SCHOOL OF ENGINEERING AND APPLIED SCIENCE (SEAS)

Explanation of Course Numbers

- Courses in the 1000s are primarily introductory undergraduate courses
- Those in the 2000s to 4000s are upper-level undergraduate courses that also may be taken for graduate credit with permission and additional work assigned
- Those in the 6000s and 8000s are for master's, doctoral, and professional-level students
- The 6000s are open to advanced undergraduate students with approval of the instructor and the dean or advising office

SEAS 0920. Continuing Research - Master's. 0 Credits.
Continuing research.

SEAS 0930. Examination Preparation. 0 Credits.
Provides continuous enrollment for graduate students who are studying for a comprehensive or qualifying examination for the current or following semester but are not enrolled in any courses.

SEAS 0940. Continuing Research - Doctoral. 0 Credits.
Continuing research.

SEAS 1001. Engineering Orientation. 1 Credit.
Introduction to careers in engineering and computer science, University resources, and computer skill development. Emphasizes teamwork skills by applying them to several design projects. (Fall)

SEAS 1099. Variable Topics. 1-36 Credits.

SEAS 1800. Special Topics in Engineering. 1-3 Credits.
Experimental offerings on introductory-level topics and applications related to various disciplines in engineering. Topics vary by semester. May be repeated for credit provided the topic differs. Consult the Schedule of Classes for more details. Open both to GW undergraduate students and to high school students. (Fall, spring, And summer)

SEAS 4800. Special Topics. 1-3 Credits.
Special topics related to new technology and advances, experimental offering on new course topics and applications. Topic to be announced in the schedule of classes. May be repeated for credit provided the topic differs. Recommended background: Undergraduate student. (Fall, spring, And summer)

SEAS 5099. Variable Topics. 1-99 Credits.

SEAS 6014. Introduction to Software and Hardware Security. 3 Credits.
Fundamental principles of designing secure software and hardware systems and the range of attacks that seek to compromise them. Overview of computer architecture and present attacks targeting the hardware, operating system, and application layers. Restricted to SEAS online students only.

SEAS 6100. Innovation and Technology. 3 Credits.
Introduction to design and management of technology; Law of Diffusion of Innovation; identification of fundamental engineering design limits; sustained vs. disruptive engineering and technology, best practices from innovators and visionaries; engineering solutions at the prototype state; benefits of intellectual property protections; transformative technology and assessment from a holistic and global view point; application of the lean start-up approach to real-world challenges including sustainability. Restricted to SEAS students or with the instructor's permission.

SEAS 6200. Launching Technical Ventures. 3 Credits.
Fundamentals of building an organization and the capabilities necessary to launch and nurture early-stage ventures. Lean start-up management practices, with insights and lessons learned to avoid common mistakes associated with launching new businesses. (Spring)

SEAS 6300. Climate Change Policy and Regulation. 3 Credits.
Past and present policies, regulations, and standards at the local, national, and international levels addressing climate change-related challenges facing society; creating and guiding policy that is scientifically sound and resonates with the public; technological, institutional, and political infrastructures of air-land-water interactions; regulation of technologies at the forefront of climate action policy. (Fall, spring, and summer, Every year)

SEAS 6303. Climate Change Capstone. 3 Credits.
Case studies suggested by examination of NASA's Soil Moisture Active Passive (SMAP) satellite mission; the Department of Energy's Innovation Hub (JCAP); federal climate change policy with regard to the Paris Agreement; Intended Nationally Determined Contributions; and other topics. (Fall, spring, and summer, Every year)

SEAS 6401. Data Analytics Foundations and Practicum. 3 Credits.
Introduction to concepts and techniques in data analytics. Basic techniques of data science; algorithms for data mining; basics of statistical modeling and their "Big Data" applications. Concepts, abstractions, and practical techniques. Restricted to students in the MS in data analytics program. (Fall, Every year)

SEAS 6402. Data Analytics Capstone. 3 Credits.
Students apply previously learned data analytics concepts and tools to the solution of practical problems in a year-long project. Planning, design, and construction of the project, including project demonstration, project specifications, report writing, and presentations. Restricted to students in the MS in data analytics program. Prerequisites: CSCI 6362 or EMSE 6765; CSCI 6441 or EMSE 6586; and CSCI 6444 and EMSE 6574. (Spring, Every year)

SEAS 6410. Security Data Visualization. 3 Credits.
Visualization aspect of security data, including study of data analytics and scaling up information security, security metrics and security monitoring techniques focusing on industry applications. Tools for security data visualization and analytics. Restricted to online program students. Prerequisites: EMSE 6767.

SEAS 6411. Management and Compliance in Cloud Computing. 3 Credits.
Maintaining compliance in the cloud. Theory, methodology, and procedures related to cloud computing; proper audit procedures for discovering system vulnerabilities; documenting findings according to the standards of compliance-based auditing. Restricted to SEAS online students. Prerequisites: ECE 6132.

SEAS 6412. Cloud Migration Strategy. 3 Credits.
Migrating traditional IT services to a cloud-based environment. Technical and business considerations necessary to develop an effective cloud migration strategy for an organization. Decision analysis framework to prioritize migration applications. Restricted to SEAS online students. Prerequisites: ECE 6132.

SEAS 6413. Cloud and Big Data Management. 3 Credits.
Topics related to big data and cloud computing, including data centers, virtualization, hardware and software architecture, as well as system-level issues on performance, energy efficiency, reliability, scalability and security. Restricted to SEAS online students. (As arranged, Every year)

SEAS 6414. Python Applications in Data Analytics. 3 Credits.
Python's applications in automating data cleaning, feature engineering, outlier detection, implementing machine learning algorithms, conducting text mining, and performing time series analysis. Restricted to SEAS online students. (As arranged, Every year)

SEAS 6505. Quantitative Foundations in AI. 3 Credits.
Essential math concepts for AI. Probability and statistics fundamentals; linear algebra principles; optimization techniques; algorithm development foundations; analytical skills for AI; technical prowess in AI; and AI algorithm analysis. Restricted to SEAS online students. Recommended background: Completion of at least one undergraduate course in calculus and one undergraduate course in statistics. (As arranged, Every year)

SEAS 6510. Natural Language Processing with Deep Learning. 3 Credits.
Deep learning for NLP; recurrent neural networks (RNNs). Long short-term memory (LSTM); transformers in NLP; text classification and sentiment analysis; sequence-to-sequence modeling; attention mechanisms; word embeddings and representation. Restricted to SEAS online students. Recommended background: At least one undergraduate-level course in calculus and one undergraduate level course in statistics. (As arranged, Every year)

SEAS 6515. Introduction to Computer Vision. 3 Credits.
Fundamentals of computer vision. Image processing techniques; feature extraction methods; object detection and recognition; deep learning in computer vision; convolutional neural networks (CNNs); practical computer vision applications. Restricted to SEAS Online students. Recommended background: Prior completion of at least one undergraduate level course in calculus and one undergraduate level course in statistics. (As arranged, Every year)

SEAS 6520. Autonomous Systems and Robotics. 3 Credits.
Design of autonomous systems; robotics operation; AI integration; sensor technologies; control algorithms. Real-world applications and industry use cases. Restricted to SEAS online students. (As arranged, Every year)

SEAS 6599. Artificial Intelligence Capstone Project. 3 Credits.
Students propose, develop, and present a comprehensive AI project, applying acquired skills and knowledge from the program. Restricted to SEAS online students. Recommended background: Prior completion of at least one undergraduate level course in calculus and one undergraduate level course in statistics. (As arranged, Every year)

SEAS 6800. Special Topics. 1-3 Credits.
Experimental offering of new course topics and applications related to advances in technology. Topic announced in the Schedule of Classes. May be repeated for credit provided the topic differs. (Fall, spring, And summer)

SEAS 8016. Network Security. 3 Credits.
Preventing network attacks and identifying gaps in security policy. Monitoring and controlling unauthorized access, unwanted modification, and misuse of networks. Processes to ensure privacy. Restricted to students in the doctor of engineering program. (As arranged, Every year)

SEAS 8188. Praxis Research for Doctor of Engineering in Cyber Analytics. 1-12 Credits.
Independent applied research in cyber analytics culminating in the final praxis report and final examination for the degree of doctor of engineering in cyber analytics. May be repeated for credit. Restricted to students in the research phase of the DEng in cyber analytics program. (As arranged, Every year)

SEAS 8400. Challenges in Cybersecurity. 3 Credits.
Investigation of the driving architectures, and technologies associated with cybersecurity analytics including secure design, hardening, vulnerability management, and incident response. Introduction to most common attacks and mitigation techniques. Restricted to students in the doctor of engineering program. (As arranged, Every year)

SEAS 8405. Cybersecurity Architectures. 3 Credits.
Concepts, benefits, and challenges of traditional network-centric and emerging cybersecurity architecture models, including DevSecOps, cloud native, and risk adaptive structures, and how they support the business/mission outcomes of an organization. Restricted to students in the doctor of engineering program. (As arranged, Every year)

SEAS 8410. Security Data Visualization and Analysis. 3 Credits.
Visualization and analysis aspect of security data, including study of data analytics and scaling up information security, security metrics and security monitoring techniques focusing on industry applications. Restricted to Students in the DEng in Cybersecurity Analytics Program. (As arranged, Every year)

SEAS 8414. Analytical Tools for Cyber Analytics. 3 Credits.
Survey of analytical tools for analyzing cyber security data with particular attention to the use of data analytics procedures in supporting appropriate cyber security policy decisions. Restricted to students in the doctor of engineering program. Recommended background: bachelor's and master's degrees in engineering, applied science, mathematics, computer science, information technology, or related field from accredited institutions. (As arranged, Every year)

SEAS 8415. Applied Cryptography and Data Protection. 3 Credits.
An overview of modern cryptography and how various cryptographic algorithms and protocols perform with respect to functionality and security as components of complex security solutions. Restricted to students in the doctor of engineering program. Recommended background: bachelor's and master's degrees in engineering, applied science, mathematics, computer science, information technology, or related field from accredited institutions. (As arranged, Every year)

SEAS 8416. Python Tools for Cybersecurity. 3 Credits.
Learning Python's role in cybersecurity. Perform secure coding, network analysis, cryptography, malware analysis, and automation of cybersecurity tasks. Restricted to SEAS online students. (As arranged, Every year)

SEAS 8499. Praxis Development for Cybersecurity Analytics. 3 Credits.
Overview of research methods for the students in the DEng in cybersecurity analytics program. Aims and purposes of the praxis. Development of praxis research strategies, formulation, and defense of a praxis proposal. Restricted to students in the DEng in cybersecurity analytics program. (As arranged, Every year)

SEAS 8500. Fundamentals of AI-Enabled Systems. 3 Credits.
Operational decomposition for AI solutions, engineering data for algorithm development, and deployment strategies. Systems perspective in designing AI systems. Full-lifecycle of creating AI-enabled systems. Ethics and biases in AI systems. Restricted to doctoral students in School of Engineering and Applied Science online programs. (As arranged, Every year)

SEAS 8505. Applied Machine Intelligence and Reinforcement Learning. 3 Credits.
Theory and practice of machine learning; leveraging open-source tools to explore ideas, algorithms and techniques. Topics include model training, support vector machines, deep learning, transformer methods, GANs and reinforcement leaning. Restricted to SEAS online doctoral students. (As arranged, Every year)

SEAS 8510. Analytical Methods for Machine Learning. 3 Credits.
Mathematical tools for building machine learning algorithms: linear algebra, analytical geometry, matrix decompositions, optimization, probability and statistics. Restricted to doctoral students in School of Engineering and Applied Science online programs. (As arranged, Every year)

SEAS 8515. Data Engineering for Artificial Intelligence. 3 Credits.
Developing python scripts to automate data pipelines, data ingestion, data processing, and data warehousing. Machine learning applications with Python including text mining and time series analysis. Restricted to doctoral students in School of Engineering and Applied Science online programs. (As arranged, Every year)

SEAS 8520. Deep Learning and Natural Language Processing. 3 Credits.
Fundamentals of deep learning and natural language processing (NLP). Designing modern deep learning networks using Keras and Tensorflow. NLP topics including sentiment analysis, bag of words, TFIDF, large language models. Restricted to SEAS online doctoral students. (As arranged, Every year)

SEAS 8525. Computer Vision and Generative AI. 3 Credits.
Image processing, object detection, and generative models in generative adversarial networks and neural networks. Tools for creative AI applications in art and design. Ethical considerations and societal impacts of generative AI technology. Restricted to SEAS online doctoral students in School of Engineering and Applied Science online programs. (As arranged, Every year)

SEAS 8550. AI, Security, Privacy, and Ethics. 3 Credits.
Key topics in privacy and ethics of AI, including intrinsic bias and the significance of models. AI and individual responsibility. Differentiating humans from machines in AI. Addressing legal and regulatory issues. Restricted to doctoral students in SEAS online programs. (As arranged, Every year)

SEAS 8588. Praxis Research for Doctor of Engineering in Artificial Intelligence and Machine Learning. 1-12 Credits.
Independent applied research in AI and machine learning culminating in the final praxis report and final examination for the degree of doctor of engineering in AI and machine learning. May be repeated for credit. Prerequisites: Successful completion of all coursework in the doctor of engineering in AI and ML program. (As arranged, Every year)

SEAS 8599. Praxis Development for Artificial Intelligence. 3 Credits.
Overview of research methods. Aims and purpose of the Praxis. Development of Praxis research strategies. Formulation and defense of a Praxis proposal. Restricted to Students in the D.Eng. in the field of artificial intelligence and machine learning program. Recommended background: Students who have completed 18 credits of the coursework in the DEng program. (As arranged, Every year)

SEAS 8998. Advanced Reading and Research. 3 Credits.
Self-paced guided independent research course used to investigate advanced topics in the field. Restricted to students in the doctor of engineering program. (As arranged, Every year)