area 26A, Telecommunications Systems Engineer. His first assignment as an FA26A was with 50th Signal Battalion at Ft. Bragg, NC where he served as the Battalion Network Systems Engineer.
CPT Daniel Hawthorne
Instructor
Cyber

B.S., Computer Science, Central State University (Ohio), 2009
M.S., Computer Information Systems, Texas A&M University (Central Texas), 2012
D.C.S., Digital Systems Security, Colorado Technical University, Candidate/ABD

CPT Daniel Hawthorne was assigned to Third Brigade, First Cavalry Division at Fort Hood. He served as an assistant intelligence officer at both the battalion and brigade levels and as the SIGINT platoon leader in the military intelligence company. He spent a year deployed in addition to completing his M.S. while at Fort Hood. After 3.5 years at Fort Hood, he departed for the career and signals intelligence courses at Fort Huachuca. During his career training, he was accepted to the Doctor of Computer Science program at Colorado Technical University. His follow on assignment was to the 743rd Military Intelligence Battalion at Buckley AFB where he supported agency information technology operations and commanded the Headquarters and Operations Company. He proceeded to the Cyber Operations Officer Course at Fort Gordon before reporting to West Point.

LTC Malcolm Haynes
Armor
Instructor

B.S., Computer Science, United States Military Academy, 1998
M.S., Computer Science, University of Texas at Austin, 2000
M.S., Business Supply Chain Management and Logistics, University of Kansas, 2011
M.A., Military Arts and Sciences, Command and General Staff College, 2012

LTC Haynes was assigned as a Tank Platoon Leader in 2d Battalion, 12th Cavalry Reg, 1st Cavalry Division, Fort Hood, TX. Other assignments include TAC Officer, Officer Candidate School, 3rd Battalion, 11th Infantry Reg, Fort Benning TX; Assistant Operations Officer and Company Commander, 2d Battalion, 23d Infantry Reg, 4th Stryker Brigade Combat Team, 2d Infantry Division; Ft Lewis, Washington; Military Transition Team Chief, 1st Battalion, 19th Reg, Iraqi Army, Khalis, Iraq; Financial Management Officer, 43d Sustainment Brigade, Fort Carson, Colorado; Future Operations Maneuver Planner, 3d Corps, Fort Hood, TX; Operations Officer and Executive Officer, 2d Squadron, 3d Stryker Calvary Reg, Fort Hood, TX. He deployed to Iraqi in Afghanistan in support of Operation Enduring Freedom in 2010 and 2013.
**MAJ Jason Hussey**  
**Network Systems Engineer**  
**Instructor**  
B.S. Computer Science, Bowling Green State University, 2005.  
M.S. Telecommunications, University of Colorado at Boulder, 2013.  
MAJ Hussey commissioned into the Army in 2005 as an Infantry officer. He voluntarily transferred to the Network Systems Engineer (26A) functional area in 2009. Presently, he serves as an instructor in the Department of Electrical Engineering and Computer Science at the US Military Academy at West Point. He has served as a Mechanized Infantry Platoon Leader, Mechanized Infantry Company Executive Officer, and Division Chief of a Regional Cyber Center's Network Division. MAJ Hussey is a graduate of the Command and General Staff Course, Telecommunications Systems Engineering Course, Maneuver Captain's Career Course, Mechanized Leader's Course, Ranger School, Airborne School, and Infantry Officer's Basic Course. His professional certifications include the Cisco Certified Network Professional (CCNP) and Certified Information Systems Security Professional (CISSP).

**MAJ Scott Hutchison**  
**Signal Corps**  
**Instructor**  
B.S. Computer Science, Texas A&M University, 2005  
M.S. Cyber Operations, Air Force Institute of Technology, 2015  
CPT Hutchison has served in the US Army since 2005 and has successfully completed two tours to Iraq. He is a Signal Corps officer and is an instructor in the Electrical Engineering and Computer Science department at the US Military Academy at West Point. Recently, he attended the Air Force Institute of Technology and obtained a Masters of Science degree in Cyber Operations. He has also served as as Signal Company Commander and a Battalion S-6. His academic interests include distributed computing, navigation, computer security, and artificial intelligence. CPT Hutchison's military education includes the Infantry Officer Basic Course, the Signal Captain's Career Course, Ranger school, and Airborne schools.
MAJ Alexander Kedrowitsch  
Instructor  
Signal Corps

B.S., Pennsylvania State University, 2004  
Certificate of Graduate Studies, Space Studies, American Military University, 2013  
M.S., Computer Science, Virginia Polytechnic Institute and State University, 2017

MAJ Alexander Kedrowitsch has served in the US Army since 2005 and has completed two combat tours in Iraq and one in Afghanistan. He is a Signal Corps officer and an instructor in the Electrical Engineering and Computer Science department at the US Military Academy at West Point. Recently, MAJ Kedrowitsch attended the Virginia Polytechnic Institute and State University (Virginia Tech) and graduated with a Masters of Science in Computer Science. Previous duties served include two Company Commands, BN S-6, and Division Network Operations Current Operations Officer. His academic interests include deception-based computer security and privacy leakage from wireless signals.

CPT Daniel Konopa  
Instructor  
Infantry

B.S., Electrical Engineering, United States Military Academy, 2008  
M.S., Electrical & Computer Engineering, Purdue University, 2016

CPT Dan Konopa graduated from the United States Military Academy in 2008 and was commissioned as an infantry officer. His first assignment was to 1st Brigade, 2-327 Infantry at Ft. Campbell, KY. In 2010 he deployed in support of Operation Enduring Freedom where he served as an anti-armor platoon leader and rifle company executive officer. In 2012 CPT Konopa was assigned to 1-25 SBCT at Ft. Wainwright, AK where he served for 16 months as a stryker infantry company commander of Alpha Company, 3-21 Infantry. CPT Konopa is a graduate of the US Army Infantry Officer Basic Course, Maneuver Captains Career Course, Air Assault School, Airborne School, and Ranger School.
MAJ Brian Lebiednik  
Cyber  
Instructor  
B.S., United States Military Academy, 2005  
M.S., Interdisciplinary Telecommunications, University of Colorado, Boulder, 2015  
M.S., Computer Science Information Security, Georgia Tech, 2017  
MAJ Brian Lebiednik commissioned as an Infantry Officer from the United States Military Academy in 2005. He served a platoon leader and executive officer in 1st battalion 325th A.I.R including a deployment in support of Operation Iraqi Freedom. Other assignments include S-3 Oklahoma City Recruiting Battalion and Sensor Manager at Army Cyber Command. He is a graduate of Ranger School, Airborne School, Air Assault School, Infantry Officer Basic Course, Telecommunications Systems Engineering Course, Signal Company Commander Course, and Command and General Staff College.

CPT(P) Keith Major  
Instructor  
Cyber  
B.S., Information Technology, United States Military Academy, 2008  
M.S., Engineering Management, Missouri Science and Technology, 2013  
M.S., Computer Science, Stanford University, 2017  
CPT Major commissioned as an Engineer Officer from USMA in 2008. CPT Major has experience as a Platoon Leader, XO, Assistant S3 and a Company Commander in the Engineer Regiment. He has one deployment to Afghanistan where he was a Construction Program Manager for Regional Support Command South. CPT Major transferred to the Cyber Branch in 2015. His military Education includes Engineer Officer Basic Course, Engineer Captain's Career Course, Sapper Leader School and Airborne School.
CPT Austin Minter  
Cyber Instructor  
B.S., United States Military Academy, 2008  
M.S., Information Security Policy and Management, Carnegie Mellon University, 2017  
Captain Austin R. Minter is a Cyber Warfare officer. He graduated from the United States Military Academy and served his next seven years in the signal corps in numerous positions and locations including Fort Gordon, Fort Lewis, Seoul, South Korea; and Basra, Iraq. While in Seoul, South Korea he took command of the signal company responsible for the Army’s telecommunications infrastructure in Seoul. Prior to his assignment to West Point he attended and graduated from Carnegie Mellon University's Heinz College with a M.S. in Information Security Policy and Management.

MAJ Sean O’Neil  
Armor Instructor  
B.S., Electrical Engineering, Tulane University, 2001  
M.S., Electrical Engineering, University of Southern California, 2017  
MAJ Sean Patrick O’Neil enlisted as an Infantryman in 2001 and served with 2/75 Ranger Reg and 3-21 Infantry before commissioning as an Armor Officer in 2007 through Officer Candidates School. His first post-commissioning assignment was with 6-9 Cavalry, 3rd Brigade Combat Team, 1st Cavalry Division at Fort Hood, TX. There, he served as a Platoon Leader, Troop Executive Officer, and Assistant Squadron Operations Officer. After attending the Maneuver Captains Career Course in 2011, he was assigned to the 3rd Brigade Combat Team, 82nd Airborne Division at Fort Bragg, NC. There, he served as the Brigade’s Air Operations Officer and commanded B Troop, 5-73 Cavalry. He has deployed in support of Operation Enduring Freedom, three times in support of Operation Iraqi Freedom, and once in support of Operation Inherent Resolve. His academic interests include robust, multivariable control and nonlinear control.
CPT Roy Ragsdale
Instructor
Cyber
B.S., Computer Science, United States Military Academy, 2009
M.S., Electrical & Computer Engineering, Carnegie Mellon University, 2017
CPT Roy Ragsdale received his commission from the United States Military Academy as a Military Intelligence Officer in 2009. He first served as an Assistant Intelligence Officer for 3d Squadron, 2d Stryker Cavalry Regiment in Vilseck Germany. With the 2d SCR he deployed to Kandahar Afghanistan in support of Operation Enduring Freedom where his Squadron fought under 2nd BDE, 101st Airborne Division. CPT Ragsdale then joined the newly established 782d Military Intelligence Battalion as an Assistant Operations Officer. In June 2013, he assumed Command of the newly activated Alpha Company, 782d Military Intelligence Battalion. His military education includes the Basic Officer Leaders Course (BOLC), Military Intelligence Officer Basic Course (MIOBC), Military Intelligence Officer Captain’s Career Course (MICCC), and Air Assault School.

CPT Joseph Sagisi
Instructor
Signal Corps
B.S., Electrical Engineering, United States Military Academy, 2004
M.S., Computer Engineering, Virginia Tech, 2017
CPT Sagisi is a Network Systems Engineer (FA26A). He has served in multiple capacities, including operational deployments to Iraq and Egypt, as a Signal Officer and Network Engineer. His previous assignments include Signal Platoon Leader and Executive Officer, 324th Network Support Company, 41st Fires Brigade; Battalion Signal Officer, 2-20th Field Artillery Battalion, 41st Fires Brigade, Fort Hood, TX; Network Engineer, 2nd Infantry Division, Camp Red Cloud Korea; Telecommunications Systems Engineer, 1st Theater Sustainment Command, Fort Bragg, NC; Network Engineer, Brigade S6, and Multinational Force Communications Officer for Task Force Sinai, Multinational Force and Observers, El Gora, Egypt. He has also earned certification as a Certified Information Systems Security Professional (CISSP). Military education includes: Basic Officer Leaders Course, Signal Officer Basic Course, Signal Captain's Career Course, Telecommunications Systems Engineer Course, and Sabalanusi Air Assault School.
Mr. Charles Schooler  
**Instructor**

B.S. Business, University of New Hampshire, 1980

M.S. Human Computer Interaction, Georgia Institute of Technology, 2010

Mr. Schooler is a 30-year veteran of the technology industry and remains an avid student of technologies that can be used to solve business-related problems. He has spent his career working with customers in the roles of software engineer, product manager, and technical support engineer. During this time, Mr. Schooler has been involved with projects as diverse as overhauling Canada’s national air traffic control system, accelerating the transaction speed of the foreign exchange trading system for a global bank, upgrading a Fortune 100 company's system management infrastructure, and launching Internet-defining security and firewall products.

CPT Jacob Shaha  
**Signal Corps**  
**Instructor**

B.S., Computer Engineering, University of Utah, 2006

M.S., Applied Statistics, Pennsylvania State University, 2014

M.S., Electrical Engineering, University of Michigan, 2016

CPT Jacob Shaha is a Signal Officer. He has served two combat tours as a Battalion S6 in the 101st Airborne Division, one in Iraq and the other in Afghanistan. CPT Shaha also deployed as a Signal Company Commander with 4th ID. He is a graduate of the Signal Officers Basic Course and Signal Captains Career Course. His academic interests include self-forming radio networks, adaptive antenna architectures, and user interface design.
MAJ Eric Sturzinger
Instructor
Infantry
B.S., Oregon State University, 2006
M.S., University of California, Davis, 2017
MAJ Eric Sturzinger is a Network Systems Engineer (FA26A) who has served in various positions across multiple combatant commands. He initially served as a Platoon Leader in B Co., 52nd Infantry Reg (Anti-Tank), 2nd Stryker Brigade Combat Team, 25th Infantry Division from 2009-2010 at Schofield Barracks, HI. He then deployed to Iraq in support of Operation Iraqi Freedom and Operation New Dawn from 2010-2011, serving as Executive Officer of HHC, 2nd SBCT, 25th ID. Upon graduating the Telecommunication System Engineer Course in 2012, he served as Systems Engineer of 7th Theater Tactical Signal Brigade in Schweinfurt, Germany from 2012-2013 and later as Systems Engineer of 44th Expeditionary Signal Battalion from 2013-2015 in Grafenwoehr, Germany where he regularly supported EUCOM, CENTCOM, and NATO operations, exercises, and training.

MAJ Sang Yim
Systems Automations
Instructor
B.S., Computer Science, Hawaii Pacific University, 2005
M.S., Information Systems Management, Syracuse University, 2015
MAJ Yim has served in the US Army since 2006 and has successfully completed two tours to Afghanistan. He is a Signal Corps officer and is an instructor in the Electrical Engineering and Computer Science department at the US Military Academy at West Point. Recently, he attended Carnegie Mellon University and obtained a Masters of Science degree in Information Technology Security. He has also served as Division Automations Officer and a Battalion S-6. His academic interests include software defined radios, software reverse engineering, and wireless security. MAJ Yim's military education includes the Signal Officer Basic Course, the Signal Captain's Career Course, Information Systems Management Course, Ranger school, and Airborne schools.