

# CYBER SYSTEMS

## Department Program Educational Objectives

The UNK Cyber Systems Department seeks to produce well-prepared Cyber Systems graduates who in their careers:

- Apply computing and cyber systems knowledge to real-world problems,
- Keep current in their fields of expertise,
- Communicate effectively with colleagues and other stakeholders,
- Exhibit high standards of responsibility and ethics, and
- Accumulate experiences in collaborating effectively as team members.

## College of Business and Technology Graduation Requirements

- All students graduating with a degree from the College of Business and Technology must take at least 50% of their major area credit hour requirements from the College of Business and Technology at the University of Nebraska at Kearney.
- All students graduating with a degree from the College of Business and Technology must take a minimum of 30 of their last 36 hours of credit needed for their degree from the University of Nebraska at Kearney.
- All students graduating with a degree from the College of Business and Technology are required to complete 3 credit hours of designated Experiential Learning (EL) coursework.

## Cyber System Requirements

All Cyber Systems majors contain the following core course:

- CYBR 101 OR CYBR 102 OR CYBR 103
- The common core course allows students to defer the decision as to which options to select.

All major courses in the CS Comprehensive, Applied CS, Cyber Security Operations, and Information Technology programs require a minimum grade of "C".

1. Computer Science Applied (<http://catalog.unk.edu/undergraduate/departments-programs/cyber-systems/applied-computer-science-bs/>) - Bachelor of Science Degree
2. Computer Science Comprehensive (<http://catalog.unk.edu/undergraduate/departments-programs/cyber-systems/computer-science-comprehensive-bs/>) - Bachelor of Science Degree
3. Cyber Security Operations Comprehensive (<http://catalog.unk.edu/undergraduate/departments-programs/cyber-systems/cyber-security-operations-comprehensive-bs/>) - Bachelor of Science Degree
4. Information Technology and Networking Comprehensive (<http://catalog.unk.edu/undergraduate/departments-programs/cyber-systems/information-networking-telecommunications-comprehensive-bs/>) - Bachelor of Science Degree
5. Business Administration Comprehensive Bachelor of Science Degree- Business Intelligence (<http://catalog.unk.edu/undergraduate/departments-programs/cyber-systems/business-administration-comprehensive-business-intelligence-emphasis-bs/>) Emphasis
6. Information Technology (<http://catalog.unk.edu/undergraduate/departments-programs/cyber-systems/information-technology-bs/>) - Bachelor of Science Degree

- Web Development Emphasis (<http://catalog.unk.edu/undergraduate/departments-programs/cyber-systems/information-technology-bs/#web>)
- System Administration Emphasis (<http://catalog.unk.edu/undergraduate/departments-programs/cyber-systems/information-technology-bs/#system>)
- Data Analytics Emphasis (<http://catalog.unk.edu/undergraduate/departments-programs/cyber-systems/information-technology-bs/#general>)
- General Information Technology Emphasis (<http://catalog.unk.edu/undergraduate/departments-programs/cyber-systems/information-technology-bs/#general>)

Minors in Data Analytics (<http://catalog.unk.edu/undergraduate/departments-programs/cyber-systems/data-analytics-minor/>), Data Science (<http://catalog.unk.edu/undergraduate/departments-programs/cyber-systems/data-science-minor/>), Management Information Systems (<http://catalog.unk.edu/undergraduate/departments-programs/cyber-systems/management-information-systems-minor/>), Software Quality Assurance (<http://catalog.unk.edu/undergraduate/departments-programs/cyber-systems/software-quality-assurance-minor/>), Computer Science (<http://catalog.unk.edu/undergraduate/departments-programs/cyber-systems/computer-science-minor/>), Cybersecurity (<http://catalog.unk.edu/undergraduate/departments-programs/cyber-systems/cybersecurity-minor/>), Information Technology (<http://catalog.unk.edu/undergraduate/departments-programs/cyber-systems/information-technology-minor/>) and Information Technology and Networking (<http://catalog.unk.edu/undergraduate/departments-programs/cyber-systems/information-networking-telecommunications-minor/>).

A supplemental endorsement in Information Technology (<http://catalog.unk.edu/undergraduate/departments-programs/cyber-systems/supplemental-endorsement-information-technology/>) is available.

A certificate in Software Quality Assurance (<http://catalog.unk.edu/undergraduate/departments-programs/cyber-systems/software-quality-assurance-certificate/>).

## Cyber Systems (CYBR)

### CYBR 100 – Programming Logic, Design and Practice 3 credit hours

This course will teach the fundamentals of the software development with emphasis on program logic and design process. This course does not teach a particular programming language but rather emphasizes on problem solving techniques, while this course discusses the basic programming tools available in most programming languages.

**CYBR 101 – Computer Science I: Python for Analytics 3 credit hours**

A gentle first course in problem solving and software development; including logic, data storage and manipulation, data types, assignment statements, basic input/output, selection control, repetition control, subprograms, data file input/output, simple GUIs, one dimensional arrays and rudimentary software engineering techniques. Students complete programming projects using Python. Good programming techniques, program clarity, style, and effective documentation are emphasized through practice in designing, coding, and debugging programs. Intended for students with little or no programming experience. It aims to provide students with an understanding of the role computation can play in analyzing data in business, science, mathematical, and other problems. It is designed to help students, regardless of their major, feel justifiably confident of their ability to write small programs that allow them to accomplish useful goals. The class will use the Python programming language. Three hours lecture, two hours laboratory each week.

Prerequisite: Completion of or concurrent enrollment in MATH 102 or ACT Math score of 22 or above or Math placement into MATH 103 or above.

**CYBR 102 – Computer Science I: C for Security 3 credit hours**

A rigorous first course in problem solving and software development that demonstrates the power of C as a high and low level language. Includes logic, data storage and manipulation, data types, assignment statements, basic input/output, selection control, repetition control, subprograms, parameter passage, scope of identifiers, data file input/output, one dimensional arrays and rudimentary software engineering techniques. Students complete programming projects using C programming. Secure programming techniques, program clarity, style, and effective documentation are emphasized through practice in designing, coding, and debugging programs. Intended for students interested in improving their security or engineering related problem-solving abilities through the use of software development, but no programming experience is necessary. Laboratory assignments develop mastery of the C programming language and a basic understanding of modern secure software development practices. Two hours lecture, two hours laboratory each week.

Prerequisite: Completion of or concurrent enrollment in MATH 102 or ACT Math score of 22 or above or Math placement into MATH 103 or above.

**CYBR 103 – Computer Science I: Java for Software Development 4 credit hours**

An in-depth first course in problem solving and software development; including logic, data storage and manipulation, data types, assignment statements, standard input/output, selection control, repetition control, subprograms, parameter passage, scope of identifiers, data file input/output, simple GUIs, software classes, objects, one dimensional arrays and rudimentary software engineering techniques. Students complete programming projects using Java. Good programming techniques, object-oriented design, program clarity, style, and effective documentation are emphasized through practice in designing, coding, and debugging programs. Intended for students interested in improving their problem-solving abilities through high quality software development, but no programming experience is necessary. Laboratory assignments develop mastery of a high-level programming language, and programming experience in Java, and a basic understanding of modern software development practices. Three hours lecture, two hours laboratory each week.

Prerequisite: Completion of or concurrent enrollment in MATH 102 or ACT Math score of 22 or above or Math placement into MATH 103 or above or completion of MATH 102 or above.

**CYBR 105 – Cyber Systems Freshmen: Professional Practice 2 credit hours**

This course is intended to offer all CYBR Freshmen an opportunity to have an orientation to computing educational programs and pathways to professional practice. It will provide an overall orientation to all incoming freshmen about different degree programs, courses, interconnecting elements of the degree programs that connects across our different areas of comprehensive CS, Applied CS, IT, Networking, SW, CSO, and BI. In discussing Cyber Systems department program offerings, we will orient students about how departmental programs relate to each other i.e., common thread/synergies across, how students will progress from Freshman year to Senior year as well graduating from our Department which specific degree programs leading to different trajectories of career pathways.

**CYBR 106 – Computational and Inferential Thinking 3 credit hours**

A gentle introduction to data science. How can one understand the underlying phenomenon generating data across a wide variety of domains to make predictions, and improve decisions? This course focuses on building skills in inferential and computational thinking, guided by the practical questions we seek to answer. The course teaches critical concepts and skills in computer programming and statistical inference, in conjunction with hands-on analysis of real-world datasets such as economic data, document collections, health care data, geographical data, and social networks. We will also consider social and ethical issues in data analysis such as privacy and design.

**CYBR 108 – Computers in Society 3 credit hours**

This course will consist of an elementary description of the components and principles of digital computers, background and implications of information processing, computer influences on society, and uses of computers. There will be hands-on computer applications that need to be downloaded and installed. Projects are assigned in order to reinforce concepts of problem solving and critical thinking and to illustrate modern applications of computers.

**CYBR 126 – First Year Seminar 1 credit hour**

The First-Year Seminar provides students with a multidisciplinary experience in which they approach an issue or problem from the perspective of three different academic differences. The First-Year Seminar will consist of three 1-credit hour courses taken as co-requisites in a single semester. The successful completion of all three courses satisfies the General Studies LOPER 1 course requirement. Students may take the First-Year Seminar in any discipline, irrespective of their major or minor. Students admitted as readmit students or transfer students who transfer 18 or more hours of General Studies credit to UNK are exempt from taking a LOPER 1 course.

**CYBR 140 – The Internet Explained 3 credit hours**

This course is a great introduction to how the Internet works. Topics include history of telephony to the Internet, networking, wireless, cybersecurity and how these technologies are integrated into the daily lives of individuals. The course assumes no previous knowledge of the field, and can be used by all students seeking a background in fundamental networking and systems concepts. This course provides basic information needed for the student going on to pursue a career in the information technology fields. It also provides a technological foundation for students pursuing any career. With the prevalence of technology, understanding and becoming proficient with the basic terminology and concepts is a must for any student.

**CYBR 150 – Computer Science II: Object Oriented Programming 3 credit hours**

Object-Oriented (OO) programming concepts and principles, including an introduction to some basic data structures. Comprehensive study of an OO programming language with a variety of programming applications. An appropriate state-of-the-art language will be used.

Prerequisite: CYBR 101 or CYBR 102 or CYBR 103

**CYBR 151 – Cyber Programming Environment: Linux 1 credit hour**

All first-year Cyber students should take this course in their first semester. This hands-on lab course focuses on the programming environment tools and systems needed not only in the Cyber field but in most Cyber coursework.

**CYBR 158 – Introduction to Information Security 3 credit hours**

This course provides the basic concepts and principles of information security and the fundamental approaches to secure and protect computers, networks and stored data. It also provides the students with the knowledge and tools to make the computers and related technology equipment-tablets, laptops, smartphones, and wireless networks-secure. The main topics include: security basics; security management and risk assessment; software security; network authentication and secure network applications; mobile security; legal and ethical issues; and privacy. Each topic contains Hands-On projects that cover making computers secure, as well as how to use and configure security hardware and software.

Prerequisite: Completion of or concurrent enrollment in CYBR 101

**CYBR 159 – Data, Ethics, and Society 3 credit hours**

This course offers critical examination of the role of data in society as well as reviews of data practices in research, education, business and government including nonprofits. Through case studies, students will learn to examine ethical questions related to data in society and explore topics include the Internet of things, wearables, learning analytics, and black-box algorithms. In this course, students will be introduced to the ethical, legal and privacy issues surrounding the collection and use of big data as well as offers illustration how lack of awareness can impact societies at large.

**CYBR 180 – Discrete Structures 3 credit hours**

The study of mathematical topics and data structures necessary for a successful program of study in Computer Science. Topics include set theory, Boolean algebra, propositional calculus, logic circuits and finite state machines.

Prerequisite: CYBR 101 or CYBR 102 or CYBR 103.

Corequisite: Completion of or concurrent enrollment in MATH 115 or MATH 123.

**CYBR 182 – Software Productivity Tools 3 credit hours**

This lab course addresses competency and applications of computer skills. Software covered includes: operating systems and environments, word processing, spreadsheet, databases and cloud-based solutions.

**CYBR 188 – GS Portal 3 credit hours**

Students analyze critical issues confronting individuals and society in a global context as they pertain to the discipline in which the Portal course is taught. The Portal is intended to help students succeed in their university education by being mentored in process of thinking critically about important ideas and articulating their own conclusions. Students may take the Portal in any discipline, irrespective of their major or minor. Satisfies the General Studies Portal course requirement. Students may take their Portal course in any discipline. Students who transfer 24 or more hours of General Studies credit to UNK are exempt from taking a portal course.

Prerequisite: First year freshman standing or sophomore standing only.

**CYBR 190 – Data Analytics Mathematical Modeling 3 credit hours**

This course is designed to cover fundamental IT enabled models and their application in data analytics. Some areas to be covered include: systems of equations and inequalities; sequences, inductions, and the binomial theorem; counting and probability; basic statistics; simulation; data tables and what-if analysis; and enhancing decision-making using Solver. Prior completion of LOPER 4 - Mathematics, Statistics and Quantitative Reasoning course is highly recommended.

**CYBR 199 – Current Issues in Cyber Systems 1-3 credit hours**

A course designed to enable students to become knowledgeable of recent trends and issues in computer science and information technology. The course format varies depending on subject matter, instructor and student needs.

Total Credits Allowed: 6.00

**CYBR 223 – Information Technology Infrastructure 3 credit hours**

A study of computer organization as it relates to the selection of computer hardware devices. The goal of the course is to create an understanding of the organization issues that influence system design and purchasing decisions. Topics include memory management, RAID, error detection, compaction, process management, pipelining, and cloud computing.

Prerequisite: CYBR 150

Additional Course Fee Required

**CYBR 235 – Fundamentals of Networking & Systems 3 credit hours**

This course is the first technical networking & systems course. A layered approach is used with discussion centered around physical connectivity, switching, routing, protocol discovery and application layer. Technical network design is introduced with a focus on hands-on labs.

Prerequisite: CYBR 101 or passing score on the CompTIA A+ certification exam.

Additional Course Fee Required

**CYBR 240 – Information Networking Preceptorial 3 credit hours**

Students in this course study the design and operation of telecommunications and information networks actively deployed in the business enterprise. They also explore the duties and responsibilities of the network manager as they maintain the information and telecommunications networks.

Prerequisite: CYBR 235

**CYBR 280H – Special Topics 3 credit hours**

A General Studies course for Honors students. Interdisciplinary course that examines the connections between disciplines.

**CYBR 301 – Computer Organization 3 credit hours**

A study of computer organization and Assembly language. Topics include basic assembly instructions, logic design, addressing modes and instruction sets, data path, memory hierarchy. Students will gain hands on experience in programming in x86 and ARM assembly.

Prerequisite: CYBR 150 and CYBR 180

Additional Course Fee Required

**CYBR 302 – Principles of Management Information Systems 3 credit hours**

The course provides an introduction and overview to the field of management of information systems (MIS). This course is designed to familiarize students with the critical roles of information and information systems in support of organizational operations, decision-making processes, quality management, and strategic activities. It also covers management of information systems functions and professionals, as well as relevant global, ethical, societal and legal/regulatory issues. Focus is placed on the impact of rapidly changing technologies, such as the Internet, on organizations leading to new paradigms, like e-commerce and business-to-business applications, and the subsequent reengineering of organizations.

**CYBR 304 – Foundation of Computational Mathematics 3 credit hours**

This course will offer students with introductory orientation to contemporary numerical algorithms, scientific computing and different types of optimization models using real world data driven approach. Active learning will be used in which students will learn to solve computational problems and data visualization techniques. We will begin the course with the history and background of algorithmic approaches to evolutionary computation. Students will be oriented to a set of classical biological and life sciences algorithmic as they related to computational problem solving and analysis. Lectures and assessments will cover major topics and hands on data driven approaches in computational mathematics with a range of numerical algorithms to data modelling, bio-inspired algorithms and swarm intelligence.

Prerequisite: Completion of or concurrent enrollment in MATH 115.

**CYBR 305 – Healthcare Informatics & Technology 3 credit hours**

With a focus on networking, this course will examine the healthcare field and its integration with the electronic and digital realm. Topics like security protocols, patient privacy, and telemedicine will be studied and then applied to real-world technical scenarios through discussion and hands-on projects.

**CYBR 306 – Introduction to Predictive Modeling 3 credit hours**

Data Analytics uses real-time processing of sentiment, buzz, social networks, context and/or other data of interest to improve performance and impact. This course will expand on basic statistical and analytical tools for developing an understanding of advanced methods for data analysis and modeling to support decision making. Students learn how to develop, explore, model, and answer questions using analytical processes to examine datasets, including "big data". Predictive modeling is introduced to show how to use these concepts, and others, to support more informed decisions and to drive business strategy using current and rapidly changing technologies. The course covers the fundamentals of databases, data analysis, data visualization, inferential statistics, and reporting; all supporting predictive and prescriptive analytics. Two hours lecture, two hours lab per week. Prior completion of LOPER 4 - Mathematics, Statistics and Quantitative Reasoning course is highly recommended.

**CYBR 307 – Introduction to Automata, Formal Languages and Computability 3 credit hours**

A study of the fundamental concepts of language definition and translation, including the Chomsky hierarchy, finite automata, computability and Turing machines, grammars, parsing, and lexical analysis.

Prerequisite: CYBR 180 or MATH 115 and CYBR 330

**CYBR 325 – Database Systems 3 credit hours**

This course covers the design and implementation of database management systems. Topics include data models (relational, document, key/value); query languages (relational algebra, SQL, stored procedures); storage management; implementation techniques of database management systems (index structures, concurrency control, recovery, and query processing); parallel architectures (multi-core, distributed); management of semi structured and complex data; NewSQL, noSQL systems, and other tools for large-scale data analysis.

Prerequisite: CYBR 101

**CYBR 330 – Algorithms and Data Structures 3 credit hours**

A comprehensive study of data structures and algorithms with programming applications. Topics include: a review of basic data structures (linked-lists, stacks, queues) and abstract data types, advanced data structures and their associated algorithms, heaps, priority queues, hash tables, trees, binary search trees, and graphs, advanced sorting and searching algorithms, divide and conquer algorithms, greedy algorithms, and dynamic programming. Problem analysis is emphasized. Computability, asymptotic notation and NP-completeness are introduced. An object-oriented programming language will be used.

Prerequisite: MATH 115 and CYBR 150 and CYBR 180

Additional Course Fee Required

**CYBR 337 – Graph Theory 3 credit hours**

Graph theory is an important foundational computer science course which will offer students with theoretical and modelling concepts related to graph theoretic concepts as they related to construction and analysis of big data. We will introduce classical problems in graph theory starting with Königsberg bridge problem, Erdos graph, Erdos-Rényi model and how they relate to practical problem solving using Erdos collaboration graph. Conceptual and modelling challenges in constructing and interpreting graphs will be discussed. Other concepts such as the Marriage Problem, the Assignment Problem, the Network Flow Problem, and the Traveling Salesman Problem will be discussed. Students in this course will be expected to develop understanding of the graph theoretic modeling and analysis and its application within the context of large-scale network-based simulations for exploring big data visualization, cybersecurity threats data, and spatial and temporal data analysis.

Prerequisite: MATH 115 and CYBR 150 and CYBR 180.

**CYBR 345 – Intricacies of Advanced Networks & Systems 3 credit hours**

This second technical networking & systems course looks in-depth at routing and switching protocols. Students will utilize the hands-on lab environment to examine the routing and switching protocols as well as a variety of other topics like enterprise wireless, network monitoring and high availability. Students with a strong command of the concepts presented will be prepared to sit for specific industry certification exams. Two hours lecture, two hours lab per week.

Prerequisite: CYBR 235

Additional Course Fee Required

**CYBR 348 – Systems Administration I 3 credit hours**

This course provides a beginning overview for maintaining reliable systems in multi-user and device-diverse environments. This course focuses on managing infrastructure servers and their services; disaster recovery techniques; and the interaction between systems administration and the entire IT environment.

Prerequisite: CYBR 235



**CYBR 381 – Systems Analysis and Design I 3 credit hours**

Explore the systems life cycle. Learn tools and strategies for system and information analysis. Includes need identification, feasibility studies, requirements assessment, project management and group dynamics.

Prerequisite: CYBR 101 or CYBR 102 or CYBR 103 or CYBR 235

**CYBR 388 – GS Capstone 3 credit hours**

An interdisciplinary experience where students apply the knowledge, cognitive abilities, and communication skills they have gained from General Studies in designing and completing an original project or paper. Students employ methods and interpretive means of two or more disciplines to integrate knowledge and synthesize their results. Satisfies the General Studies capstone course requirement. Students may take their Capstone course

Prerequisite: Junior or Senior level standing or within 6 hours of completing general studies requirements.

**CYBR 399 – Independent Study in Cyber Systems 1-6 credit hours**

This course provides the opportunity for students to conduct independent study on any cyber systems topic not covered by other regularly offered courses. The topic will be selected in consultation with and the study will be supervised by a cyber systems faculty member. The project should be focused on an area of interest to the student. Upon completion of the project a formal presentation will be given by the student to all interested parties. A written contract specifying the topic and requirements must be submitted and approved by the department before registering for the course.

Department Consent Required

Total Credits Allowed: 6.00

Prerequisite: Junior or senior standing and permission of department chair

**CYBR 401 – Operating Systems 3 credit hours**

Introduction to modern operating system concepts and design. Topics will include: Processes, semaphores, monitors, concurrent process management, virtual memory, file systems, scheduling algorithms, deadlocks and protection, I/O control interrupt handling, client-server model, remote procedure call and threads.

Prerequisite: CYBR 330

**CYBR 404 – Software Engineering 3 credit hours**

This course will include the fundamental principles of software engineering. Software specification techniques: rigorous methods and formal methods. Software design: object-oriented design, function-oriented design, real-time systems design, user interface design. Programming techniques and tools. Software reuse and software metrics. Design patterns and component based software development. Computer-aided software engineering. Software validation and verification. The object oriented language Java will be used as the major programming language for this course.

Prerequisite: CYBR 330

Additional Course Fee Required

**CYBR 405 – Interactive Web Application Development 3 credit hours**

This course covers the wide range of state-of-the-art computer technologies for interactive web application development. Students will learn how to write both static web pages and dynamic web pages. This is a programming-intensive course.

Prerequisite: CYBR 101 or CYBR 102 or CYBR 103 or CYBR 434

**CYBR 406 – Enterprise Application Development 3 credit hours**

This course is designed to assist students in learning the skills necessary to design and build enterprise-level applications. Skills and knowledge gained in this course can be applied in the development of interactive web sites, electronic commerce systems, cloud-based applications and other service-based architectures. Security of internet based information systems will also be covered.

Prerequisite: CYBR 150

**CYBR 408 – Principles of Programming Languages 3 credit hours**

Study of the essential concepts of programming languages including, language design concepts and semantics; examination of language features and major programming paradigms with a focus on functional programming; and design and implementation of language interpreters.

Prerequisite: CYBR 407 and CYBR 301 or CYBR 330

**CYBR 410 – Big Data Visualization 3 credit hours**

This course provides an understanding of data analytics advanced techniques to extract knowledge about organizational activities from big data sources and to present their findings through writing and visualization. Managing, governing, extracting, merging, and preparing large data sets for analysis using real data are covered extensively.

Prerequisite: CYBR 306

**CYBR 412 – Fundamentals and Security of Mobile Networks 3 credit hours**

This course is the first Mobile communication course. Topics covered include network architectures of different mobile technologies, radio communication, signaling protocols, mobile authentication, validation and key agreement.

Prerequisite: CYBR 101 and CYBR 158 and CYBR 235 or CYBR 140

**CYBR 418 – E-Commerce Information Systems 3 credit hours**

This course will present, develop, explore, and illustrate the nature and use of E-commerce Information System development methodologies in an inter-organizational setting, and discuss responsibilities at all life cycle stages. It is a comprehensive study of electronic commerce, with in-depth coverage of e-commerce technologies and e-commerce business models including business-to-consumer models, business-to-business models, consumer-to-consumer models, peer-to-peer models, and mobile commerce. It introduces global e-commerce, security and encryption issues, and ethical, social and political issues related to e-commerce. E-commerce interface designs for electronic storefronts, malls, catalogs, shopping carts, search engines, auctions, e-payment systems, e-learning, and e-government will be covered. Consumer interactions with payment processing mechanisms and relationships to information technology development and support will be studied.

Prerequisite: CYBR 101 or CYBR 102 or CYBR 103 or CYBR 302 or CYBR 434 and Sophomore standing or above

**CYBR 421 – Business Process Redesign and ERP Systems 3 credit hours**

This course provides an understanding of business processes and usage of various methods and computerized tools to redesign these processes. The redesigned processes will assist organizations in providing cost-effective quality products and services to consumers. Further, this course provides an overview of the Enterprise Resource Planning (ERP) Systems which are widely used by corporations for automation of their processes.

Prerequisite: Junior standing

**CYBR 422 – Computer Graphics 3 credit hours**

Introduction to the techniques for generating lines, curves, surfaces, 2D and 3D graphics, modeling and rendering. Topics include display hardware, transformations, interactive technologies, geometric modeling, 2D and 3D display algorithms, graphics software system architecture, visible-surface algorithms, illumination and shading.

**CYBR 425 – Applied Database Management Systems 3 credit hours**

This is an interdisciplinary course designed for non-technical majors. This course is a comprehensive study of database concepts. The relational database along with proper database design will be emphasized. However, all types of databases will be studied. Additional concepts covered will be the normalization process and forms; structured query language (SQL); and various database management systems.

**CYBR 430 – Defending & Protecting Cyber Systems 3 credit hours**

This course will cover all the concepts necessary defense-in-depth of an enterprise network and system (blue team). A case study will be incorporated to achieve a strong understanding of the design, implementation and overall security of a large network. Hands-on labs will be conducted using a variety of networking and systems equipment. Students with a strong command of the concepts presented will be prepared to sit for specific industry certification exams. This course presents a comprehensive study of needs and characteristics of a global internetwork and the issues encountered on such a network. Topics studied will include security, servers, user identity, and wireless. Hands-on labs will be conducted using a variety of network equipment.

Prerequisite: CYBR 101 and CYBR 235

Additional Course Fee Required

**CYBR 434 – Information Technology Teaching Methods 3 credit hours**

This course will include information technology curriculum development and instruction, with a focus on applying programming concepts to K-12 education. Intended only for students in education fields.

Prerequisite: Junior or senior standing

**CYBR 435 – Reverse Engineering: Thinking like an Adversary 3 credit hours**

This course will cover all the concepts necessary to think like an adversary by breaking down malicious software using a reverse engineering approach. Different approaches and techniques will be used for comprehension and evaluation of sandboxing, obfuscation, with both static and dynamic analysis of software. In this manner, the students will learn how to better defend applications, systems and networks by comprehensively reverse engineering the offensive playbook.

Prerequisite: CYBR 101 and CYBR 235

Additional Course Fee Required

**CYBR 440 – Systems Audit 3 credit hours**

This course provides an understanding of many types of audit needs, such as organizational IT audits (management control over IT), technical IT audits (infrastructure, data centers, data communication), application IT audit (business, financial, operational), development/implementation IT audits (specification/requirements, design, development, and post development phases), and compliance IT audits involving national and international standards.

Prerequisite: Senior standing

**CYBR 441 – Artificial Intelligence 3 credit hours**

An in-depth study of intelligent agents, tree and search methods, constraint satisfaction problems, optimization problems, game-playing, logical analysis, and uncertainty modeling. Machine learning techniques are introduced. Applications to robotics, psychology, business intelligence and data mining are also discussed.

Prerequisite: CYBR 150

Additional Course Fee Required

**CYBR 442 – Cryptography 3 credit hours**

This course is an introduction to the fundamental theories and applications of cryptography techniques used in computer security and secure software development. Topics will include ciphers, cryptographic hashing, message integrity, authentication, key management, public-key infrastructure, encryption (secret-key and public-key), digital signatures, network security protocols, digital rights management, zero-knowledge protocols and quantum cryptography. The course is intended for advanced undergraduates with experience in theory of computation concepts, basic proof techniques, number theory and advanced programming.

Prerequisite: CYBR 307 and CYBR 330

**CYBR 444 – Software Reverse Engineering 3 credit hours**

This course provides students with the opportunity to standard techniques used to Reverse Engineer software systems. These techniques will allow students to understand the process involved in program compilation, such that they can deduce the functionality of a program and recreate a programs source code without the original source.

Prerequisite: CYBR 301

**CYBR 448 – System Administration II 3 credit hours**

This course provides an advanced overview for maintaining reliable systems in multi-user and device-diverse environments. This course focuses on securing and hardening systems and servers; advanced authentication techniques; and advanced policy discussions on how to manage a complex systems environment.

Prerequisite: CYBR 348

**CYBR 450 – Software Quality Assurance 3 credit hours**

This course will provide students with the knowledge and skills to define and implement software quality management. We will explore ways to develop a quantifiably effective software quality management function and measure the success of quality assurance (QA) plans, teams and tools. The course will explore the latest industry standards, tools and approaches, and will explore the challenges of managing the QA function for modern software application environments.

Prerequisite: CYBR 381

**CYBR 458 – Computer Security 3 credit hours**

This course provides an overview of security issues associated with the development and deployment of information systems. Topics include authentication, encryption, firewalls, security standards and protocols, attack prevention, detection, and recovery.

Prerequisite: CYBR 101 or CYBR 102 or CYBR 103 or CYBR 235 or CYBR 448

**CYBR 460 – Virtualization Essentials 3 credit hours**

Examining the new world of virtualization, this technical essentials course looks at concepts such as cloud computing, virtualized hardware, networks, storage and data center concepts. Although the focus will be virtualization at the data center, these fundamentals are easily transferrable and highly needed in small to large enterprise. Topics such as hypervisors, software-defined networking and cloud architectures are discussed in-depth.

Additional Course Fee Required

**CYBR 468 – Advanced Security: Playing Both Sides 3 credit hours**

This course provides an introduction to advanced security topics associated with the development and deployment of information systems. Topics include WiFi and cellular networks, fuzzing, software vulnerabilities, and secure development practices .

Prerequisite: CYBR 435

**CYBR 475 – Internship in Cyber Systems 1-6 credit hours**

An internship is a professional or technical position in a professional environment that provides a student with sufficient practical work experience for a limited period of time, allows for career decision-making, and provides the employer valuable skills to accelerate business objectives. Internships are mutually beneficial for all involved. The student gains the opportunity to apply classroom learning to a workplace environment; the employer has the chance to work with students eager to learn and apply skills; and the university benefits from connections with business and industry, which provide potential for program development and enhancement. The learning experience is organized and supervised by the academic department, the CBT Career Center, and personnel of selected industries. All internships must be approved by the CBT Career Center and students must have a major or minor in the Cyber Systems department. The course will be evaluated on a credit/no credit basis.

Department Consent Required

Total Credits Allowed: 6.00

**CYBR 478 – Cybersecurity for Managers & Leaders 3 credit hours**

This course has been implemented for organizational leaders and managers, who are seeking knowledge that will help develop, or improve upon, a cybersecurity framework or program for their own organization (or future organization). Cybersecurity is an enterprise-level management challenge that has far-reaching impacts on all organizational levels. This course will cover cybersecurity frameworks and vocabulary to help build the cyber leadership and management skills needed to better prepare organizations for current and future cyber threats.

**CYBR 479 – Cyber Risk and Threat Modeling 3 credit hours**

This course covers the scientific concepts cyber risk and threat modeling. In contrast to popular cybersecurity management courses covering best practices, this course equips the students with the scientific mindset and tools needed to understand dynamic networks and security that exceeds the limitations of static networks. This course opens a window into the future of strategic cybersecurity.

Prerequisite: CYBR 478 and CYBR 485

**CYBR 484 – Parallel Computing 3 credit hours**

Introduces parallel computing including parallel computer architectures, analytical modeling of parallel programs, principles of parallel algorithm design. Introduces existing mainstream parallel programming environments and present development situations to provide students with skills to design, code, debug, analysis and optimize some mainstream parallel software. Provides hands-on practice with parallel computing that provides student with a successful start to practice in the area of parallel.

Prerequisite: CYBR 401

**CYBR 485 – Information Systems Strategy and Management 3 credit hours**

To provide a set of practical and powerful tools to ensure the understanding of strategic, tactical, and operational responsibilities of the chief information officer (CIO). The strategic responsibilities include the strategic alignment among information technology and business functions of the organizations.

Prerequisite: Junior or Senior standing

**CYBR 486 – Machine Learning 3 credit hours**

This course provides an introduction to theoretical foundations, algorithms, and methodologies for machine learning, beginning with topics such as classification and linear regression and ending up with more recent topics such as boosting, support vector machines, hidden Markov models, and Bayesian networks. The course will give the student the basic ideas and intuition behind modern machine learning methods as well as a bit more formal understanding of how, why, and when they work. The underlying theme in the course is statistical inference as it provides the foundation for most of the methods covered. The course will end with a look at more advanced techniques, such as building ensembles, deep learning, and practical limitations of predictive models.

Prerequisite: CYBR 190 and CYBR 330

**CYBR 490 – Information Networking Law and Public Policy 3 credit hours**

This course provides a current and historical review of statutes, regulations, and municipal ordinances in telecommunications and information network security. Fundamental cybersecurity requirements are examined for several industry sectors. Topics also include network breach notification requirements, the NIST Risk Management Framework and NIST Cybersecurity Framework.

Prerequisite: Junior or Senior standing.

**CYBR 491 – Analysis of Spatial and Temporal Data 3 credit hours**

The course is conceptualized to introduce students to statistical analysis in temporal and spatial domain. This course will focus on applications of spatial, temporal, and spatio-temporal statistical methodology. Emphasis will be on: (i) exploring and visualizing spatio-temporal data, (ii) specifying appropriate statistical models for natural processes in time and space, (iii) assessing and validating statistical models, and (iv) interpreting and communicating analyses of spatio-temporal data. The course will cover a mixture of mathematical properties of spatio-temporal models and implementation using R/Python.

Prerequisite: CYBR 337 and CYBR 486

**CYBR 492 – Computational Natural Language Processing 3 credit hours**

Natural Language Processing (NLP) is at the heart of many of today's most exciting technological achievements, including machine translation, automatic conversational assistants and Internet search. This course covers both fundamental and cutting-edge topics in NLP and provides students with hands-on experience in NLP applications in the form of programming assignments in Python, and a group project where students have the freedom to pick the programming tools of their choice. Students will develop an in-depth understanding of both the algorithms available for processing linguistic information and the underlying computational properties of natural languages. This course will introduce NLP methods and applications including probabilistic language models, machine translation, and parsing algorithms for syntax and the deeper meaning of text.

Prerequisite: CYBR 304 and CYBR 486

**CYBR 493 – Social Dynamics of Cybercrime 3 credit hours**

This course takes a multidisciplinary perspective for understanding how social dynamics of individuals, groups or organizations. We will introduce students with social dynamics modeling approaches drawn from social networks analysis combined with text mining or natural language processing to develop statistical model representative of cybercrime behavior. Using social networks, dynamic modeling of networks and organizational risk analyzer toolkit, this course will offer students a broader theoretical and methodological understanding of how these network-based modelling toolkits can be used for predicting cybercrime. We will first introduce a set of theories and methodological approaches drawn from social networks theories and analysis and use social networks modelling toolkit to demonstrate its usability in understanding and predicting cybercrime behavior. This course will conclude with connecting social dynamics and modelling approaches to understanding technology-driven crime and corporate challenges related to cyber threats, ransomware attacks and preventative measures for safeguarding corporate information.

**CYBR 494 – Directed Research in Cyber Systems 1-6 credit hours**

Independent original research in a Cyber Systems area, under the direction of a Cyber Systems faculty member. A written contract specifying the topic and requirements must be submitted and approved by the department before registering for the course. Upon completion of the project a formal presentation will be given by the student to all interested parties.

Department Consent Required

Total Credits Allowed: 6.00

Prerequisite: Junior or senior standing and permission of department

**CYBR 495 – Cyber Systems Capstone 3 credit hours**

This course provides experience and background that will prepare the student for an actual working environment. Reinforcement and validation of knowledge gained in previous course work, enhancement of communication skills, and learning to work with people will be emphasized. Primary tasks will include a team-based project using technologies appropriate to the student's program of study, the study of ethics for cyber systems professionals, and project design and development and project oversight using appropriate project management tools. This course also provides opportunity for writing in the cyber systems disciplines.

Prerequisite: CYBR 330 or CYBR 381 or CYBR 490

Additional Course Fee Required

**CYBR 498 – Special Topics in Cyber Systems 3 credit hours**

Course is designed to enable students to become knowledgeable of recent trends and issues in cyber systems. The course format varies depending on subject matter, instructor and student needs.

Total Credits Allowed: 6.00

**CYBR 499 – Special Problems 1-3 credit hours**

Independent investigations of organizational problems. Topics to be investigated may be tailored to meet the needs of the student. The course is designed to integrate the knowledge acquired in other courses in the student's program of study and provides the opportunity for students to conduct independent study on any cyber systems topic not covered by other regularly offered courses. The study topic will be selected in consultation with the supervising cyber system's faculty member. A written contract specifying the topic and requirements must be submitted and approved by the department before registering for the course.

Department Consent Required

Total Credits Allowed: 6.00

Prerequisite: Junior or senior standing

## Computer Science and Information Technology (CSIT)

**CSIT 100 – Computing Environments 1 credit hour**

This course presents any one of a variety of currently demanded computer topics. It focuses on hands-on exposure to computer-based enhancement of personal productivity. Grading method is credit/no credit.

**CSIT 100.1 – Computing Environments: Word Processing 1 credit hour****CSIT 100.2 – Computing Environments: Spreadsheet 1 credit hour****CSIT 100.3 – Computing Environments: Database 1 credit hour****CSIT 100.5 – Computing Environments: Presentation Graphics 1 credit hour****CSIT 100.6 – Computing: Networking 1 credit hour****CSIT 100.9 – Computing Environments: Software Sampler 1 credit hour****CSIT 100D – Computing Environments: Windows 1 credit hour****CSIT 100E – Computing Environments: WWW Home Pages 1 credit hour****CSIT 100F – Computing Environments: MVS 1 credit hour****CSIT 100G – Computing Environments: JCL 1 credit hour****CSIT 210 – Structured Transaction Programming 3 credit hours**

This is an introductory programming course. The topics include basic computer concepts and terminology, in conjunction with program development using elements of a programming language. Stress is placed upon transaction processing algorithm using structured programming. The assignments are exercises that develop in-depth skills and techniques from the lecture topics. CSIT 100.F MVS and CSIT 100.G JCL are recommended co-requisites.

**CSIT 310 – Programming Data and File Structures 3 credit hours**

Study of advanced structured COBOL programming techniques and applications with respect to table handling, subprograms, sequential files, and indexed sequential files.

Prerequisite: CSIT 210

**CSIT 350 – Information Systems Concepts 3 credit hours**

This course deals with the role, structure and objectives of information systems. Other topics include theory of systems and information, decision support, human considerations, applications of information systems, system evaluation and selection.

Prerequisite: Completion of CSIT 111 or CSIT 130 and ENG 102

Enrollment not allowed in CSIT 350 if MIS 302 has been completed

**CSIT 380 – Systems Analysis and Design 3 credit hours**

Explore the System Development Life Cycle. Learn tools and strategies for system and information analysis, including need identification, feasibility studies, data and process modeling, requirements assessment, project management and group dynamics.

Prerequisite: Completion of CSIT 150 Enrollment not allowed in CSIT 380 if MIS 381 has been completed.

**CSIT 399 – Campus Lab Consultantship 1-3 credit hours**

Work in campus computer labs as a consultant to computer science and computer information technology students. (A total of three credit hours in any combination of CSIT 399 and CSIT 492-495 may be applied toward a computer science/information technology major or minor.)

Department Consent Required

Total Credits Allowed: 9.00



**CSIT 405 – Compiler Construction 3 credit hours**

Techniques and organization of compilers, assemblers, and interpreters. Structure of programming language symbol tables, scans, and object code generation.

Prerequisite: CSIT 402

**CSIT 426 – Computer Architecture 4 credit hours**

The study of the logic and theory of operation of the main hardware blocks of computers, their control, and their software/hardware interactions. The emphasis is on microcomputer architecture, including laboratory experiments with various systems and their I/O and interfacing characteristics.

Prerequisite: PHYS 205 and PHYS 205L or PHYS 275 and PHYS 275L and six hours of CSIT courses preferably CSIT 130 and CSIT 301.

**CSIT 428 – Data Communications and Distributed Processing 3 credit hours**

The study of network topology, protocols, management, and communication media. Evaluate present communication hardware, software, and future advancements in networking.

Prerequisite: CSIT 130 or CSIT 434 or ITEC 345

**CSIT 493 – Directed Readings in Computer Science/Information Technology 1-3 credit hours**

Independent readings on advanced or contemporary topics in computer science/ information technology, to be selected in consultation with and directed by a computer science/ information technology faculty member. A written contract specifying readings and requirements for the course is required before registering for the course. Any topic that is thoroughly covered by any regularly offered computer science or information technology course is not allowed for Directed Readings. Upon completion of the project a format presentation will be given by the student to all interested parties. (A total of three credit hours of any combination of CSIT 399 and CSIT 492-495 may be applied toward a computer science/information technology major or minor.)

Department Consent Required

Total Credits Allowed: 6.00

Prerequisite: CSIT 150 and permission of department chair

**CSIT 497 – Seminar in Information Technology 3 credit hours**

This course provides experience and background that will prepare the student for an actual working environment. Reinforcement and validation of knowledge gained in previous course work, enhancement of communication skills, and learning to work with people will be stressed. Primary tasks will include a team-based information systems development project and the study of ethics for CS/IT professionals.

Prerequisite: Completion of CSIT 380 and completion of or concurrent enrollment in CSIT 425.

Additional Course Fee Required