جامعة الفيصل
Alfaisal University

BS in Data Science and Engineering Program

Alfaisal University, College of Engineering & Advanced Computing

Effective: Fall 2025

Approved: April 2025
Revised: May 2026

Curriculum Structure and Study Plan

The Data Science and Engineering program curriculum is composed of **128** Credit Hours (CRHs) divided as follows:

I. University General Education Requirements (19 CRHs)
1. Arts & Humanities (6 CRHs)
2. Social Sciences (9 CRHs)
3. Sciences (4 CRHs)

II. Major Requirements (109 CRHs)
1. Core Major Requirements (94 CRHs)
2. Technical Electives (15 CRHs)
3. Summer Internship (0 CRHs)

I. University General Education Requirements (19 CRHs)

1. Arts & Humanities (6 CRHs)

Course Code	Course-Title	Credit Hours (CRHs)				Prerequisite Course Code	Co-Requisite Course Code
		Total-CRHs	Lect.	Lab	Tut		
ENG 101	University Writing	3	3	0	0		
ENG 222	Technical Writing	3	3	0	0	ENG 101	

2. Social Sciences (9 CRHs)

Course Code	Course-Title	Credit Hours (CRHs)				Prerequisite Course Code	Co-Requisite Course Code
		Total-CRHs	Lect.	Lab	Tut		
____	Social Sciences Elective I*	3	3	0	0		
____	Social Sciences Elective II *	3	3	0	0		
____	Social Sciences Elective III*	3	3	0	0		

* Select any three 3-CRHs courses (i.e., 9 CRHs in total) from the University-approved list of Social Sciences courses.

3. Sciences (4 CRHs)

Course Code	Course-Title	Credit Hours (CRHs)				Prerequisite Course Code	Co-Requisite Course Code
		Total-CRHs	Lect.	Lab	Tut		
SE 100	Programming for Engineers	3	3	0	0		SE 100L

SE 100 L	**Programming for Engineers Lab**	**1**	**0**	**2**	**0**		**SE 100**

II. Major Requirements (109 CRHs)

1. Core Major Requirements (94 CRHs)

Course Code	Course-Title	Credit Hours (CRHs)				Pre-Requisite Course Code	Co-Requisite Course Code
		Total-CRHs	Lect	Lab	Tut		
MAT 101	Calculus I	3	3	0	1		
MAT 112	Calculus II	3	3	0	0	MAT 101	
MAT 211	Calculus III	3	3	0	0	MAT 112	
MAT 212	Linear Algebra	3	3	0	0	MAT 112	
PHU 103	Physics I	3	3	0	1		MAT 101, PHU 103L
PHU 103 L	Physics I Lab	1	0	2	0		PHU 103
COE 100	Student Orientation & Academic Success	1	1	0	0		
EE 210	Digital Logic Design	3	0	0	0	PHU 103	EE 210L
EE 210 L	Digital Logic Design Lab	1	0	2	0		EE 210
SE 120	Object-Oriented Programming I	3	3	0	0	SE 100	SE 120L
SE 120 L	Object-Oriented Programming I Lab	1	0	2	0		SE 120
SE 151	Discrete Mathematics	3	3	0	0	SE 100	
DSE 200	Introduction to Data Science	3	3	0	0	SE 120	STA 212
SE 201	Introduction to Software Engineering	3	3	0	0	SE 120	
DSE 251	Data Visualization	3	3	0	0	DSE 200	
STA 212	Probability and Statistics	3	3	0	0	MAT 112	
SE 215	Data Structures	3	3	0	0	SE 120	SE 215L
SE 215 L	Data Structures Lab	1	0	2	0		SE 215
SE 239	Network Programming	3	3	0	0	SE 120	
AI 250	Introduction to Artificial Intelligence	3	3	0	0	SE 215	

CSE 250	Introduction to Cybersecurity	3	3	0	0	SE 239	
SE 252	Database Management Systems	3	3	0	0	SE 215	SE 252L
SE 252 L	Database Management Systems Lab	1	0	2	0		SE 252
SE 314	Operating Systems	3	3	0	0	SE 215	
DSE 300	Data Preparation and Feature Design	3	3	0	0	DSE 200, SE 215	
SE 301	Analysis of Algorithms	3	3	0	0	SE 215	
DSE 302	Optimization for Data Science	3	3	0	0	STA 212, MAT 212	
SE 316	Application Development	3	3	0	0	SE 252	
DSE 320	Data Mining	3	3	0	0	DSE 300	
DSE 322	Big Data and Data Warehousing	3	3	0	0	SE 252	
DSE 324	Social Network Analysis	3	3	0	0	SE 301, DSE 251	
AI 347	Introduction to Machine Learning	3	3	0	0	MAT 212, STA 212	
AI 480	Natural Language Processing	3	3	0	0	AI 347	
DSE 495	Capstone Project I	3	0	6	0	DSE 320, DSE 322, AI 347	
DSE 496	Capstone Project II	3	0	6	0	DSE 495	
SE 481	Ethics and Professional Development	1	1	0	0		

2. **Technical Electives (15 CRHs)**
   Select from the following courses:

Course Code	Course-Title	Credit Hours (CRHs)				Pre-Requisite Course Code	Co-Requisite Course Code
		Total-CRHs	Lect	Lab	Tut		
AI 447	Deep Learning	3	3	0	0	AI 347	
DSE 451	Advanced Databases	3	3	0	0	SE 252	

DSE 452	Data Engineering and Pipelines	3	3	0	0	DSE 320, DSE 322	
DSE 401	Optimization Techniques for ML	3	3	0	0	AI 347	
SE 435	Undergraduate Research in Software Engineering	3	0	6	0	SE 310, SE 322 or CSE 250, SE 316, and Department Chair approval. A GPA of at least 3.0/4.0, and a signed research contract	
SE 440	Special Topics in Software Engineering	3	3	0	0	SE 316	
SE 441	Telecommunications Software Design	3	3	0	0	SE 239	
SE 442	Social Networks for Software Engineers	3	3	0	0	SE 316	
SE 443	Cloud Computing	3	3	0	0	SE 316, SE 239	
AI 444	Artificial Intelligence	3	3	0	0	AI 250	
CSE 445	Information and Software Security	3	3	0	0	CSE 250, SE 316	
SE 448	Blockchain Development	3	3	0	0	SE 215, SE 239	
DSE 449	Data Analytics	3	3	0	0	SE 252, STA 212	
CSE 451	Secure Software Engineering	3	3	0	0	SE 310, CSE 442	
CSE 442	Network Security	3	3	0	0	CSE 350	
CSE 454	Ethical Hacking and Systems Defense	3	3	0	0	CSE 442	
CSE 453	Security Risk Management & Control	3	3	0	0	CSE 250	
AI 480	Natural Language Processing	3	3	0	0	AI 347	
AI 455	Generative AI	3	3	0	0	AI 347	
SE 461	Game Engine Architecture & Implementation	3	3	0	0	SE 316	
SE 462	Fundamentals of Game Design	3	3	0	0	SE 310	

SE 463	Game Mechanics, Prototyping, and Production	3	3	0	0	SE 412	
SE 464	Innovative Topics in Immersive Game Development	3	3	0	0	SE 316	
CSE 444	Web and mobile security	3	3	0	0	SE 316, CSE 250	
CSE 472	Penetration Testing	3	3	0	0	CSE 442	
CSE 410	Security Architecture	3	3	0	0	SE 201, CSE 250	
SE 400	Theory of Computation	3	3	0	0	SE 151, SE 215	
AI 462	Product Management for AI	3	3	0	0	AI 250	
AI 460	Agent Based Systems	3	3	0	0	SE 215, AI 250	
AI 472	Expert Systems	3	3	0	0	AI 250	
AI 483	AI in Robotics	3	3	0	0	AI 250	
AI 475	Game Theory	3	3	0	0	SE 301	
SE 423	Software Construction & Processes	3	3	0	0	SE 412	
AI 451	AI Tools and applications	3	3	0	0	AI 250	AI 347

3. Summer Internship (0 CRHs)

Course Code	Course-Title	Credit Hours (CRHs)	Pre-Requisite Course Code	Co-Requisite Course Code
DSE 390	Internship	0	Department approval	

Typical Study Plan- Data Science and Engineering Program

4-Year Curriculum: ***128*** ***Credit Hours Total***

Each course below follows the following format:
Course code, Course Title, and Course Credit Hours (Lecture contact hours – Lab contact hours – Tutorial contact hours)

1st Year			
Fall	Course Code	Course-Title	CRHs
	SE 100	**Programming for Engineers**	**3 (3-0-0)**
	SE 100 L	**Programming for Engineers Lab**	**1 (0-2-0)**
	COE 100	**Student Orientation & Academic Success**	**1 (1-0-0)**
	MAT 101	**Calculus I**	**3 (3-0-2)**
	PHU 103	**Physics I**	**3 (3-0-1)**
	PHU 103 L	**Physics I Lab**	**1 (0-2-0)**
	ENG 101	**University Writing**	**3 (3-0-0)**
	_ _ _ _ _ _	**Social Sciences Elective I**	**3 (3-0-0)**
		Total	**18**
Spring	Course Code	Course-Title	CRHs
	SE 120	**Object-Oriented Programming I**	**3 (3-0-0)**
	SE 120 L	**Object-Oriented Programming I Lab**	**1 (0-2-0)**
	SE 151	**Discrete Mathematics**	**3 (3-0-0)**
	MAT 112	**Calculus II**	**3 (3-0-2)**
	EE 210	**Digital Logic Design**	**3 (3-0-0)**
	EE 210 L	**Digital Logic Design Lab**	**1 (0-2-0)**
	ENG 222	**Technical Writing**	**3 (3-0-0)**
		Total	**17**

2nd Year

Fall	Course Code	Course-Title	CRHs
	DSE 200	**Introduction to Data Science**	**3 (3-0-0)**
	SE 215	**Data Structures**	**3 (3-0-0)**
	SE 215 L	**Data Structures Lab**	**1 (0-2-0)**
	SE 239	**Network Programming**	**3 (3-0-0)**
	STA 212	**Probability and Statistics**	**3 (3-0-0)**
	MAT 212	**Linear Algebra**	**3 (3-0-0)**
		Total	**16**
Spring	Course Code	Course-Title	CRHs
	SE 252	**Database Management Systems**	**3 (3-0-0)**
	SE 252 L	**Database Management Systems Lab**	**1 (0-2-0)**
	DSE 251	**Data Visualization**	**3 (3-0-0)**
	AI 250	**Introduction to Artificial Intelligence**	**3 (3-0-0)**
	CSE 250	**Introduction to Cybersecurity**	**3 (3-0-0)**
	MAT 211	**Calculus III**	**3 (3-0-0)**
		Total	**16**

3rd Year			
Fall	Course Code	Course-Title	CRHs
	DSE 300	**Data Preparation and Feature Design**	**3 (3-0-0)**
	SE 301	**Analysis of Algorithms**	**3 (3-0-0)**
	SE 314	**Operating Systems**	**3 (3-0-0)**
	SE 316	**Application Development**	**3 (3-0-0)**
	AI 347	**Introduction to Machine Learning**	**3 (3-0-0)**
		Total	**15**
Spring	Course Code	Course-Title	CRHs
	SE 201	**Introduction to Software Engineering**	**3 (3-0-0)**
	DSE 302	**Optimization for Data Science**	**3 (3-0-0)**
	DSE 320	**Data Mining**	**3 (3-0-0)**

	DSE 322	**Big Data and Data Warehousing**	**3 (3-0-0)**
	DSE 324	**Social Network Analysis**	**3 (3-0-0)**
	_ _ _ _ _ _	**Social Sciences Elective II**	**3 (3-0-0)**
			18

Summer	Course Code	Course-Title	CRHs
	DSE 390	**Internship**	**0**
		Total	**0**

4th Year			
Fall	Course Code	Course-Title	CRHs
	_ _ _4 _ _	**Technical Elective I**	**3 (3-0-0)**
	_ _ _4_ _	**Technical Elective II**	**3 (3-0-0)**
	AI 480	**Natural Language Processing**	**3 (3-0-0)**
	DSE 495	**Capstone Project I**	**3 (0-6-0)**
	_ _ _ _ _ _	**Social Sciences Elective III**	**3 (3-0-0)**
		Total	**15**
Spring	Course Code	Course-Title	CRHs
	SE 481	**Ethics and Professional Development**	**1 (1-0-0)**
	_ _ _4 _ _	**Technical Elective III**	**3 (3-0-0)**
	_ _ _4_ _	**Technical Elective IV**	**3 (3-0-0)**
	_ _ _4_ _	**Technical Elective V**	**3 (3-0-0)**
	DSE 496	**Capstone Project II**	**3 (0-6-0)**
		Total	**13**

Course Descriptions

In this section, we give brief descriptions of courses in the Data Science and Engineering program. Each course below follows the following format:

Course code: Course Title Course credit hours (Lecture contact hours – Lab contact hours – Tutorial contact hours)

Course Description

Prerequisite(s)

Co-requisites

Core Courses

SE 100: Programming for Engineers 3 (3-0-0)

The course introduces the students to basic notions of computers and computing and then introduces them to programming starting from abstract ways like flowcharts and pseudocode and finally using a typical programming language. The students will be introduced to the basic concepts of data types and structures, operators, and the different ways of data storage, manipulation, and representation.
Emphasis is on problem-solving and structured program design methodologies.
Prerequisite(s): None
Co-requisites: SE 100L

SE 100 L: Programming for Engineers Lab 1 (0-2-0)

This course constitutes the lab component of the Programming for Engineers course (SE 100). The purpose of this lab is to provide hands-on training on programming concepts, technologies and techniques introduced during lectures.
Prerequisite(s): None
Co-requisites: SE 100

SE 120: Object-Oriented Programming I 3 (3-0-0)

After completing this course, students will be equipped with the necessary skills and tools to write programs in Java based on a procedural and object-oriented approach. Topics of focus will include basic Java programming, conditional statements, strings, iteration, methods, arrays, creating classes, encapsulation, inheritance and polymorphism, abstract classes, packages, principles of object-oriented design, as well as exceptions and interfaces.
Prerequisite(s): SE 100
Co-requisites: SE 120L

SE 120 L: Object-Oriented Programming I Lab 1 (0-2-0)

This course constitutes the lab component of the Object-Oriented Programming I course (SE 120). The purpose of this lab is to provide hands-on training on the basics of Java and advanced object-oriented programming. Topics covered include data types and operators, logical expressions, control structures, methods, arrays, inheritance; polymorphism; abstract classes and interfaces. be covered.
Prerequisite(s): None
Co-requisites: SE 120

SE 151: Discrete Mathematics **3 (3-0-0)**
This course covers the mathematical elements of computer science including formal logic, propositional logic, predicate logic, logic in mathematics, sets, functions and relations, recursive thinking, mathematical induction, counting, combinatorics, algorithms, matrices, graphs, trees, and Boolean logic. Students will learn to recognize and express mathematical ideas graphically, numerically, symbolically, and in writing.
Prerequisite(s): SE 100

DSE 200: Introduction to Data Science **3 (3-0-0)**
This course introduces students to the fundamental concepts, techniques, and applications of Data Science. Students will learn the complete data science workflow, including data collection, preprocessing, exploratory data analysis, visualization, and basic predictive modeling. The course covers essential topics such as data representation, statistical analysis, data cleaning, feature engineering, and introductory machine learning concepts. Students will also gain hands-on experience using data science tools and programming environments to analyze datasets and extract meaningful insights for decision-making. Real-world applications from domains such as healthcare, business, finance, and smart systems will be explored to demonstrate the practical use of data science techniques.
Prerequisite(s): SE 120
Co-requisites: STA 212

DSE 251: Data Visualization **3 (3-0-0)**
This course introduces the principles, techniques, and tools used for effective visualization and communication of data. Students will learn how to transform raw data into meaningful visual representations that support analysis and decision-making. Topics include data exploration, visual encoding techniques, chart and dashboard design, interactive visualization, data storytelling, and best practices for presenting information clearly and effectively. The course also introduces visualization tools and programming libraries used for creating visual analytics solutions. Through hands-on exercises and projects, students will gain practical experience in developing informative and visually compelling data presentations for real-world applications.
Prerequisite(s): DSE 200

SE 201: Introduction to Software Engineering **3 (3-0-0)**
This course is designed to present students with several principles relevant to Software Engineering. Students will gain insights into various software process models throughout the course. The curriculum strongly emphasizes the agile software development approach, highlighting the importance of adaptability and collaborative teamwork. Students will acquire knowledge and skills in requirements engineering. The course covers systems modeling and project management strategies. It addresses the value of software reuse and introduces students to human computer interaction and software testing. The final segment of the course focuses on configuration management.
Prerequisite(s): SE 120

STA 212: Probability and Statistics **3 (3-0-0)**
The course is designed to teach students the basics of probability and statistics as used in engineering and the sciences. The course covers introduction to probability theory, random variables, statistics, and regression.
Prerequisite(s): MAT 112

AI 250: Introduction to Artificial Intelligence **3 (3-0-0)**
This course introduces students to the fundamental concepts, techniques, and tools used in artificial intelligence (AI). Topics include perception, reasoning, learning, and search algorithms (informed and uninformed). Students will gain skills in applying AI techniques to real-world problems.
Prerequisite(s): SE 215

SE 215: Data Structures **3 (3-0-0)**
The course involves the study of important data structures and sorting methods commonly encountered in object-oriented software engineering. It covers the design, performance analysis, and implementation of the related algorithms, stressing their practical use and performance.
Prerequisite(s): SE 120
Co-requisites: SE 215L

SE 215 L: Data Structures Lab **1 (0-2-0)**
Survey of important computer algorithms and related data structures used in object-oriented software engineering. Design, performance analysis and implementation of such algorithms, stressing their practical use and performance certification of large software applications. Understand how to "seal" designs to guarantee performance goals and ensure that all error conditions are caught. Laboratory experiments dealing with Algorithms and Data Structures.
Prerequisite(s): None
Co-requisites: SE 215

SE 239: Network Programming **3 (3-0-0)**
The course teaches the fundamental concepts of communication networks and is concerned specifically with network architectures and protocols. The objective of the course is to allow students to develop a thorough understanding of the architectures of networks and the basic principles and protocols that allow the transmission of data over networks.
Prerequisite(s): SE 120

SE 252: Database Management Systems **3 (3-0-0)**
The focus is to teach database fundamentals required in the development and evolution of most software applications by providing a basic introduction to the principles of relational database management systems such as Entity-Relationship approach to data modeling, relational model of database management systems and the use of query languages.
Prerequisite(s): SE 215
Co-requisites: SE 252 L

SE 252 L: Database Management Systems Lab **1 (0-2-0)**
Laboratory experiments dealing with database management systems.
Prerequisite(s): None
Co-requisites: SE 252

SE 314: Operating Systems **3 (3-0-0)**
Theory and construction of operating systems, including real-time and embedded systems aspect from an engineering point of view, stressing performance measurement and metrics. Quality of Service issues leading to certification that an operating system will satisfy hard real-time constraints.
Prerequisite(s): SE 215
Co-requisites: None

DSE 300: Data Preparation and Feature Design **3 (3-0-0)**
This course delves into the critical preprocessing steps required to convert raw data into meaningful formats for analysis. Students will learn techniques for handling missing data, detecting outliers, scaling features, and encoding categorical variables. The course also emphasizes feature engineering and selection strategies to improve the performance of machine learning models through practical exercise.
Prerequisite(s): SE 215, DSE 200

SE 301: Analysis of Algorithms **3 (3-0-0)**
This course examines the design and analyses algorithms with an emphasis on their application in real world environments. Topics include time complexity, space complexity, and optimization strategies for various algorithms. Students will gain experience with sorting, searching, and graph algorithms, as well as dynamic programming techniques. Special focus will be placed on algorithmic problem-solving in real world environments.
Prerequisite(s): SE 215

DSE 302: Optimization for Data Science **3 (3-0-0)**
This course introduces the fundamental principles and techniques of optimization used in data science and machine learning applications. Students will learn mathematical and computational methods for finding optimal solutions to problems involving data analysis, predictive modeling, and decision-making. Topics include linear and nonlinear optimization, constrained and unconstrained optimization, convex optimization, gradient-based methods, stochastic optimization, and optimization techniques used in machine learning algorithms. Students will also explore practical applications of optimization in areas such as model training, parameter tuning, resource allocation, and data-driven decision systems. Through hands-on exercises and projects, students will gain experience in applying optimization techniques to solve real-world data science problems.
Prerequisite(s): STA 212, MAT 212

SE 316: Application Development **3 (3-0-0)**
This course covers the principles of applications deployed on different platforms such as mobiles, web, and cloud. Students will explore different development environments, and understand concepts from memory management, user interface design, GPS, and motion sensing. Multiple programming languages will be explored such as markup languages (e.g., XHTML, XML), scripting languages (e.g., JavaScript, PHP, Ruby), Ajax, web services, and database integration (e.g., MySQL). Through project-based learning, students will develop professional-quality applications for real-world deployment.
Prerequisite(s): SE 252

DSE 320: Data Mining **3 (3-0-0)**
Data mining focuses on extracting meaningful patterns and knowledge from large datasets. This course covers foundational data mining techniques such as association rule mining, clustering, and classification. Emphasis is placed on understanding the theoretical concepts behind these methods while applying them to practical scenarios. Students will explore tools and libraries used for data mining tasks and tackle projects that simulate real-world applications.

Prerequisite(s): DSE 300

DSE 322: Big Data and Data Warehousing **3 (3-0-0)**
Big data is transforming industries by enabling the analysis of massive datasets. This course focuses on the architecture, tools, and methodologies used in big data analytics and data warehousing. Students will learn about distributed systems like Hadoop and Spark, as well as the principles of data warehousing design and implementation.
Prerequisite(s): SE 252

SE 443: Cloud Computing **3 (3-0-0)**
This course explores the role of cloud computing, including scalable data storage, distributed computing, and cloud-based machine learning. Students will gain hands-on experience with cloud platforms like AWS and Google Cloud to execute workflows efficiently.
Prerequisite(s):SE 316, SE 239

DSE 324: Social Network Analysis **3 (3-0-0)**
Social networks represent complex relationships and interactions. This course introduces students to methods for analysing social networks, including graph theory, community detection, and influence propagation. Applications in marketing, public health, and communication studies are highlighted.
Prerequisite(s): SE 301, DSE 251

CSE 250: Introduction to Cybersecurity **3 (3-0-0)**
This course provides an overview of core cybersecurity concepts, emphasizing the fundamental principles, tools, and procedures used to secure information systems. Students will employ the CIA triad as a guiding framework, explore prevalent threats, and examine various information security solutions. The course focuses on security and risk management, business impact analysis (BIA), asset security, vulnerabilities, threats and countermeasures, identity and authentication management, incident response and BCP/DRP, as well as key compliance and regulatory issues. By the end of the course, students will have broad, practical knowledge of cybersecurity, including the ability to identify security risks, implement effective defensive measures, and approach cybersecurity challenges with strategic thinking.
Prerequisite(s): SE 239

AI 347: Introduction to Machine Learning **3 (3-0-0)**
This course introduces machine learning with a practical approach covering some of the most common learning models, algorithms, tools, and techniques. From supervised learning, it covers linear regression, logistic regression, and neural networks. From unsupervised learning, it covers Kmeans clustering, dimensionality reduction (principal component analysis), and anomaly detection. The course also discusses practical aspects considered when applying machine learning: data visualization, model selection, flow, model evaluation (testing, validation, overfitting, underfitting, bias, variance), regularization, and large-scale machine learning.
Prerequisite(s): MAT 212, STA 212

AI 460: Agent Based Systems **3 (3-0-0)**
This course introduces the concepts, principles, and techniques used in designing intelligent agent-based systems. Students will learn about autonomous agents, agent architectures, agent environments, and the interaction mechanisms among multiple agents. The course covers topics such as reactive and deliberative agents, multi-agent systems, cooperation and coordination strategies, communication protocols, decision-making processes, and learning in agent environments. Students will also explore practical applications of agent-based systems in domains such as robotics, smart systems, distributed computing, game environments, and autonomous decision

support systems. Through hands-on projects and case studies, students will gain experience in developing and analyzing intelligent agent-based solutions for real-world problems.

Prerequisite(s): SE 215, AI 250

DSE 390: Internship **(0 CRHs)**

An internship is an important aspect of the DSE curriculum that provides the student with hands-on experience and a good sense of what an actual job in an organization will be like. Students are required to join an IT department in a government or private organization for a summer period of at least 8 weeks in the last summer prior to student graduation. Students should be able to relate the internship experience to the knowledge that he or she has gained through the DSE program courses.
Prerequisite(s): Department approval

SE 400: Theory of Computation **3 (3-0-0)**

This course introduces fundamental concepts in the theory of computation. Students will be introduced to formal languages, automata, computability and computational complexity. These include finite automatons, Turing machines, grammars, decidable problems, reductive procedures and different kinds of computational problems. The course aims to explore these theoretical concepts to apply on practical issues of interest to software engineering, data science, and AI, for instance, natural language processing, algorithmic development and evaluation of computational efficiency. By the end of this course, students will be able to assess the performance bounds of computing models and their applicability towards modern computing problems.
Prerequisite(s): SE 151, SE 215

DSE 401: Optimization Techniques for ML **3 (3-0-0)**

This course delves into advanced optimization methods used in machine learning, such as convex optimization, stochastic gradient descent, and optimization under constraints. Students will apply these techniques to improve machine learning model performance, focusing on real-world challenges in tuning and scalability.
Prerequisite(s): AI 347

AI 480: Natural Language Processing **3 (3-0-0)**

This course introduces the concepts and techniques used in natural language processing (NLP), including text preprocessing, word embeddings, and language models. Students will explore applications such as sentiment analysis, machine translation, and chatbot development. Projects focus on using modern NLP libraries and frameworks to solve practical challenges.
Prerequisite(s): AI 347

DSE 495: Capstone Project I **3 (0-6-0)**

This course is the first part of a two-semester senior capstone project designed to provide students with practical experience in solving real-world data science and engineering problems. Students will work individually or in teams to identify a problem, analyze requirements, conduct literature review, collect and prepare data, and propose an appropriate data-driven solution. The course emphasizes project planning, problem formulation, methodology selection, system design, and development of a project proposal. Students are expected to apply the knowledge and skills acquired throughout the program while considering technical, ethical, and professional aspects of the project.
Prerequisite(s): DSE 320, DSE 322, AI 347

DSE 496: Capstone Project II **3 (0-6-0)**

Building on the groundwork laid in DSE 495, this course focuses on implementing and completing the capstone project. Students will execute their proposed solutions. Teams will utilize industry standard tools and techniques to develop a functional prototype or system. The course culminates with a comprehensive project report and a formal presentation to faculty and/or industry stakeholders, demonstrating the ability to tackle complex, real-world problems with data-driven strategies. Emphasis is placed on teamwork, project management, and effective communication of findings.
Prerequisite(s): DSE 495

AI 475: Game Theory **3 (3-0-0)**

Game theory underpins several important recent advancements in AI such as multi-agent reinforcement learning and generative adversarial networks. Applications within computer science include the use of games in automated verification & model checking to model computing systems in an unknown and possibly adverse environment. In AI, games are applied to the analysis of multiagent systems. Recently, with the advent of the internet and e-commerce, many game theoretic questions in the interplay between economics & computing have received extensive attention. These include electronic auctions, & more generally mechanism design questions (inverse game theory) related to finding incentive structures for cooperation between independent entities on the internet. The course introduces students to the theory of non-cooperative games covering both its economic and algorithmic aspects. Topics that will be covered include equilibria, their existence and quality, equilibrium learning and computation.
Prerequisite(s): SE 301

COE 100: Student Orientation & Academic Success **1 (1-0-0)**

This course introduces students in the College of Engineering (COE) to their rights and responsibilities as a student at the COE and develops their skills to foster academic success. Students will develop a thorough understanding of the academic policies and procedures applicable to the COE Students, including policies and procedures related to attendance vs participation, academic integrity, academic probations, outside studies programs and credit transfer, grade appeals, GPA calculations, repeating courses, make-up exams, sick-leave, student advising, etc. The course will also familiarize students with their study plans, including requirements for adding a minor or a double major; equip them with the skill required to access and utilize the rich library resources; introduce them to the set of extracurricular activities available at Alfaisal; and enhance their time management and study skills. The course will be delivered as a combination of online and face-to-face sessions. It will use online resources as well as guest speakers to educate students on the important aspects of their academic life.
Prerequisite(s): None

SE 481: Ethics and Professional Development **1 (1-0-0)**

The course will integrate modules covering ethics, career and professional development, along with preparations for taking the Jahiziyah/ Saudi Engineering Council Exams. The course will introduce professional ethics and compare it with personal ethics and common morality. Professional ethics will be studied within the Engineering context where differentiation between Ethics, Morals and the Law will be discussed. Typical Ethical issues that engineers face such as safety, health, confidentiality and conflict of interest will be covered. The course will also cover professional development lecture series for the students to introduce them to topics and application related to their fields, job market as well as trends in the local and international economies. The students will also be prepared for the Jahiziyah and the Saudi Engineering Council Exams through lectures, discussions and mockup exams.
Prerequisite(s): None

AI 462: Product Management for AI **3 (3-0-0)**
This course introduces the principles of AI product management, focusing on developing, launching, and managing AI-driven products. Students will learn about the product lifecycle, from concept to market launch, while addressing key challenges such as user needs, ethics, and scalability in AI applications.
Prerequisite(s): AI 250

AI 451: AI Tools and Applications **3 (3-0-0)**
This course introduces students to widely used Artificial Intelligence tools, platforms, and practical applications across various domains. Students will gain hands-on experience with modern AI technologies and frameworks used for data analysis, machine learning, deep learning, natural language processing, computer vision, and generative AI applications. The course covers the use of AI development environments, cloud-based AI services, pre-trained models, and AI-assisted tools for building intelligent solutions. Students will explore real-world applications of AI in healthcare, business, cybersecurity, robotics, and smart systems while considering ethical, social, and responsible AI practices. Through practical exercises and projects, students will develop the skills required to select, utilize, and integrate AI tools to solve real-world problems.
Prerequisite(s): AI 250
Co-requisite(s): AI 347

AI 472: Expert Systems **3 (3-0-0)**
This course introduces students to expert systems in general and to rule-based systems in specific. Students learn how to build a rule-based expert system in a variety of application areas. They also learn advanced programming techniques which include topics of inexact reasoning, intelligent database management methods, and how to develop a community of expert systems. Students are also given the opportunity to demonstrate their understanding of the technology by building a rule-based expert system that addresses a real-world problem.
Prerequisite(s): AI 250

AI 483: AI in Robotics **3 (3-0-0)**

This course focuses on integrating AI with robotics to develop intelligent autonomous systems. Students will study perception, decision-making, motion planning, and control using AI techniques like computer vision, reinforcement learning, and path planning algorithms. The course emphasizes practical applications in robotic systems, including autonomous navigation, object manipulation, and human-robot interaction.
Prerequisite(s): AI 250

AI 447: Deep Learning **3 (3-0-0)**
This course introduces the fundamental concepts and techniques of Deep Learning, a subfield of artificial intelligence that uses multi-layer neural networks to learn complex patterns from data. Students will learn the principles of deep neural networks, model architectures, training techniques, and optimization methods used in modern AI systems. The course covers key architectures such as Artificial Neural Networks (ANNs), Convolutional Neural Networks (CNNs), and Recurrent Neural Networks (RNNs), along with concepts such as regularization, transfer learning, and model evaluation. Students will gain hands-on experience in designing, training, and applying deep learning models to real-world problems in areas such as computer vision, natural language processing, and predictive analytics.
Prerequisite(s): AI 347

DSE 451: Advanced Databases **3 (3-0-0)**
This course introduces advanced concepts, architectures, and technologies used in modern database systems. Students will explore advanced database design principles, query optimization techniques, transaction processing, distributed databases, and database performance management. The course also covers emerging database paradigms such as NoSQL databases, data warehousing, big data storage systems, and cloud-based database technologies. Students will gain practical experience in designing, implementing, and managing advanced database solutions for large-scale and data-intensive applications through hands-on exercises and projects.
Prerequisite(s): SE 252

DSE 452: Data Engineering and Pipelines **3 (3-0-0)**
This course focuses on designing and implementing robust data pipelines to automate the flow of data from diverse sources. Students will learn about ETL (Extract, Transform, Load) processes, real-time data streaming, and frameworks like Apache Airflow and Kafka. Practical projects simulate building scalable and efficient pipelines for enterprise-level applications.
Prerequisite(s): DSE 320, DSE 322

SE 435: Undergraduate Research in Software Engineering **3 (0-6-0)**
Students participate in supervised research with a faculty member. Supervised research can be: 1) independent research undertaken by the student (thesis, independent study), or 2) assistance on a faculty member's research project. Students must find a faculty member who is willing to supervise him/her as an assistant on an existing project or as the author of an individual project. The student and the faculty supervisor will complete and sign a research contract which will be submitted to the chair of the Software Engineering Department. Drafting the contract will allow the student to develop ideas about what should be accomplished and understand the scope and expectations of the faculty supervisor.
Prerequisite(s): SE 310, SE 322 or CSE 250, SE 316 and Department Chair approval. A GPA of at least 3.0/4.0, and a signed research contract

SE 440: Special Topics in Software Engineering **3 (3-0-0)**
This course provides instruction and experience in timely topics related to the design and development of quality-engineered software.
Prerequisite(s): SE 316

SE 441: Telecommunications Software Design **3 (3-0-0)**
Formal models for telecommunications software design and analysis. Protocol specification, design and validation. Protocol verification and testing. Conformance testing. Protocol synthesis. Protocol conversion.
Prerequisite(s): SE 239

SE 442: Social Networks for Software Engineers **3 (3-0-0)**
Students will learn the fundamental interface, systems, and algorithms concepts in designing social software. The case-based syllabus will cover insights from both research and industry. As a student, the student will contribute to this burgeoning field through a quarter-long, team-based project. Students are required to enter the class with an initial project idea.
Prerequisite(s): SE 316

SE 443: Cloud Computing **3 (3-0-0)**

This course will leverage the World Wide Web to fulfill computing needs. It packages applications, computing power, and storage as a metered service similar to a utility. This model is designed to supplant the traditional mechanism of desktop computing in many cases. This course will cover the origin, theory, enabling technology, and hands-on labs for key concepts in cloud computing.
Prerequisite(s): SE 316, SE 239

AI 444: Artificial Intelligence **3 (3-0-0)**
In this course, students will learn the foundational principles that drive AI applications and practice implementing some of the AI-enabled systems. Specific topics include machine learning, search methods, game playing, Markov decision processes, constraint satisfaction, graphical models, and logic. Students will be introduced to tools and systems to tackle new AI problems they might encounter in life.
Prerequisite(s): AI 250

CSE 445: Information and Software Security **3 (3-0-0)**
This course provides an introduction to the topic of security in the context of computer networks. The goals are to provide students with a foundation allowing them to identify, analyze, and solve network-related security problems in information systems with the emphasis on the engineering aspects of information security and software security issues.
Prerequisite(s): CSE 250, SE 316

SE 448: Blockchain Development **3 (3-0-0)**
In this course the students will learn concepts of the Blockchain technology such as business networks, participants, assets, and trusted transactions. They will also learn how to develop a complete Blockchain network solution using up-to-date tools and platforms.
Prerequisite(s): SE 215, SE 239

DSE 449: Data Analytics **3 (3-0-0)**
This course prepares students to gather, describe, and analyze data, and use advanced statistical tools to make decisions on operations, risk management, finance, marketing, etc. Analysis is done targeting economic and financial decisions in complex systems that involve multiple partners. Topics include probability, statistics, hypothesis testing, regression, clustering, decision trees, and forecasting.
Prerequisite(s): SE 252, STA 212

CSE 451: Secure Software Engineering **3 (3-0-0)**
This course involves an in-depth study of the processes and techniques associated with secure software engineering. The objective is to plan, manage, document, and communicate security related aspects of different phases of a secure software development life cycle process to all stakeholders. Topics include secure software development life cycle processes, security requirements and their representation techniques and tools, security requirements engineering processes, secure design principles and guidelines and how to represent them effectively, threat modeling, risk analysis, inspection of requirements, design, and code to identify vulnerabilities, assessing the security posture of a secure software development artifact, secure implementation practices, and security testing techniques.
Prerequisite(s): SE 310, CSE 442

CSE 442: Network Security **3 (3-0-0)**
The course will start with an introduction to the security concepts and how the data sent over the network is threatened by illegal activities. This course will discuss how cryptographic algorithms can be used to secure data (confidentiality and integrity). Different protocols which have been developed for securing network communication, along with their weaknesses and strengths, will be discussed. This will enable the students to deploy existing protocols, and design new ones, to make data communication more secure.

The students will also understand how different factors in a real-world setup can influence the choice of network security protocols.
Prerequisite(s): CSE 350

CSE 453: Security Risk Management & Control **3 (3-0-0)**
This course introduces the principles, methodologies, and frameworks used in managing cybersecurity risks within organizations. Students will learn techniques for identifying, assessing, analyzing, and mitigating security risks affecting information systems and digital assets. The course covers topics such as risk assessment methodologies, threat and vulnerability analysis, security governance, compliance requirements, business continuity planning, incident response, and the implementation of administrative, technical, and operational security controls. Students will also explore industry standards and frameworks used in risk management and gain practical experience through case studies and real-world security scenarios.
Prerequisite(s): CSE 250

CSE 454: Ethical Hacking and Systems Defense **3 (3-0-0)**
The course will start with an analysis of various vulnerabilities in an application, system/device or a network protocol (or network) which can be exploited to threaten the data and services of a software system. Using these vulnerabilities, students will learn how to collect information before the attack, gain access, retrieve useful information, keep the access for a period of time, and avoid leaving traces of the attack. Countermeasures for each of the vulnerabilities explored will also be discussed. Students will also learn how to assess the security state of an application/system/network based on the vulnerabilities present in it. The course will include both theoretical and practical aspects: concepts learned in the lectures will be practiced in a closed environment using virtual machines.
Prerequisite(s): CSE 442

AI 455: Generative AI **3 (3-0-0)**
This course provides an in-depth exploration of Large Language Models (LLMs) and Generative AI. Students will learn about the theoretical underpinnings, architectures, applications, and limitations of these transformative technologies. The course emphasizes practical understanding, enabling students to implement and fine-tune LLMs for various use cases, including natural language processing, content generation, and advanced reasoning tasks. Key topics include transformers, fine-tuning techniques, model evaluation, and ethical considerations. The course integrates hands-on projects, assignments, and assessments to reinforce learning outcomes.
Prerequisite(s): AI 347

SE 461: Game Engine Architecture & Implementation **3 (3-0-0)**
This comprehensive course delves into the foundations of designing and implementing game engines. Through hands-on experience with object-oriented game engine scripting languages, used in some game engines, students will also explore event-driven and data-driven programming paradigms. The curriculum covers essential topics such as game engine data structures, graphics concepts, and AI principles. Students will learn key aspects of game development, including asset preparation, sprite and bitmap animation, collision detection, game and level design, pathfinding algorithms, sound and music integration, game input devices, and advanced lighting techniques. This course provides a unique opportunity for students to collaborate on team projects, designing and building their own games or 3D interactive learning environments using a game engine. By the end of the course, students will have a solid understanding of game engine architecture and implementation of advanced game projects.
Prerequisite(s): SE 316

SE 462: Fundamentals of Game Design **3 (3-0-0)**
This course introduces students to the foundational elements of game design by exploring how designers invent, test, and improve games. It provides students with fundamental learning opportunities focused especially on concept development, gameplay design, texture mapping, core mechanics, user interfaces, narratives, and storytelling. In this course, students explore the psychology and history of games, employ industry tools like game design documentation (GDD) for requirements engineering and software design and communication methods, and learn from established designers.
Prerequisite(s): SE 310

SE 463: Game Mechanics, Prototyping, and Production **3 (3-0-0)**
This course allows students to embark on a comprehensive exploration of the dynamic world of game design by delving into the fundamentals principles of game mechanics, offering hands-on approach to understanding game rules, interactions, player motivation, engagement strategies, gaming psychology, narrative design, and systems (e.g. feedback system) that are used mainly to shape the player experience. Through practical exercises, students should learn to translate creative concepts into tangible, playful prototypes to boost their skills in game design and to train them on refining requirements and on problem solving mechanisms. Moreover, this course focuses on the intricacies of game production which provides insights into the iterative development process and steps required for successful post-development and launch stages. It provides a holistic understanding of the game development pipeline, needed to equip students with necessary tools to navigate the complexities of game design from conceptualization to execution.
Prerequisite(s): SE 412

SE 464: Innovative Topics in Immersive Game Development **3 (3-0-0)**
This course introduces the art of crafting immersive gaming experiences using extended reality (XR) technologies. Through a series of hands-on projects and guided exercises, students will learn to design and develop captivating virtual reality (VR) and augmented reality (AR) applications. They will delve into the fundamentals of XR design, exploring concepts such as spatial interaction, user interface design, and digital storytelling. Additionally, students will gain proficiency in leveraging XR platforms to create dynamic gameplay mechanics, realistic environments, and engaging narratives. Furthermore, students will explore the integration of XR with cutting-edge technologies such as the Internet of Things (IoT), Artificial Intelligence (AI), or Cybersecurity, enhancing their understanding of the evolving landscape of game development. By the end of the course, students will emerge with a comprehensive skill set and a portfolio of innovative immersive gaming projects.
Prerequisite(s): SE 316

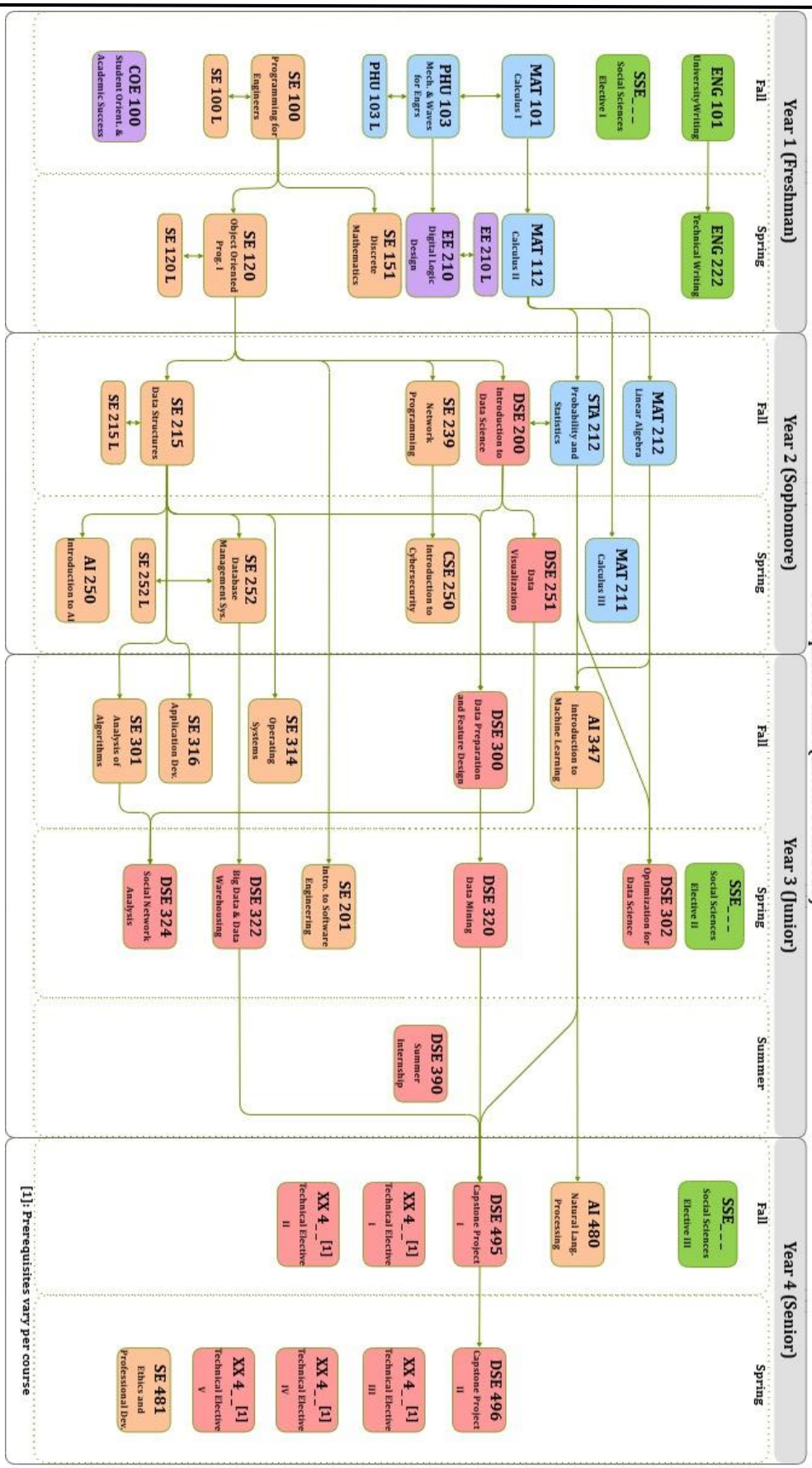
CSE 472: Penetration Testing **3 (3-0-0)**
In this hands-on course, students learn to think like attackers to identify vulnerabilities before malicious actors can exploit them. They practice reconnaissance, vulnerability scanning, exploitation techniques, and the safe use of testing tools. Ethical guidelines, scoping agreements, and reporting findings are integral parts of the curriculum. Students emerge with a structured methodology for uncovering system flaws and providing recommendations to strengthen defensive measures.
Prerequisite(s): CSE 442

CSE 444: Web and Mobile Security **3 (3-0-0)**
This course focuses on the unique security challenges associated with web applications and mobile platforms. Students examine common vulnerabilities such as cross-site scripting, broken authentication, insecure data storage, and malicious code injection. Topics extend beyond basic weaknesses to include API security, single-page application (SPA) safeguards, mobile application sandboxes, secure session

management, and hardened containerized deployments. By mastering these concepts, students will be equipped to build and maintain secure web and mobile applications that protect user data and privacy across multiple platforms.
Prerequisite(s): SE 316, CSE 250

CSE 410: Security Architecture **3 (3-0-0)**
This course provides a comprehensive overview of designing and evaluating robust security architectures within enterprise environments. Students move beyond foundational concepts to explore layered defense models, identity and access management frameworks, and Zero Trust Network Access (ZTNA). Topics include integrating cryptographic controls, establishing secure communication channels, leveraging threat intelligence, and applying architecture frameworks such as SABSA or TOGAF. Students will also assess emerging technologies and evolving regulatory requirements to ensure that architectures remain adaptive and forward-looking. Upon completion, they will be able to create strategic, standards-based security designs that protect complex systems against diverse threats.
Prerequisite(s): SE 201, CSE 250

SE 423: Software Construction & Processes **3 (3-0-0)**
This course introduces principles and techniques to develop software such that it is more maintainable and evolvable. This implies that the developed software is traceable, easy to understand, and ready for change. Such qualities are necessary for all software which will have a considerable lifespan and would have additions/changes in their functionality during their lifetimes. The course will discuss the most common design patterns which help in making a software more robust.
Software reengineering will also be introduced since many of the largest software systems are successors of existing systems and in the absence of clear documentation, most of the time, functional details and design choices must be extracted from existing code.
The course will also introduce the concept of functional programming, its differences with imperative programming languages, its uses and its pitfalls. Understanding of functional programming will help students explore a new programming paradigm and broaden their horizon.
Prerequisite(s): SE 412


Alfaisal University – Bachelor of Science Data Science and Engineering Program
Prerequisites Chart (Effective Fall 2025)
Year 1 (Freshman)
Year 2 (Sophomore)
Year 3 (Junior)
Year 4 (Senior)
Fall
Spring
Summer
ENG 101 University Writing
ENG 222 Technical Writing
SSE_ _ _ Social Sciences Elective I
MAT 101 Calculus I
MAT 112 Calculus II
PHU 103 Mech. & Waves for Engrs
PHU 103 L
EE 210 Digital Logic Design
EE 210 L
SE 100 Programming for Engineers
SE 100 L
SE 120 Object Oriented Prog. I
SE 120 L
SE 151 Discrete Mathematics
COE 100 Student Orient. & Academic Success
MAT 212 Linear Algebra
STA 212 Probability and Statistics
MAT 211 Calculus III
DSE 200 Introduction to Data Science
SE 239 Network Programming
SE 215 Data Structures
SE 215 L
DSE 251 Data Visualization
CSE 250 Introduction to Cybersecurity
SE 252 Database Management Sys.
SE 252 L
AI 250 Introduction to AI
AI 347 Introduction to Machine Learning
DSE 300 Data Preparation and Feature Design
SE 314 Operating Systems
SE 316 Application Dev.
SE 301 Analysis of Algorithms
SSE_ _ _ Social Sciences Elective II
DSE 302 Optimization for Data Science
DSE 320 Data Mining
SE 201 Intro. to Software Engineering
DSE 322 Big Data & Data Warehousing
DSE 324 Social Network Analysis
DSE 390 Summer Internship
AI 480 Natural Lang. Processing
SSE_ _ _ Social Sciences Elective III
DSE 495 Capstone Project I
XX 4_ _ [1] Technical Elective I
XX 4_ _ [1] Technical Elective II
DSE 496 Capstone Project II
XX 4_ _ [1] Technical Elective III
XX 4_ _ [1] Technical Elective IV
XX 4_ _ [1] Technical Elective V
SE 481 Ethics and Professional Dev.
[1]: Prerequisites vary per course