University of Sciences and Arts in Lebanon

Computer Science undergraduate Programs

Computer Science Department - 2024

Table of Contents

Introduction

With the advent of technological progress, it has become increasingly evident that computers have surpassed their initially assigned role of mere computation. They have evolved into electronic brains capable of much greater generality, revolutionizing various fields. One such field that has greatly benefited from this progress is computer science itself.

Computer science is a multidisciplinary discipline that not only advances its own domain but also contributes significantly to other fields such as health care, environmental science, and engineering. The impact of computer science can be seen in the way it has transformed these fields, enabling breakthroughs and innovations that were previously unimaginable.

Within the realm of computer science, the Computer Science (CS) department in USAL plays a crucial role in equipping students with the necessary knowledge and skills to navigate this rapidly evolving landscape. The CS department offers an undergraduate major that provides students with a broad and solid knowledge base, supported by technical skills and a high capability for problem-solving.

The undergraduate majors of computer science aim to provide students with a well-rounded education that covers both theoretical foundations and practical applications. Students are exposed to a wide range of topics, including algorithms, data structures, programming languages, computer architecture, artificial intelligence, software engineering, and more. This comprehensive curriculum ensures that students have a solid understanding of the fundamental concepts and principles of computer science.

In addition to theoretical knowledge, the CS department also emphasizes the development of technical skills. Students are given opportunities to apply their knowledge through hands-on projects, programming assignments, and real-world case studies. This practical approach helps students develop the necessary skills to tackle complex problems and find innovative solutions.

Problem-solving, critical thinking, and mathematical analysis are key focuses of the CS department. Students are trained to approach problems analytically, break them down into smaller components, and apply their knowledge and skills to devise effective solutions. This analytical mindset is highly valuable in a wide range of industries and sectors, where there is a constant need for individuals who can tackle complex challenges and drive innovation.

Furthermore, the CS department recognizes the importance of staying up-to-date with the latest advancements in the field. The curriculum is regularly updated to incorporate emerging technologies and trends, ensuring that students are equipped with the most relevant knowledge and skills. This adaptability to change is crucial in an industry that constantly evolves and demands professionals who can keep pace with new developments.

This document provides an overview of the primary majors available in the computer science

department, as well as the key prerequisites for admission into these majors. It also outlines the program's design and how the courses offered meet the demands of the job market.

Degree

The majors' programs also allow students to obtain a Bachelor of Science (B.S.) in CS with one of the following two major areas of high needs for the labor market in Lebanon and worldwide: Computing, and Computer and Network Security.

i. **Computing**
ii. **Computing for Data Science**
iii. **Computer and Network Security**

Program Design

The design of our computer science program with its three concentrations is built on the CS2023 - ACM/IEEE-CS/AAAI Computer Science Curricula (Gamma Version) guidelines coupled with the inputs from the domain experts of the program advisory board.

The CS2023 curricula design guidelines were developed throughout a worldwide joint effort between leading industrialists, experts, and leading educators in the field of computer science. It provides a framework for adopting institutions to create their own competency model tailored to local needs.

The CS2023 builds on and extends the CS2013 design guidelines to incorporate all the updated needs for the computer science curriculum from social, professional, programmatic and pedagogical perspectives.

The CS2023 categorizes the knowledge in the computer science fields into 18 knowledge areas (KA), each of which consisting of several knowledge units (KU) including different core topics. It also suggests illustrative learning outcomes for each knowledge unit. Core topics are classified into (1) CS core topics that every Computer Science graduate must know, and (2) KA core topics recommended for inclusion in any dedicated course in the knowledge area. While all the programs must cover CS core topics, a program may choose to cover some knowledge areas in greater depth/breadth than other knowledge areas. This choice - according to CS2023 - is mainly dictated by the curricular emphasis based on local/regional market needs and demands, and the local availability of instructional expertise.

Being inline with the latter, we have considered the CS core topics in the proposed program and carefully "shaped" the KA Core topics choices according to the local/regional market needs based on the feedback of the program advisory board consisting of experts (industry professionals and educators) in the different CS fields related to the program concentrations.

Our computer science program, meticulously designed in accordance with the cutting-edge CS2023 Computer Science Curricula guidelines, is optimally positioned to equip graduate students with the essential competencies required for seamless integration into local, regional, and international tech markets. The adoption of the CS2023 framework, a product of extensive global collaboration, guarantees alignment with dynamic industry standards and evolving demands within the computer science field. Furthermore, the active involvement of industry professionals and educators within our program advisory board strengthens our commitment to remaining perpetually attuned to the evolving needs of the tech market. Through this strategic alignment and unwavering commitment to collaboration, the program cultivates graduates equipped with a diverse skill-set and comprehensive knowledge base, empowering them to excel within the dynamic and interconnected world of computer science.

Competencies and Program Outcomes

To ensure that every student is equipped with the necessary skills and knowledge, we have established a set of competencies. These competencies encompass the following areas:

1. Proficiency in the practice of computer science, with a focus on computing, computer and network security, or computing for data science.

2. Analysis, modeling, critical thinking, and problem-solving abilities.

3. Effective communication and interpersonal skills.

4. Research skills and the ability to adapt to evolving technology.

To ensure that students fulfill these competencies, we have developed a set of program outcomes. These program outcomes serve as a guide, ensuring that students who achieve these outcomes will possess the necessary competencies. The program outcomes are detailed as follows:

1. **Proficiency in the practice of computer sciences**
   a. **Computing Infrastructure**: Assess and manage computing infrastructure, including hardware, software, management systems, programming environments, and operating systems.
   b. **Computing Solutions**: Formulate, analyze, and compare computing solutions for various problems and software.
   c. **Computing Systems Development**: Develop, implement, and manage computing systems using efficient methodologies and emerging technologies.

   d. **Computing concentration**
      i. **Advanced Algorithms**: Apply advanced algorithmic concepts to design and analyze efficient solutions for computing problems.

5

ii. **Mathematical Modeling**: Apply mathematical modeling in the design and development of computing and software solutions.

iii. **Robust Applications**: Design, develop, and deploy robust and user-friendly applications for web, mobile, or other platforms.

e. **Networking and Computer Security Concentration**
i. **Network Architecture Expertise**: Demonstrate a deep understanding of network architecture in order to analyze diverse environments as well as to design and configure networks adhering to industry standards, emphasizing performance, reliability, and security.

ii. **Computer Security Mastery**: Demonstrate mastery of computer security concepts, including the ability to identify vulnerabilities, apply effective countermeasures against cyber threats, and implement robust security measures.

iii. **Incident Response and Digital Forensics:** Respond to and mitigate security incidents, analyzing breaches and conducting digital forensics investigations.

f. **Computing for Data Science concentration**
i. **Data Preprocessing**: Apply data preprocessing techniques to clean, transform, and analyze large datasets.

ii. **Machine Learning and Deep Learning**: Develop and apply machine learning and deep learning algorithms to effectively process and analyze data, including images, text, and other types of data, for various tasks.

iii. **Statistical Analysis**: Utilize statistical methods and tools to analyze data and draw meaningful insights.

iv. **Data Visualization**: Apply data visualization techniques to effectively communicate findings and trends.

2. **Analysis, modeling, critical thinking, and problem solving**
a. **Algorithmic and Mathematical Analysis**: Analyze real-world problems in diverse application domains using algorithmic and mathematical capabilities.
b. **Problem-Solving Skills**: Project theoretical and analytical theories in the computer science to solve a complex work processes
c. **Critical Thinking**: Conceive and validate correct, efficient, and mathematical-based problem solving schemes strengthened with well-structured thinking

3. **Effective communication and interpersonal skills**
a. **Teamwork and Collaboration**: Work and engage collaboratively as a member or a leader in a team to achieve group goals and objectives.

b. **Communication Skills**: Efficiently communicate technical knowledge in written and oral forms in simple terms to clearly present the information.
c. **Professional and Ethical Responsibility**: Demonstrate professional and ethical responsibility in the computer science profession.

4. **Research and adaptation to evolving technology**
   a. **Advanced Studies and Research**: Apply mathematical and computing concepts to advanced studies and research in computer science.
   b. **Adaptability**: Adapt to evolving methodologies and technologies in the field of computer science.

Courses Learning Outcomes

In order to ensure that all program outcomes are met, the courses within the program have been carefully developed. These courses align with the learning outcomes specified in the CS2023 - ACM/IEEE-CS/AAAI Computer Science Curricula. Figure 1 provides an overview of the percentage of CS2023 outcomes covered in our program.

Based on the figure, it can be observed that the common areas of coverage are approximately 79% for the CS core, around 50% for the Knowledge areas core, and 26% for the Non-Core areas. These percentages are considered high for an undergraduate program consisting of 104 credits.

The common learning outcomes with the Computer Science Curricula standard

■ CS core   ■ KA core   ■ Non-core

100.00%	
75.00%	78.88%
50.00%	50.29%
25.00%	26.17%
0.00%	

Common course learning outcomes
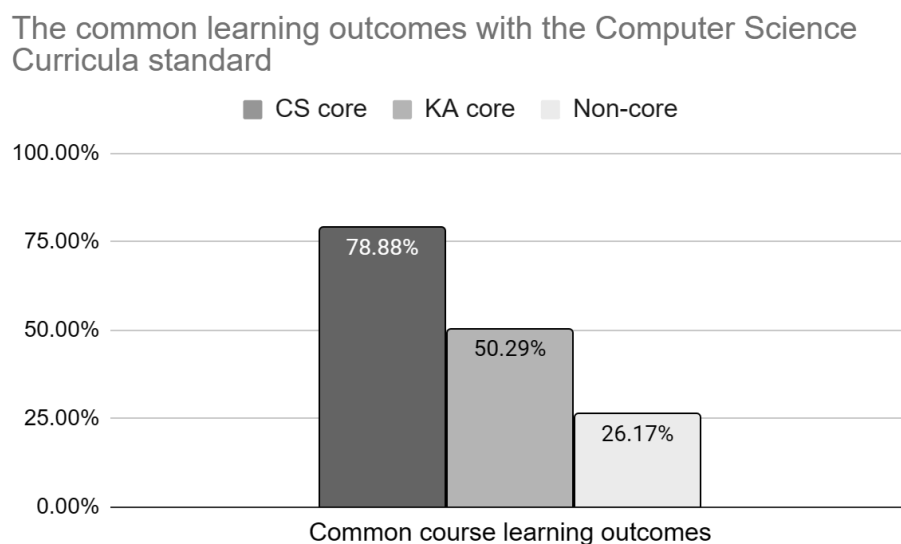
Figure 1. Common areas between USAL CS curricula and CS2023 - ACM/IEEE-CS/AAAI Computer Science Curricula

Regarding the CS core, the few outcomes that are not covered are in advanced areas such as computational models, architecture and organizations (which involve low-level programming and computer electronics), and parallel and distributed computing (typically found at the master's level).

In the Knowledge Area core, not all outcomes are mandatory to cover, and the level of fulfillment may vary depending on the specific program outcomes. Therefore, achieving a percentage of 50% is considered more than sufficient, given the market demands in Lebanon and the Middle East, followed by the international market.

As for the Non-Core outcomes, our program covers selected topics that are of interest and relevance to our students. These topics include game development and design, machine learning and related areas, and cloud computing.

As a summary, the program has been designed to ensure comprehensive coverage of the program outcomes while taking into consideration the specific needs and market demands of the region.

Courses Learning outcomes per domain

In addition to aligning our courses with the CS2023 - ACM/IEEE-CS/AAAI Computer Science Curricula, we have developed our courses in our own way and compared them to the program outcomes we adopted. We then mapped the outcomes of each course to the program outcomes, and the results are shown in Figure 2. The symbols 1-a, 1-b, and so on, are the same as the ones mentioned earlier in the Program Outcomes section. We can see that all the program outcomes are covered by the course outcomes of the program. However, some outcomes are highly covered, like Computing Infrastructure, Computing Systems Development, and Algorithmic and Mathematical Analysis. On the other hand, some outcomes are less covered, such as Mathematical Modeling and Data Preprocessing. This is because some outcomes are addressed in multiple courses, while others are specific to certain fields, like Data Preprocessing or Mathematical Modeling.
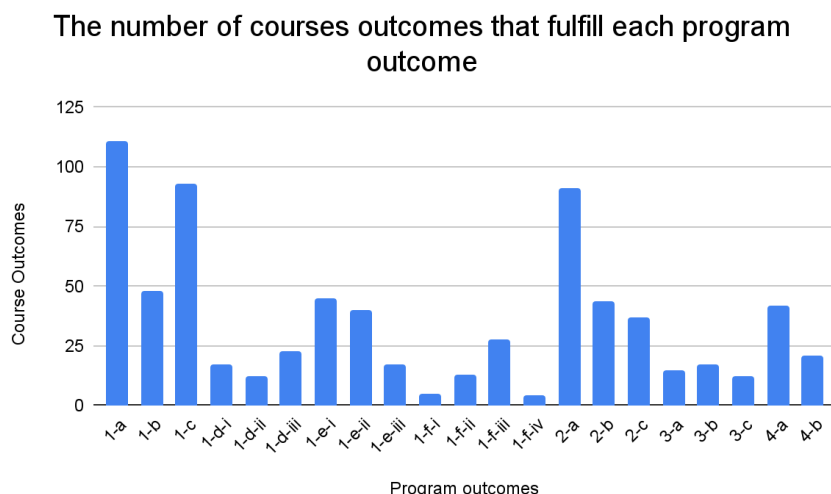
Figure 2. Mapping the courses outcomes to the program outcomes

When examining the program outcomes domains at a higher level, it becomes apparent that all domains are well fulfilled, including the domains of "Effective Communication and Interpersonal Skills" and "Research and Adaptation to Evolved Technologies." While these domains are met in nearly all courses, the number of outcomes associated with them may be low. This is because only one outcome in each course specifically meets these requirements, while the remaining outcomes are mapped to other program outcomes.

The number of courses outcomes fulfilling each program outcome domain
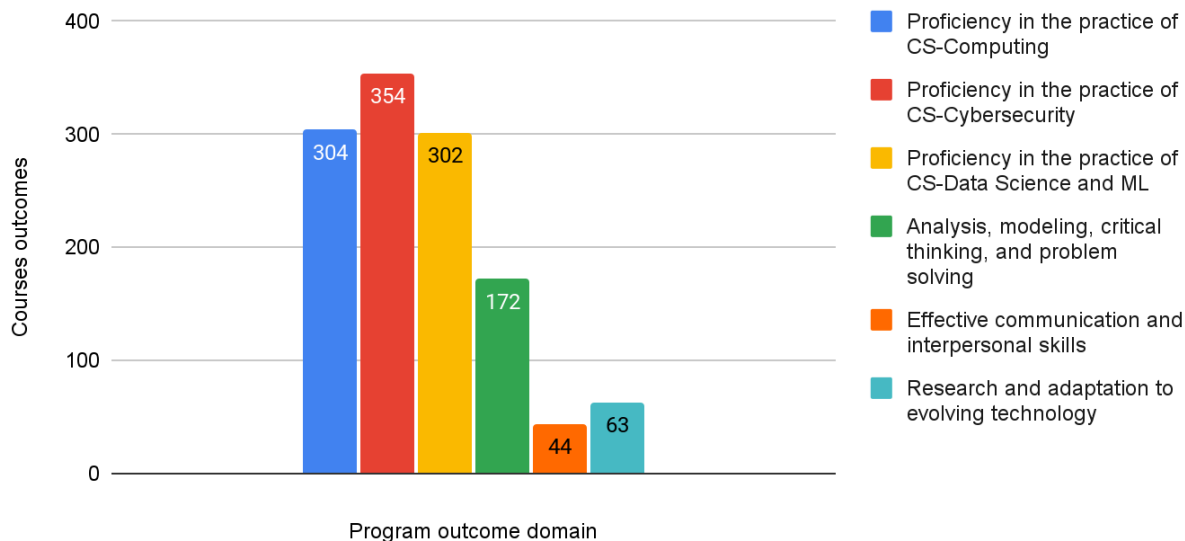
Graduation Requirements

1. Achieving successfully **104 credits** as follows:

University Requirement	10 credits
Department Requirement (Core)	52 credits
Concentration Requirements	30 credits
Elective Requirements	
● Department elective	6 credits
● Free elective	6 credits
Total credits	**104 credits**

2. Obtaining a minimum cumulative GPA of **2.0** over **4**.

Program Duration

3 years for non-transfer students, with an official Lebanese BACC II degree, who successfully pass their placement tests (English, Arabic, Math, and IT).

3 -3.5 years for non-transfer students, with an official Lebanese BACC II degree, who need some remedial courses (English, Arabic, Math, and IT).

Transfer students' study duration depends on the amount of transferred credits.

Double Concentration

CS students who want to get a double concentration should take fifteen extra credits to be discussed with their advisor. They are encouraged to make their decision in this regard as early as possible while in their studies.

Placement Test

Candidates aiming to join the CS department at USAL should sit for four placement tests:

- English
- Arabic,
- Math
- IT

Program Admission

Students who do not successfully pass the placement tests will be required to take some remedial courses.

Students who do not get 12/20 on the Math placement tests can't enroll in computer science core courses. They must enroll in two remedial math courses MATH010 and MATH011. In order to be able to enroll in core courses, the students must pass both MAT010 and MATH011 courses.

Courses of the curricula

General Requirements & Electives

Code	Subject	Credits
GENR201	Religion and public life	1
ENGL201	English communication skills I	3
ENGL202	English communication skills II	3
ARAB201	مهارات التواصل في اللغة العربية I Arabic communication skills I	3
	General elective 1	3
	General elective 2	3
	Department elective 1	3
	Department elective 2	3
Total		**22**

Core and Major Courses

Code	Subject	Credits
MATH203	Linear Algebra	3 credits
MATH201	Calculus	3 credits
MATH210	Discrete Mathematics	3 credits
MATH204	Probability and Statistics I	3 credits
CSCI205	Computer Science Overview	3 credits
CSCI206	Introduction to Programming	4 credits (3;1)
CSCI207	Object Oriented Programming	4 credits (3;1)
CSCI210	Computer Architecture and Logic Design	3 credits
CSCI212	Computer Networks I	3 credits
CSCI311	Introduction to Database Systems	3 credits
CSCI315	Web development	4 credits (3;1)
CSCI316	Data Structure and Algorithms	3 credits
CSCI317	Software Engineering	3 credits
CSCI320	Operating Systems	4 credits (3;1)
CSCI410	Artificial intelligence and Machine learning	3 credits
CSCI420	Final Year Project	3 credits
Total		**52**

Computing concentration courses		
Code	**Subject**	**Credits**
SECU301	Introduction to Computer Security	3 credits
COMP301	Introduction to Linux	3 credits
COMP305	Advanced Programming	3 credits
COMP310	Game Design and Development	3 credits
COMP411	Advanced Data Structure and Algorithms	3 credits
COMP412	Advanced Databases	3 credits
COMP413	Mobile Computing	3 credits
COMP414	Cloud computing	3 credits
COMP420	Application development	3 credits
MATH310	Numerical Computation and Analysis	3 credits
Total		**30**

Computing for Data Science concentration courses		
Code	**Subject**	**Credits**
DTSC301	Introduction to Data Science	3 credits
DTSC420	Natural Language Processing	3 credits
DTSC422	Time series and statistical forecasting	3 credits
DTSC424	Deep learning	3 credits
MATH304	Probability and Statistics II	3 credits
MATH307	Statistical Models	3 credits
MATH310	Numerical Computation and Analysis	3 credits
COMP305	Advanced Programming	3 credits
COMP411	Advanced Data Structure and Algorithms	3 credits
COMP412	Advanced Databases	3 credits
Total		**30**

Computer and Network Security concentration courses		
Code	**Subject**	**Credits**
SECU301	Introduction to Computer Security	3 credits
COMP301	Introduction to Linux	3 credits
SECU313	Computer Networks II : Routing and Switching Essentials	3 credits
SECU314	Computer Networks III : Scaling and Connecting Networks	4 credits
SECU316	Systems and network administration	3 credits
SECU420	Network Security	3 credits
SECU422	Web application security	3 credits
SECU424	Ethical Hacking and penetration testing	3 credits
SECU426	Information security management	3 credits
SECU430	Introduction to digital forensics	2 credit
Total		**30**

Computer Science Department Curricula

Courses distribution plan – Computing Undergraduate Program

First year - fall

Code	Course Name	Nb of weeks	Nb of Lecture hours	Nb of labs hours	credits
GENR201	Religion and Public Life	15	15	-	1
MATH203	Linear Algebra	15	45	-	3
ENGL201	English Communication skills I	15	45	-	3
ARAB201	Arabic Communication skills	15	45	-	3
CSCI206	Introduction to programming	15	45	30	4 (3; 1)
CSCI205	Computer Science Overview	15	45	-	3
Total					**17**

First year – spring

Code	Course Name	Nb of weeks	Nb of Lecture hours	Nb of labs hours	credits
MATH210	Discrete Mathematics	15	45	-	3
ENGL202	English Communication Skills II	15	45	-	3
CSCI207	Object Oriented Programming	15	45	30	4 (3; 1)
CSCI210	Computer Architecture and Organization	15	45	-	3
MATH201	Calculus	15	45	-	3
CSCI212	Computer Networks I : Networking fundamentals	15	45	-	3
Total					**19**

Second year – fall

Code	Course Name	Nb of weeks	Nb of Lecture hours	Nb of labs hours	credits
CSCI311	Introduction to Database	15	45	-	3
CSCI316	Data-Structure and Algorithms	15	45	-	3
Math204	Probability and Statistics I	15	45	-	3
SECU301	Introduction to Computer Security	15	45	-	3
MATH310	Numerical Computation and Analysis	15	45	-	3
COMP301	Introduction to Linux	15	45	-	3
Total					**18**

Second year – spring

Code	Course Name	Nb of weeks	Nb of Lecture hours	Nb of labs hours	credits
COMP305	Advanced Programming	15	45	-	3
CSCI315	Web Development	15	45	30	4(3; 1)
CSCI317	Software Engineering	15	45	-	3
CSCI320	Operating Systems	15	45	30	4(3;1)
COMP310	Game Design and Development	15	45	-	3
Total					**17**

Third year – fall

Code	Course Name	Nb of weeks	Nb of Lecture hours	Nb of labs hours	credits
COMP420	Application Development	15	45	-	3
CSCI410	Artificial Intelligence and Machine Learning	15	45	-	3
COMP414	Cloud Computing	15	45	-	3
COMP413	Mobile Computing	15	45	-	3
DPEL201	Department Elective I	15	45	-	3
GNEL201	General Elective I	15	45	-	3
Total					**18**

Third year – spring

Code	Course Name	Nb of weeks	Nb of Lecture hours	Nb of labs hours	credits
COMP411	Advanced Data Structure and Algorithms	15	45	-	3
CSCI420	Final Year Project	-	-	-	3
COMP412	Advanced Databases	15	45	-	3
DPEL202	Department Elective II	15	45	-	3
GNEL202	General Elective II	15	45	-	3
Total					**15**

Courses distribution plan – Computer and Network Security Undergraduate Program

First year - fall

Code	Course Name	Nb of weeks	Nb of Lecture hours	Nb of labs hours	credits
GENR201	Religion and Public Life	15	15	-	1
MATH203	Linear Algebra	15	45	-	3
ENGL201	English Communication skills I	15	45	-	3
ARAB201	Arabic Communication skills	15	45	-	3
CSCI206	Introduction to programming	15	45	30	4 (3; 1)
CSCI205	Computer Science Overview	15	45	-	3
Total					**17**

First year – spring

Code	Course Name	Nb of weeks	Nb of Lecture hours	Nb of labs hours	credits
MATH210	Discrete Mathematics	15	45	-	3
ENGL202	English Communication Skills II	15	45	-	3
CSCI207	Object Oriented Programming	15	45	30	4 (3; 1)
CSCI210	Computer Architecture and Organization	15	45	-	3
MATH201	Calculus	15	45	-	3
CSCI212	Computer Networks I : Networking fundamentals	15	45	-	3
Total					**19**

Second year – fall

Code	Course Name	Nb of weeks	Nb of Lecture hours	Nb of labs hours	credits
CSCI311	Introduction to Database	15	45	-	3
CSCI316	Introduction to Data-Structure and Algorithms	15	45	-	3
Math204	Probability and Statistics I	15	45	-	3
COMP301	Introduction to Linux	15	45	-	3
SECU301	Introduction to Computer Security	15	45	-	3
SECU313	Computer Networks – II : Routing and Switching	15	45	-	3
Total					**18**

Second year – spring

Code	Course Name	Nb of weeks	Nb of Lecture hours	Nb of labs hours	credits
SECU314	Computer Networks – III : Scaling and Connecting Networks	15	45	30	4(3;1)
CSCI315	Web Development	15	45	30	4(3; 1)
CSCI317	Software Engineering	15	45	-	3
CSCI320	Operating Systems	15	45	30	4(3;1)
GNEL201	General Elective I	15	45	-	3
Total					**18**

Third year – fall

Code	Course Name	Nb of weeks	Nb of Lecture hours	Nb of labs hours	credits
SECU420	Network Security	15	30	30	3
CSCI410	Artificial Intelligence and Machine Learning	15	45	-	3
SECU316	Systems and network administration	15	30	30	3
SECU422	Web application security	15	45	-	3
GNEL201	Department Elective I	15	45	-	3
GNEL202	General Elective II	15	45	-	3
Total					**18**

Third year – spring

Code	Course Name	Nb of weeks	Nb of Lecture hours	Nb of labs hours	credits
SECU424	Ethical Hacking and penetration testing	15	30	30	3
CSCI420	Final Year Project	-	-	-	3
SECU426	Information security management	15	45	-	3
SECU430	Introduction to digital forensics	15	30	-	2
DPEL202	Department Elective II	15	45	-	3
Total					**14**

Courses distribution plan – Computing for Data Science Undergraduate Program

First year - fall

Code	Course Name	Nb of weeks	Nb of Lecture hours	Nb of labs hours	credits
GENR201	Religion and Public Life	15	15	-	1
MATH203	Linear Algebra	15	30	-	3
ENGL201	English Communication skills I	15	45	-	3
ARAB201	Arabic Communication skills	15	45	-	3
CSCI206	Introduction to programming	15	45	30	4 (3; 1)
CSCI205	Computer Science Overview	15	45	-	3
Total					**17**

First year – spring

Code	Course Name	Nb of weeks	Nb of Lecture hours	Nb of labs hours	credits
MATH210	Discrete Mathematics	15	45	-	3
ENGL202	English Communication Skills II	15	45	-	3
CSCI207	Object Oriented Programming	15	45	30	4 (3; 1)
CSCI210	Computer Architecture and Organization	15	45	-	3
MATH201	Calculus	15	45	-	3
CSCI212	Computer Networks I : Networking fundamentals	15	45	-	3
Total					**19**

Second year – fall

Code	Course Name	Nb of weeks	Nb of Lecture hours	Nb of labs hours	credits
CSCI311	Introduction to Database	15	45	-	3
CSCI316	Introduction to Data Structure and Algorithms	15	45	-	3
Math204	Probability and Statistics I	15	45	-	3
MATH310	Numerical Computation and Analysis	15	45	-	3
COMP305	Advanced Programming	15	45	-	3
GNEL201	General Elective I	15	45	-	3
Total					**18**

Second year – spring

Code	Course Name	Nb of weeks	Nb of Lecture hours	Nb of labs hours	credits
DTSC301	Introduction to Data Science	15	45	-	3
CSCI315	Web Development	15	45	30	4(3; 1)
CSCI317	Software Engineering	15	45	-	3
CSCI320	Operating Systems	15	45	30	4(3;1)
MATH304	Probability and Statistics II	15	45	-	3
Total					**17**

Third year – fall

Code	Course Name	Nb of weeks	Nb of Lecture hours	Nb of labs hours	credits
DTSC422	Time series and statistical forecasting	15	45	-	3
CSCI410	Artificial Intelligence and Machine Learning	15	45	-	3
DTSC420	Natural Language Processing	15	45	-	3
MATH307	Statistical Models	15	45	-	3
DPEL201	Department Elective I	15	45	-	3
GNEL202	General Elective II	15	45	-	3
Total					**18**

Third year – spring

Code	Course Name	Nb of weeks	Nb of Lecture hours	Nb of labs hours	credits
COMP411	Advanced Data Structure and Algorithms	15	45	-	3
CSCI420	Final Year Project	-	-	-	3
COMP412	Advanced Databases	15	45	-	3
DTSC424	Deep learning	15	45	-	3
DPEL202	Department Elective II	15	45	-	3
Total					**15**

[1] One credit is equivalent to 15 lecture hours or 30 laboratory hours per semester.

Courses Descriptions

Course No.	Course Name	Prerequisites	Cr.

ARAB201 **Arabic I** 3 **cr.**
Course
Description This course builds vocabulary, grammar, and general communicative competence. Students will develop all four skills: speaking, reading, writing and listening.

ENGL201 **English Communication skills I** 3 **cr.**
Course
Description This course is designed to give extensive practice in the writing process, with emphasis on expository forms appropriate to everyday personal, business, and academic writing.

ENGL202 **English Communication skills II** ENGL 201 3 **cr.**
Course
Description This course continues practice in the composing process, with emphasis on argumentation and research. It involves gathering, analyzing, and documenting information from secondary sources.

MATH203 **Linear Algebra** 3 **cr.**
Course
Description This course covers matrix theory and linear algebra, emphasizing topics useful in other disciplines. Linear algebra is a branch of mathematics that studies systems of linear equations and the properties of matrices. The concepts of linear algebra are extremely useful in physics, economics and social sciences, natural sciences, and engineering. Due to its broad range of applications, linear algebra is one of the most widely taught subjects in college-level mathematics. The basic operations of linear algebra are those you learned in grade school – addition and multiplication to produce "linear combinations." But with vectors, we move into four-dimensional space and n-dimensional space.

MATH210 **Discrete Mathematics** 3 **cr.**
Course
Description This course enables students to strengthen and increase the understanding of discrete mathematics with special emphasis on computer science applications. Topics include formal logic, types of proofs, sets, sequences, recurrence, introduction to number theory and some of its applications, graph theory, paths, trees and graph coloring.

MATH201 **Calculus** 3 **cr.**
Course
Description This course covers topics of differential and integral calculus including limits and continuity, derivatives and Taylor series that may approximate functions with small errors. Proper integrals that are used in finding areas, calculating some probabilities and many other applications. We move from one variable function

to several variables. These functions can illustrate a quantity that depends on many variables that may be time, demand on items, prices, ... However, partial derivatives, gradient vector and Hessian matrix are introduced together with double integrals; all may be applied in studying optimization problems.

| MATH204 | Probability and Statistics I | | 3 **cr.** |

Course Description
This course is intended as an elementary introduction to the theory of probability for students in mathematics, statistics, engineering, and the sciences (including computer science, the social sciences, and management science). It presents the basics and mathematics of probability theory. Topics include basic combinatorics, probability axioms, conditional probability, random variables, and probability distributions.

| MATH304 | Probability and Statistics II | MATH204 | 3 **cr.** |

Course Description
Statistics is the science of extracting reliable information from empirical data. Probability Theory is the mathematics of reasoning about chance and randomness. Although these are two distinct disciplines, they are inherently intertwined. This course covers essentially the distribution theory, random sampling, estimation and tests of statistical hypotheses. More specifically, the topics of this course include: Random variables, properties of expectation, Functions of random variables, descriptive statistics, graphical statistics, Sampling distributions, estimation, and statistical testing.

| MATH307 | Statistical Models | MATH304 | 3 **cr.** |

Course Description
This course provides a foundation in statistical modeling, essential for data science. It covers a broad spectrum of methodologies, including linear statistical models, Bayesian multivariate models, estimation of probability density functions, and both parametric and non-parametric methods. Additionally, the course delves into advanced topics, including Gaussian Mixture Models for classification and clustering tasks, as well as Markov models and Hidden Markov Models for sequential data analysis. Emphasis is placed on developing practical skills related to these methodologies, such as parameter estimation, model fitting, and diagnostic checks. This course equips students with both theoretical knowledge and practical skills for data science.

| MATH310 | Numerical Computation and Analysis | MATH203, MATH201 | 3 **cr.** |

Course Description
This course is primarily addressed to students majoring in Computer Science. Its main purpose is the introduction of mathematical and computational tools to handle basic numerical methods. The main tool for algorithm development is MATLAB/Octave. Topics include: Floating-point number representation, finding roots of nonlinear equations, Numerical interpolation, Numerical differentiation and Integration, and an introduction to optimization problems including

mathematical modeling, linear programming (LP) problems and solving some unconstrained optimization problems using Newton's method and the Gradient descent method.

CSCI 205	**Computer Science Overview**	**1 cr.**
Course Description		

This course offers a comprehensive introduction to computer science, covering a wide range of foundational concepts. It begins by exploring data and information, including the data cycle and mechanisms for computer search, control, and sealing. Students will also learn about the conversion between the analogue and digital worlds, gaining insights into the transition from the physical to the digital realm. The course focuses on the distinction between hardware and software components, highlighting their individual functions and how they interact within computer systems. It provides a thorough understanding of computer networks and the Internet, emphasizing their importance in modern computing. Additionally, there is a dedicated Windows work lab that covers tasks such as command line operations (CMD) and using control panel functions to view and modify system settings. The second part of the course emphasizes practical application through graphical programming on Code.org. Students will have the opportunity to engage in hands-on activities and creatively apply programming concepts. The use of Code.org's user-friendly environment enables students to explore programming and app development in a practical and accessible way. The practical application of theoretical knowledge is a key focus of this part of the course.

CSCI206	**Introduction to Programming**	**4 cr. (3;1)**
Course Description		

This course serves as an introduction to essential programming concepts. Students will develop a foundational understanding of algorithmic thinking, problem-solving, and structured programming skills. The course covers the fundamentals of programming using a modern language, currently Java. Students will explore important programming concepts, including control structures, simple data structures, and fundamental principles of computer programming. Topics covered include elementary programming, selection, repetition, arrays, and methods. By the end of the course, students will have acquired a basic knowledge and skill set necessary for programming and problem-solving in a structured manner.

CSCI207	**Object Oriented Programming**	**CSCI206**	**4 cr. (3;1)**
Course Description			

This course focuses on the principles of Object-Oriented Programming (OOP) using the Java Programming Language. It begins with an introduction to creating applications using Java and progresses to cover key topics in OOP. Students will

learn how to define classes, declare objects, and explore important concepts such as constructors, methods, dependency, aggregation, inheritance, polymorphism, abstract classes, and interfaces. The course also delves into advanced concepts including exceptions, streaming, graphical user interface (GUI) development, and event handling, which enables students to create their own applications with user-friendly designs.

CSCI210 Course Description	**Computer Architecture and Logic Design**	3 **cr.**

This course provides an introduction to key concepts in computer architecture, functional logic, and design, as well as computer arithmetic. The course covers the fundamentals of modern computer architecture and operation. Students will explore computer arithmetic, including binary, hexadecimal, and decimal number conversions, binary number arithmetic, and the IEEE binary floating-point number standard. The course also delves into basic computer logic, including gates, combinational circuits, sequential circuits, and adders. Students will gain an understanding of computer components and their interactions. Additionally, the course offers an advanced study of modern digital design principles and techniques. Topics covered include assembly language and the Marie simulator, as well as the use of advanced programmable logic devices like FPGA.

CSCI212 Course Description	**Computer Networks I**	3 **cr.**

This course provides an in-depth introduction to the fundamental concepts of computer networks. Students will explore the architecture, protocols, and technologies that form the backbone of modern communication systems. The course combines theoretical knowledge with practical hands-on labs using Cisco Packet Tracer, allowing students to apply concepts learned in class to real-world scenarios. Topics covered include network layers, transmission media, data link layer, network layer, transport layer and application layer.

CSCI311 Course Description	**Introduction to Database Systems**	CSCI206, MATH210	3 **cr.**

This course provides a solid foundation in database systems. It begins by exploring the significance of the database approach in various real-life scenarios and the advantages of adopting a Database Management System (DBMS). Students will gain insights into the process of identifying system requirements that necessitate a database, as well as the transition from existing models to a well-structured database schema. Emphasis is placed on the relational model, covering topics such as database definition language, database manipulation language, data retrieval techniques, and some advanced topics including triggers, functions, indexing, normalization, and stored procedure. Practical skills in designing, implementing, and querying relational databases using popular DBMS tools e.g. MySQL will be developed throughout the course. By the end,

students will be equipped with the necessary knowledge and abilities to effectively work with and leverage DBMS technologies in real-world applications.

CSCI316	**Data Structure and Algorithms**	**CSCI207, MATH210**	3 **cr.**

Course Description

This advanced programming course covers the design and implementation of important data structures and their algorithms with the aim of offering students a solid technical training on java programming. The main goal is to teach the students how to select and design data structures and algorithms that are appropriate for problems that they might encounter. The data structures considered include arrays, stacks, queues, lists, linked lists, trees and Hashmap. An approach based on abstract data types and classes will be emphasized. This course is also an introduction to algorithms. We will be studying their correctness and computational complexity.

CSCI315	**Web Development**	**CSCI207, CSCI311**	4 **cr. (3;1)**

Course Description

This course covers front-end and back-end web development. Students start in the first part of this course by learning HTML, CSS, JavaScript (including jQuery) to be able to create interactive web pages. They then switch to Python for back-end development, including building web applications and connecting to SQL databases. Lastly, there is a brief introduction to React for front-end development. Practical exercises and projects reinforce learning, and students gain skills in full-stack web development. The course prepares students for careers in web development, providing them with the ability to create functional and visually appealing websites and web applications.

CSCI317	**Software Engineering**	**CSCI207**	3 **cr.**

Course Description

This course provides an understanding of the system development process which links user requirements to the computer based system. This course emphasizes problem formulating and problem solving. Students will learn project management techniques, explore and compare software solutions, evaluate project feasibility, and design final software solutions. The course includes how to analyze a problem domain and develop the appropriate analysis and design models to formalize the requirements using object oriented methods and appropriate theory. Practical exercises and real-world projects enhance learning outcomes

| CSCI320 | **Operating Systems** | CSCI210, CSCI206 | 4 **cr. (3;1)** |

CSCI320   **Operating Systems**   CSCI210, CSCI206   4 **cr. (3;1)**

Course Description   This course aims to provide an introduction to the internal operation of modern operating systems. The operating system provides a well-known, convenient, and efficient interface between user programs and the computer hardware on which they run. The operating system is responsible among others for allowing resources such as processors, disks and networks to be shared, providing common services needed by many different programs. The course discusses the major components of most modern operating systems, with particular emphasis on three major OS subsystems: process management (processes, threads, CPU scheduling, synchronization, and deadlock), memory management (segmentation, paging, swapping), and file systems.

CSCI410   **Artificial intelligence and Machine learning**   CSCI207, MATH210, MATH204   3 **cr.**

Course Description   This course provides an introduction to machine learning, covering key concepts and techniques. Students will learn about different learning styles, such as supervised, reinforcement, and unsupervised learning. They will gain practical experience implementing and evaluating machine learning algorithms, including classification, regression, clustering, and dimensionality reduction. The course emphasizes both theoretical foundations and hands-on application, preparing students to apply machine learning to real-world problems.

SECU301   **Introduction to Computer Security**   MATH210   3 **cr.**

Course Description   This course provides students with a basic understanding of cryptographic tools and techniques that are used in modern systems to achieve security objectives, such as confidentiality, integrity, and authentication. The course first presents classical cryptography (historical ciphers), then it details the different elements and techniques of modern cryptography along with their applications and their most known algorithms. The topics include symmetric encryption (also known as secret key cryptography), asymmetric encryption (also known as public key cryptography), Cryptographic Data Integrity algorithms and mutual trust. The course provides students with the theoretical foundations (including some related mathematical concepts) as well as with the practical skills through a number of lab sessions.

COMP301   **Introduction to Linux**   CSCI212   3 **cr.**

Course Description   This course spends time examining the topics you need to know in order to gain a complete and comprehensive understanding. For example, you'll find a hefty chapter looking at the command-line prompt, arguably the heart of Linux and the element that gives Linux most of its power. There's also an entire chapter

discussing how to initially install Ubuntu on your computer. Topics should include: the boot process, installing and updating software, command line operations, processes, file operations, user environment, the bash shell and bash scripting.

COMP305 **Course Description**	**Advanced Programming**	**CSCI203**	**3 cr.**

This course explores the dynamic nature of Python, a versatile language widely used across various domains. While Python offers simplicity and power, ensuring code readability, reusability, and maintainability can be a challenge. This course begins by introducing the new features in Python 3.7. Students will gain a solid understanding of Python syntax and delve into advanced object-oriented concepts and mechanisms. Throughout the course, emphasis is placed on adopting best practices for naming packages and creating executables. Students will also explore code management tools, learn to write clear documentation, and apply test-driven development principles to produce clean code. By the end of the course, students will have enhanced their proficiency in Python, enabling them to write code that is not only functional but also readable, reusable, and easily maintainable.

COMP310 **Course Description**	**Game Design and Development**	**CSCI207**	**3 cr.**

This course introduces students with a strong programming background to the world of game development using the Unity platform and C# programming language. Students will learn game design principles, physics, animation, input handling, mechanics, and artificial intelligence. Through hands-on projects, they will develop their own games, gaining practical experience in coding game components and optimizing performance. By the end of the course, students will have the skills to create fully functional games and understand the game development process. This course opens doors to exciting careers in the game development industry.

COMP411	**Advanced Data Structure and Algorithm**	**CSCI316**	**3 cr.**
Course Description			

This course continues the study of data structures and algorithms, focusing on algorithm design and analysis and the relationships between data representation, algorithm design, and program efficiency. Topics include key algorithm design techniques, analysis of the time and space requirements of algorithms, and characterizing the difficulty of solving a problem. Advanced topics such as dynamic programming, greedy algorithms, and graph algorithms.

COMP412   **Advanced databases**   CSCI311   3 cr.

Course
Description   This course provides the students with the ability to control, manage and maintain the organization's data. Give an in-depth understanding of database resiliency and disaster recovery after gaining knowledge in planning, designing, implementing and fine-tuning the database operations. Students will know how to use and implement policies in an organization as well as secure and audit the data accessed by others. The course utilizes the open-source relational database PostgreSQL. PostgreSQL is the most professional of the relational Open Source databases. It is a highly reliable, stable, scalable and secure system, and has been around for more than two decades now. PostgreSQL is professionally maintained and developed software, capable of running complex, data-driven applications.

COMP413   **Advanced Data Structure and Algorithms**   CSCI207, CSCI311   3 cr.

Course
Description

This course provides a comprehensive understanding of mobile computing principles, technologies, and applications. Students will explore topics such as mobile operating systems, application development, network protocols, user interface design, data synchronization, location-based services, and mobile security. They will gain hands-on experience in developing mobile applications for Android and iOS platforms using industry-standard tools. The course prepares students for careers in mobile application development and equips them with the skills to navigate challenges specific to mobile computing. Ethical and legal considerations in mobile computing are also covered. This course focuses on teaching students how to design, implement, test, debug and publish smartphone applications. Students will learn how to take their innovative ideas through a series of Labs and group projects.

COMP414   **Cloud computing**   CSCI207   3 cr.

Course
Description   This course covers a series of current cloud computing technologies, including technologies for Infrastructure as a Service, Platform as a Service, Software as a Service, and Physical Systems as a Service. An overview of the main elements of the cloud is given, as well as the different ways the data can be stored and managed. The course will also go over the virtualization technology in the cloud. In addition, it will pass through the distributed computing technologies and tools such as Apache Hadoop, Kafka, and Spark. At the end, it explains the four NoSQL database types and focuses on the MongoDB Atlas which is the MongoDB online cloud service.

| COMP420 | **Application development** | **CSCI315** | **3 cr.** |

Course Description

This course introduces the students ASP.NET MVC, a powerful web development framework that allows them to build scalable and efficient web applications. Through hands-on exercises, students will learn how to design and organize their application's code using the Model-View-Controller (MVC) architectural pattern for improved reusability and maintainability. They will gain practical experience in creating dynamic and interactive user interfaces using HTML, CSS, and JavaScript. The course will cover essential features of ASP.NET MVC, including routing, data validation, and authentication, enabling students to develop robust and secure web applications. Whether students are beginners or experienced developers, this course will equip them with the skills needed to leverage the full potential of ASP.NET MVC in their projects.

| DTSC301 | **Introduction to Data Science** | **CSCI206, MATH304** | **3 cr.** |

Course Description

The Introduction to Data Science course provides students with a foundational understanding of key concepts and techniques in data science. Students learn to use the R programming language for statistical analysis, data cleaning, and data visualization. They acquire skills in obtaining and organizing data from various sources, including the web, APIs, and databases. The course covers important topics such as cluster analysis, variability, distributions, confidence intervals, and regression analysis. Students also learn to create graphical displays of data, including high-dimensional data. The course emphasizes reproducibility in data analysis and equips students with the ability to build prediction functions. By the end of the course, students have a strong grasp of fundamental data science principles and practical skills in working with data using R.

| DTSC420 | **Natural Language Processing** | **MATH304, CSCI410** | **3 cr.** |

Course Description

The Natural Language Processing course covers essential topics and techniques in computational language processing. Students will learn and implement classic and stochastic algorithms for NLP tasks. They will explore challenges in representing meaning and understand the advantages of using standard corpora. The course introduces techniques for information retrieval, language translation, and text classification. Students will gain hands-on experience with implementing TF/IDF transforms and training machine learning algorithms for text classification. The course also covers deep learning approaches for language modeling, feature representations, and self-supervised learning in NLP. By the end of the course, students will be equipped with practical NLP skills and knowledge.

DTSC422	**Time series and statistical forecasting**	**MATH304, CSCI206**	**3 cr.**

Course Description

This course focuses on the analysis and modeling of time series data. Students will learn how to understand the temporal patterns in data, apply statistical techniques for forecasting, and evaluate the performance of time series models. Topics covered include stationarity, autocorrelation, trend analysis, seasonal decomposition, and various time series models such as ARIMA and exponential smoothing. Practical applications and hands-on experience with real-world time series data will be emphasized. By the end of the course, students will be able to effectively analyze and forecast time series data for decision-making purposes.

DTSC424	**Deep learning**	**CSCI410**	**3 cr.**

Course Description

The Deep Learning course is a comprehensive program that delves into both the fundamentals and advanced techniques of deep learning and neural networks. This course is designed to offer students a profound understanding of the underlying concepts, essential tools, and effective strategies necessary for constructing and optimizing powerful neural network models. Through a combination of theoretical lectures, practical programming assignments, and real-world application examples, students will gain the expertise needed to excel in the rapidly evolving field of deep learning.

SECU313	**Computer Networks – II : Routing and Switching**	**CSCI212**	**3 cr.**

Course Description

This Computer Networks – II : Routing and Switching Essentials delves deeper into the fundamental building blocks of network connectivity: routers and switches. Expanding on introductory knowledge obtained in CSCI212, students will gain a comprehensive understanding of their architecture, components, and crucial functionalities. Students will explore how these intermediary network elements weave together the fabric of networks, ensuring seamless data flow across devices. The course covers both theoretical and practical aspects. On the theoretical side, students will master the core roles of routers and switches, unraveling their inner workings and grasping their significance in routing protocols, network segmentation (VLANs), and address translation (NAT). Additionally, they will be introduced to essential network security and monitoring concepts, equipping you with a holistic view of network operations. On the practical side, students will learn to configure routers and switches for basic functionality. Through labs and simulated scenarios, they will learn to tackle common network issues with confidence, employing skills in static and dynamic routing, VLAN configuration, network address translation, and security access control lists. They will also explore dynamic host configuration and network monitoring protocols, empowering them to manage and troubleshoot your network efficiently.

| **SECU314** | **Computer Networks – III : Scaling and Connecting Networks** | **SECU313** | **4 cr. (3;1)** |

Course Description

This course builds upon the knowledge acquired in the CSCI212 and SECU313 courses, delving into the architecture, components, and operations of routers and switches within larger and more complex networks. Students will gain proficiency in configuring routers and switches for advanced functionality. By the end of the course, students will have the ability to configure and troubleshoot routers and switches, addressing common issues with OSPF, EIGRP, and STP in both IPv4 and IPv6 networks. Additionally, students will develop the knowledge and skills necessary to implement a WLAN in a small-to-medium network.

| **SECU316** | **Systems and network administration** | **SECU313** | **3 cr.** |

Course Description

This course provides a comprehensive understanding of network and system administration. Through lectures, labs, and hands-on exercises, students will explore networking protocols, server management, virtualization, security, automation, and other core aspects. Emphasizing both theoretical principles and practical application, the course aims to equip students with the skills needed for a career in network and system administration.

| **SECU420** | **Network Security** | **SECU313, SECU301** | **3 cr.** |

Course Description

This course is designed to equip students with a deep understanding of contemporary security measures in computer networks. Beginning with an introduction to essential concepts, the course progresses through a journey that includes Firewalls, Intrusion Prevention Systems (IPS), Mail Security, Web Application Firewalls (WAF), LAN and Endpoint Security, Sandboxing, Security Information and Event Management (SIEM), Securing Network Devices, and Wireless Network Security. Through a blend of theoretical discussions, hands-on labs, and real-world case studies, students will gain practical skills to implement, manage, and troubleshoot diverse security measures to safeguard network infrastructures.

| **SECU422** | **Web application security** | CSCI315, SECU301, SECU313 | **3 cr.** |

Course Description

This 3-credit course provides students with a comprehensive understanding of the security principles and practices necessary for modern web applications. It covers the core security challenges, attack vectors, defense mechanisms, and hands-on lab sessions using vulnerable web applications like OWASP Juice Shop and WebGoat. Students will gain the knowledge and skills required to secure web applications and protect them from various security threats.

| **SECU424** | **Ethical Hacking and penetration testing** | **SECU313, SECU301** | **3 cr.** |

Course Description This course provides a comprehensive introduction to ethical hacking and penetration testing, following the Certified Ethical Hacker (CEH) professional certification framework. It provides a comprehensive grounding in the methodology, techniques and culture of ethical hacking. Students will learn the essential skills and techniques required to identify and counteract security vulnerabilities, with a focus on ethical and responsible hacking practices.

| **SECU426** | **Information security management** | **SECU301, SECU316** | **3 cr.** |

Course Description This course introduces students to the fundamentals of information security management, preparing them to protect an organization's critical information assets. Through a comprehensive exploration of key concepts, legal frameworks, risk management strategies, and security management practices, students will gain the knowledge and skills needed to design, implement, and maintain effective information security programs.

| **SECU430** | **Introduction to digital forensics** | **SECU301, SECU313** | **2 cr.** |

Course Description This course introduces students to the fundamental concepts and techniques of digital forensics, focusing on the acquisition, preservation, and analysis of digital evidence in the context of computer security and networking. Students will gain hands-on experience in investigating cybercrimes and security incidents.

| **CSCI420** | **Final Year Project** | **90 credits** | **3 cr.** |

Course Description This course is a culmination of the students' academic journey, where they prepare their senior projects with a focus on software engineering or system engineering for cybersecurity students. In the initial phase, students analyze project requirements and formulate comprehensive project plans. They then transition into the development and design stage, working collaboratively in groups to divide tasks and create robust solutions. Emphasis is placed on applying software engineering principles and cybersecurity best practices. During the testing phase, students rigorously verify and validate their solutions, ensuring reliability, functionality, and security. Finally, students present and demonstrate their projects, showcasing features and innovations to an audience of peers and professionals. Clear roles, efficient communication, and coordinated efforts are emphasized. Regular progress updates and peer feedback promote accountability. The course provides hands-on experience in project management, software/system engineering, development, testing, and presentation skills. It prepares students for future endeavors and showcases their achievements.