**CYBER SYSTEMS (CYBR)**

**CYBR 100 – Computer Science Principles  3 credit hours**
This course provides a broad, inspiring overview of computer science that is appropriate for all students. By the end of this course, students will become empowered to critically analyze computing innovations as well as create inspiring applications that express their interests. In addition, they will be ready to incorporate computational thinking into their future fields of study.

**CYBR 101 – Computer Science I: Python for Analytics  4 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 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 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 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 – 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 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.

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

CYBR 251 – Linux Programming Environment 1 credit hour
A survey of the fundamental concepts of the Linux operating system, including hands on experience with various components including the command line and graphical user interface.

CYBR 252 – Cloud Computing and Containerization 1 credit hour
A survey of the fundamental concepts of building and hosting Linux applications running with operating system level virtualization (containerization).
Prerequisite: CYBR 251

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 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.
Prerequisite: MGT 233 or STAT 241 or STAT 345 or BIOL 305 or PSY 250

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: ENG 102 and MATH 115 and CYBR 180 and CYBR 150
Additional Course Fee Required

CYBR 335 – Fundamentals of Networking & Systems 3 credit hours
This course is the first technical networking & systems course. Topics covered include layered network architectures, packet sniffing with protocol analysis, virtual local area networks, basic network security and network design through v4 and v6 subnetworking.
Prerequisite: CYBR 101 or CYBR 102 or CYBR 103 or CYBR 140 or passing score on CompTIA A+ certification exam.
Additional Course Fee Required
**CYBR 340 – Information Networking Preceptorial** 4 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 335

**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 335
Additional Course Fee Required

**CYBR 350 – Predictive Modeling II** 3 credit hours
Study of predictive modeling using data analytics tools such as data mining to support various organizational activities. This course is designed to familiarize students with the critical role of data warehousing and data mining as predictive modeling tools to enhance the organizational decision making process.
Prerequisite: CYBR 302 and junior standing

**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 335

**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 Web Application Development** 3 credit hours
This course is designed to assist students in learning the skills necessary to design and build enterprise-level web 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 407 – Introduction to Automata, Formal Languages, and Computability** 3 credit hours
A survey of the fundamental concepts and conclusions in the theory of computation. Topics cover regular languages and finite automata, context-free languages and pushdown automata, formal grammars, Chomsky hierarchy, Turing machine and computability, computational complexity.
Prerequisite: Junior standing and CYBR 180 or MATH 115

**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 I** 3 credit hours
This course provides an understanding of data analytics advanced techniques to extract intelligence about organizational activities from big data sources. Managing, governing, extracting, merging, and preparing large data sets for analysis using real data are covered extensively.
Prerequisite: CYBR 350

**CYBR 411 – Big Data II** 3 credit hours
This course provides a set of practical and powerful tools to enhance the understanding of big data. Exposure to computerized tools facilitating the loading and cleansing of data for analysis provides an experiential learning approach to understanding big data concepts.
Prerequisite: CYBR 410
Additional Course Fee Required

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 – Database Systems  3 credit hours
This course is a comprehensive study of multi-user database concepts. The relational model and relational database management systems along with proper database design will be emphasized. The normalization process and the various normal forms will be covered. Internet database applications are introduced. SQL will serve as the standard language for database manipulation. Several current database management systems will be introduced and will serve as the sample DBMSs for implementation of the course material.
Prerequisite: CYBR 101 or CYBR 102 or CYBR 103 or CYBR 434

CYBR 430 – Protecting & Defending Networks & 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 335 and CYBR 101 or CYBR 102 or CYBR 103
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 – Thinking like an Adversary: Systems Side Security  3 credit hours
This course will cover all the concepts necessary to play offense against different types of enterprise networks and systems (red team). Different scenarios will be "played out" utilizing a series of hands-on labs with the idea that students will learn the concept of "thinking like an adversary". In this manner, the students will learn how to better defend networks by understanding the offensive playbook.
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 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  3 credit hours
This course provides an overview of how to manage a server and its users. Topics include but not limited to installing server operating system, creating user and group accounts, setting up policies, adding and configuring devices and drivers, managing data storage, setting up security evaluating performance, trouble shooting, and virtualization.
Prerequisite: CYBR 101 or CYBR 102 or CYBR 103 or CYBR 345 or CYBR 434

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 150 or CYBR 345 or CYBR 448

CYBR 460 – Virtualization Essentials  3 credit hours
Examiing 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.

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 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 standing

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.

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