



الجامعة الألمانية الأردنية
German Jordanian University

German Jordanian University

School of Electrical Engineering and Information Technology

Department of Computer Science

Bachelor of Science in Computer Science

Study Plan 2022

(Last updated: Apr. 10, 2023)

I. Program Vision

To graduate highly qualified people with a Bachelor of Science degree in computer science and strong capabilities of computational and analytical approaches of computer science in their chosen professions.

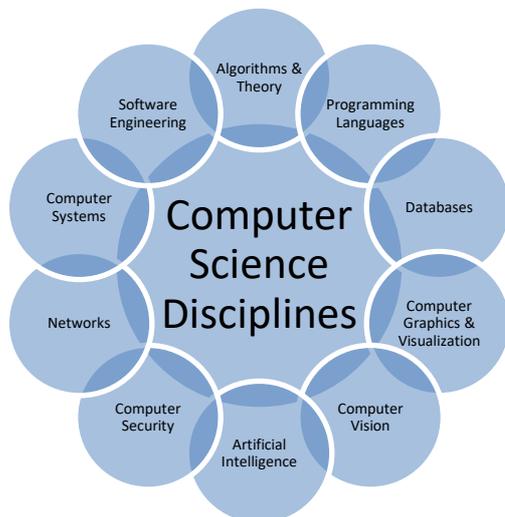
II. Program Mission

To arm students with the required knowledge and experience in the field of computer science that enable them to fulfill society and market needs.

III. Program General Description

Computer Science (CS) is the study of computation, automation, and information. Computer science spans theoretical disciplines (e.g., algorithms and theory of computation) to practical disciplines (including the implementation of a web or mobile application).

At GJU, the department of computer science offers a bachelor program in computer science in which student is equipped with solid theoretical background and practical hands-on in various fields including programming languages, algorithms and theory, databases, software engineering, computer graphics and visualization, computer vision, artificial intelligence, computer security, networks, and computer systems.



The advent of computers has facilitated a systems approach to solving many problems in science, business, and industry. There is currently a great demand for information analysts to define how systems will perform these functions and for programmers to implement production systems on computers.

The Department of Computer Science at GJU offers a unique and powerful Bachelor Program whose successful completion opens the doors to rewarding professional careers, graduate studies, and lifelong learning.

IV. Program Objectives

The primary objectives of the CS program are to:

- a. Create an understanding of the principles of computer science and problem solving.
- b. Build an awareness of computing practices in industry and emerging technologies, emphasizing a working knowledge of current software design and development techniques.
- c. Provide a broad education that enables graduates to understand the impact of computing technologies in a societal context.
- d. Provide a computer science education that enables our graduates to pursue rewarding professional careers, graduate studies, and lifelong learning.

V. Learning Outcomes

At GJU, the computer science program graduates bachelor's students with an understanding of fundamental computer science concepts, methodologies, and technologies as demonstrated by:

- a. An ability to demonstrate a fundamental understanding of algorithms, data structures, software design, concepts of programming languages, and computer organization and architecture, and an awareness of the evolution and dynamic nature of the foundational core of computer science.
- b. An ability to demonstrate the ability to analyze and solve computing problems.
- c. An ability to demonstrate knowledge of a variety of programming languages and a proficiency in at least one higher-level language.
- d. An ability to demonstrate understanding of discrete mathematics, differential and integral calculus, and probability and statistics.
- e. An ability to demonstrate the ability to collect, analyze, and interpret data.
- f. An ability to demonstrate an awareness of emerging technologies and the ability to evaluate and utilize currently available software development tools.
- g. An ability to demonstrate knowledge of the principles and practices for software design and development.
- h. An ability to demonstrate the ability to successfully apply the principles and practices for software design and development to real problems.
- i. An ability to demonstrate the ability to communicate effectively, both orally and in written form, and work in a team environment.
- j. An ability to demonstrate familiarity with basic concepts, emerging technologies, and contemporary issues relating to the societal impacts of computing.
- k. An ability to demonstrate an understanding of professional and ethical considerations related to computing.
- l. An ability to demonstrate an ability to acquire new knowledge in the computing discipline and to engage in life-long learning.
- m. An ability of being competitive in the computing job market and/or being admitted to a good graduate program in computing.

Course Code: The course code is structured as follows (from left to right):

CS: Computer Science.

First digit: 1, 2, 3 or 4 for course level year.

Second digit: subject area as follows:

- 0 = mathematics
- 1 = programming languages
- 2 = algorithms
- 3 = graphics, multimedia, and games
- 4 = software engineering
- 5 = other topics in computer science
- 6 = data management and analysis
- 7 = bioinformatics and security
- 8 = special topics in computer science
- 9 = project and field training

The rest of the digits are meant to give the course an identifying code.

VI. Framework for B.Sc. Degree (Credit Hours)

Classification	Credit Hours			ECTS		
	Compulsory	Elective	Total	Compulsory	Elective	Total
University Requirements	21	6	27			
School Requirements	26	0	26			
Program Requirements	80	12	92			
Total	127	18	145			

Students can choose one of following tracks.

General Track:

Students will be provided with extended knowledge and training in the theoretical and practical aspects of various fields in computer science including algorithms and theory, programming languages, databases, software engineering, computer graphics and visualization, computer vision, artificial intelligence, computer security, networks, and computer systems. The students will engage in courses with projects to acquire the required skills and competencies.

Data Science:

Students will be provided with extended knowledge and training in the theoretical and practical aspects of data science applications and technologies. The students will engage in courses with projects to acquire the required skills and competencies.

Cybersecurity:

Students will be provided with extended knowledge and training in the theoretical and practical aspects of cybersecurity techniques. The students will engage in courses with projects to acquire the required skills and competencies related to cryptography, ethical hacking, and digital forensics.

1. University Requirements: (27 credit hours)

1.1. Prerequisite courses (6 credit hours)

Course ID	Course Name	Credit Hours	ECTS	Contact Hours		Prerequisites / Co-requisites
				Lect	Lab	
ARB099	Arabic 99 ^a	0		3	-	-
ENGL099	English II ^a	0		3	-	
Total		0		6	0	

1.2. Compulsory: (21 credit hours)

Course ID	Course Name	Credit Hours	ECTS	Teaching method	Contact Hours		Prerequisites / Co-requisites
					Lect	Lab	
ARB100	Arabic	3			3	-	ARB099
ENGL101	English III	1			3	-	ENGL099
ENGL102	English IV	1			3	-	ENGL101
ENGL201	English V	2			3	-	ENGL102
ENGL202	English VI	2			3	-	ENGL201
GERL101B1	German I B1 track	3			9	-	-
GERL102B1	German II B1 track	3			9	-	GERL101B1
GERL102B2	German II B2 track	3			9	-	GERL101B1
MILS100	Military Science	3			3	-	-
NE101	National Education	3			3	-	-
NEE101	National Education (English)						
Total		21			39	0	

1.3. Elective: (6 Credit Hours) (two courses out of the following)

Course ID	Course Name	Credit Hours	ECTS	Teaching method	Contact Hours		Prerequisites / Co-requisites
					Lect	Lab	
BE302	Business Entrepreneurship	3			3	-	ENGL101
DES101	Arts' Appreciation	3			3	-	ENGL101, ARB099
EI101	Leadership and Emotional Intelligence	3			3	-	ENGL101
IC101	Intercultural Communications	3			3	-	ENGL101
PE101	Sports and Health	3			3	-	ARB099
SE301	Social Entrepreneurship and Enterprises	3			3	-	ENGL101
SFTS101	Soft Skills	3			3	-	ENGL101
TW303	Technical and Workplace Writing	3			3	3	ENGL102
Total		6			6	0	

^a Not required for students who pass placement test

2. School Requirements: (26 Credit Hours)

Course ID	Course Name	Credit Hours	ECTS	Teaching method	Contact Hours		Prerequisites / Co-requisites
					Lect	Lab	
GERL201B1	German III B1 track	3		Face-to-Face	6	-	GERL102B1
GERL201B2	German III B2 track	3			6	-	GERL102B2
GERL202B1	German IV B1 track	3		Face-to-Face	9	-	GERL201B1
GERL202B2	German IV B2 track	3			9	-	GERL201B2
MATH099	Pre Math	0		Blended	3	0	-
CS116	Computing fundamentals	3		Face-to-Face	3	0	-
CS1160	Computing fundamentals lab	1		Blended	0	3	Co-requisite CS116
CE212	Digital Systems	3		Face-to-Face	3	0	ARB099, ENGL099, MATH099
CE2120	Digital Systems Lab	1		Blended	0	3	ARB099, ENGL099, MATH099, Co-requisite CE212
CE352	Computer Networks	3		Blended	3	0	CS116, CE201
MATH101	Calculus I	3		Blended	3	0	MATH099
MATH102	Calculus II	3		Face-to-Face	3	0	MATH101
ECE317	Linear Algebra	3		Blended	3	0	MATH101, Co-requisite MATH102
Total		26			36	6	

3. Program Requirements (92 credit hours)

3.1. Program Requirements (Compulsory): (80 credit hours)

The program compulsory courses are listed in several tables.

- For students enrolled in the general track, they must take the courses listed in 3.1.A and 3.1.B.
- For students enrolled in the data science track, they must take the courses listed in 3.1.A and 3.1.C.
- For students enrolled in the cybersecurity track, they must take the courses listed in 3.1.A and 3.1.D.

3.1.A. Common Compulsory Courses for all Tracks (68 credit hours):

Course ID	Course Name	Credit Hours	ECTS	Teaching method	Contact Hours		Prerequisites / Co-requisites
					Lect	Lab	
GERL301B1	German V B1 track	3		Face-to-Face	9	-	GERL202B1
GERL301B2	German V B2 track	3			9	-	GERL202B2
GERL302REG	German VI Regular	3		Face-to-Face	6	-	GERL301B1
GERL302INT	German VI Intensive	3			9	-	GERL301B1
GERL302B2	German VI B2 track	3			6	-	GERL301B2
CS201	Discrete Structures	3		Face-to-Face	3	0	MATH099, ARB099, ENGL099
CE201	Computer Architecture and Organization	3		Face-to-Face	3	0	CE212, CE2120
IE0121	Probability and Statistics	3		Face-to-Face	3	0	MATH101

CS214	Object-Oriented Programming	3		Face-to-Face	3	0	CS116, CS1160, ARB099, ENGL099, MATH099
CS2140	Object-Oriented Programming Lab	1		Blended	0	3	ARB099, ENGL099, MATH099, Co-requisite CS214
CS254	Visual Programming	3		Face-to-Face	2	2	CS214, CS2140
CS355	Web Technologies	3		Blended	2	2	CS254, CS363
CS222	Theory of Algorithms	3		Face-to-Face	3	0	CS116, CS1160, CS201
CS223	Data Structures	3		Face-to-Face	2	2	CS116, CS1160, ARB099, ENGL099, MATH099
CS342	Software Engineering	3		Blended	3	0	CS254, CS363
CE357	Operating Systems	3		Face-to-Face	3	0	CE201
CE3570	Operating Systems Lab	1		Blended	0	3	CE357
CS356	Information Security	3		Face-to-Face	3	0	CS363
CS363	Database Management Systems	3		Blended	2	2	CS223
CS391	Field Training	0		Face-to-Face	0	0	Completion of 90 Cr. Hr.
CS416	Systems Programming	3		Face-to-Face	2	2	CS223
CS323	Computational Theory	3		Face-to-Face	3	0	CS222, CS223
CS451	Artificial Intelligence	3		Face-to-Face	3	0	CS223, CS222
CS491	International Internship	12		Face-to-Face	0	36	CS391
CS492	Senior Project	3		Blended	0	9	Completion of 90 Cr. Hr.
Total		68			60	63	

3.1.B. Remaining Compulsory Courses for the General Track (12 credit hours):

Course ID	Course Name	Credit Hours	ECTS	Teaching method	Contact Hours		Prerequisites / Co-requisites
					Lect	Lab	
CS330	Image Understanding	3		Face-to-Face	2	2	CS223, ECE317
CS477	Mobile Computing	3		Face-to-Face	2	2	CS254, CS363
CS419	Compiler Construction	3		Face-to-Face	3	0	CS222, CS223
CS332	Computer Graphics	3		Face-to-Face	2	2	CS223, ECE317
Total		12			9	6	

3.1.C. Remaining Compulsory Courses for the Data Science Track (12 credit hours):

Course ID	Course Name	Credit Hours	ECTS	Teaching method	Contact Hours		Prerequisites / Co-requisites
					Lect	Lab	
CS330	Image Understanding	3		Face-to-Face	2	2	CS223, ECE317
CS460	Data Mining	3		Face-to-Face	3	0	CS363
CE377	Machine Learning	3		Face-to-Face	3	0	CS363, IE0121
CS461	Big Data	3		Face-to-Face	3	0	CS363, CS214
Total		12			11	2	

3.1.D. Remaining Compulsory Courses for the Cybersecurity Track (12 credit hours):

Course ID	Course Name	Credit Hours	ECTS	Teaching method	Contact Hours		Prerequisites / Co-requisites
					Lect	Lab	
CS455	Ethical Hacking	3		Face-to-Face	3	0	CS356
CS470	Cryptography	3		Face-to-Face	3	0	CE352, ECE317, CS222
CS471	Digital Forensics	3		Face-to-Face	3	0	CS363, CE357, CE3570
CS419	Compiler Construction	3		Face-to-Face	3	0	CS222, CS223
Total		12			12	0	

3.2. Program Requirements (Electives ^b): (12 credit hours)

Students are required to take 12 credits as elective courses. In addition to the courses listed in the following table, students may also select a maximum of six credits of 300 level and above courses from other departments in the School of Electrical Engineering and Information Technology to fulfill the elective requirements.

3.2.A. List of Elective Courses for the General Track:

Course ID	Course Name	Credit Hours	ECTS	Teaching method	Contact Hours		Prerequisites / Co-requisites
					Lect	Lab	
CS371	Bioinformatics	3		Face-to-Face	3	0	CS223, CS222
CS333	Game Programming	3		Face-to-Face	2	2	CS254
CS430	Virtual and Augmented Reality	3		Face-to-Face	2	2	CS214, CS2140
CS439	Computer Animation	3		Face-to-Face	3	0	CS332
CS364	Information Retrieval	3		Face-to-Face	3	0	CS363
CS458	Wireless Networks	3		Face-to-Face	3	0	CE352
CS353	Natural Language Processing	3		Face-to-Face	3	0	CS222
CS450	Operations Optimization	3		Face-to-Face	3	0	CS222
CS457	Decision Support Systems and Intelligent Systems	3		Face-to-Face	2	2	CS222
CS357	Cybersecurity	3		Face-to-Face	3	0	CS363
CS358	Multimedia Systems Design	3		Face-to-Face	3	0	CS223, ECE317
CS359	Internet of Things	3		Face-to-Face	3	0	CS214, CS2140
CS460	Data Mining	3		Face-to-Face	3	0	CS363
CS462	Database Design	3		Face-to-Face	3	0	CS363
CS365	Systems Analysis and Design	3		Face-to-Face	3	0	CS222, CS223
CS459	Scientific Visualization	3		Face-to-Face	3	0	CS222, CS223, CS363
CS489	Special Topics in Algorithms	3		Blended	3	0	CS222, CS223
CS481	Special Topics in Computer Graphics	3		Blended	3	0	CS332
CS482	Special Topics in Software Engineering	3		Blended	3	0	CS342
CS4833	Special Topics in Applied Computer Science	3		Blended	3	0	CS222, CS223
CS4832	Special Topics in Applied Computer Science	2		Face-to-Face	2	0	CS222, CS223
CS4831	Special Topics in Applied Computer Science	1		Face-to-Face	1	0	CS222, CS223
CS484	Special Topics in Database Technologies and Applications	3		Face-to-Face	3	0	CS363
CS480	Special Topics in Data Science Technologies and Applications	3		Face-to-Face	3	0	IE0121, CS201

3.2.B. List of Elective Courses for the Data Science Track

Course ID	Course Name	Credit Hours	ECTS	Teaching method	Contact Hours		Prerequisites / Co-requisites
					Lect	Lab	
CS364	Information Retrieval	3		Face-to-Face	3	0	CS363
CS371	Bioinformatics	3		Face-to-Face	3	0	CS223, CS222
CS353	Natural Language Processing	3		Face-to-Face	3	0	CS222
CS457	Decision Support Systems and Intelligent Systems	3		Face-to-Face	2	2	CS222
CS358	Multimedia Systems Design	3		Face-to-Face	3	0	CS223, ECE317
CS450	Operations Optimization	3		Face-to-Face	3	0	CS222
CS359	Internet of Things	3		Face-to-Face	3	0	CS214, CS2140
CS462	Database Design	3		Face-to-Face	3	0	CS363
CS456	Cloud Computing	3		Face-to-Face	3	0	CS363, CS214, CE352
CS4833	Special Topics in Applied Computer Science	3		Blended	3	0	CS222, CS223
CS4832	Special Topics in Applied Computer Science	2		Face-to-Face	2	0	CS222, CS223
CS4831	Special Topics in Applied Computer Science	1		Face-to-Face	1	0	CS222, CS223
CS484	Special Topics in Database Technologies and Applications	3		Face-to-Face	3	0	CS363
CS480	Special Topics in Data Science Technologies and Applications	3		Face-to-Face	3	0	IE0121, CS201
CS485	Special Topics in Artificial Intelligence	3		Face-to-Face	3	0	CS451

3.2.C. List of Elective Courses for the Cybersecurity Track

Course ID	Course Name	Credit Hours	ECTS	Teaching method	Contact Hours		Prerequisites / Co-requisites
					Lect	Lab	
CS357	Cybersecurity	3		Face-to-Face	3	0	CS363
CS352	Security Analytics	3		Face-to-Face	3	0	CS356, CS451
CS452	Data Privacy	3		Face-to-Face	3	0	CS356
CS354	Computer and Networks Security	3		Face-to-Face	3	0	CE352
CS370	Web Security	3		Face-to-Face	3	0	CS355, CS356
CS372	Steganography	3		Face-to-Face	3	0	CS356, CS330
CS374	Hardware Security	3		Face-to-Face	3	0	CE201
CS373	Database Security	3		Face-to-Face	3	0	CS363
CS470	Blockchain Technologies	3		Face-to-Face	3	0	CS363
CS472	Quantum Computing	3		Face-to-Face	3	0	CE352, CE201
CS458	Wireless Networks	3		Face-to-Face	3	0	CE352
CS359	Internet of Things	3		Face-to-Face	3	0	CS214, CS2140
CS487	Special Topics in Cybersecurity	3		Face-to-Face	3	0	CS356
CS4833	Special Topics in Applied Computer Science	3		Blended	3	0	CS222, CS223
CS4832	Special Topics in Applied Computer Science	2		Face-to-Face	2	0	CS222, CS223
CS4831	Special Topics in Applied Computer Science	1		Face-to-Face	1	0	CS222, CS223

^bXXXX0000 International Internship is a prerequisite for all elective courses

VII. Study Plan ^c Guide for the bachelor's degree in Computer Science

VII.A. Study Plan Guide for the General Track

First Year				
First Semester				
Course ID	Course Name	Cr Hr	Prerequisites	Co-requisite
ENGL101	English III	1	ENGL099	
GERL101	German I	3		
CS116	Computing Fundamentals	3		
CS1160	Computing fundamentals lab	1		CS116
CS201	Discrete Structures	3	MATH099, ARB099, ENGL099	
ARB100	Arabic	3	ARB099	
MATH101	Calculus I	3	MATH099	
	University Elective	3		
		Total	20	

First Year				
Second Semester				
Course ID	Course Name	Cr Hr	Prerequisites	Co-requisite
ENGL102	English IV	1	ENGL101	
GERL102	German II	3	GERL101	
CS223	Data structures	3	CS116, CS1160, ARB099, ENGL099, MATH099	
NE101	National Education	3		
CS214	Object-Oriented Programming	3	CS116, CS1160, ARB099, ENGL099, MATH099	
CS2140	Object-Oriented Programming Lab	1	ARB099, ENGL099, MATH099	CS214
MATH102	Calculus II	3	MATH101	
CS222	Theory of Algorithms	3	CS116, CS1160, CS201	
		Total	20	

^c The following study plan guide assumes having passed all placement tests

Second Year				
First Semester				
Course ID	Course Name	Cr Hr	Prerequisites	Co-requisite
ENGL201	English V	2	ENGL102	
GERL201	German III	3	GERL102	
CS363	Database Management Systems	3	CS223	
CS254	Visual Programming	3	CS214, CS2140	
CE212	Digital Systems	3	ARB099, ENGL099, MATH099	
CE2120	Digital Systems Lab	1	ARB099, ENGL099, MATH099	CE212
ECE317	Linear Algebra	3	MATH101	MATH102
CS416	Systems Programming	3	CS223	
Total		21		

Second Year				
Second Semester				
Course ID	Course Name	Cr Hr	Prerequisites	Co-requisite
GERL202	German IV	3	GERL201	
CS342	Software Engineering	3	CS254, CS363	
CE201	Computer Architecture and Organization	3	CE212, CE2120	
CS355	Web Technologies	3	CS254, CS363	
IE0121	Probability and Statistics	3	MATH101	
CS451	Artificial Intelligence	3	CS222, CS223	
	University Elective	3		
Total		21		

Third Year				
First Semester				
Course ID	Course Name	Cr Hr	Prerequisites	Co-requisite
GERL301	German V	3	GERL202	
CS323	Computational Theory	3	CS222, CS223	
CE352	Computer Networks	3	CS116, CE201	
CS419	Compiler Construction	3	CS222, CS223	
CS332	Computer Graphics	3	CS223, ECE317	
CE357	Operating Systems	3	CE201	
CE3570	Operating Systems Lab	1		CE357
		Total	19	

Third Year				
Second Semester				
Course ID	Course Name	Cr Hr	Prerequisites	Co-requisite
CS492	Senior Project	3	Completion of 90 C.H.	
CS356	Information Security	3	CS363	
ENGL202	English VI	2	ENGL201	
CS477	Mobile Computing	3	CS254, CS363	
CS391	Field Training	0	Completion of 90 C.H.	
CS330	Image Understanding	3	CS223, ECE317	
MILS100	Military Sciences	3		
GERL302	German VI	3	GERL301	
		Total	20	

Fourth Year				
First Semester				
Course ID	Course Name	Cr Hr	Prerequisites	Co-requisite
	elective course	3		
	elective course	3		
	elective course	3		
	elective course	3		
Total		12		

Fourth Year				
Second Semester				
Course ID	Course Name	Cr Hr	Prerequisites	Co-requisite
	International Internship ^d	12	CS391	
Total		12		

VII.B. Study Plan Guide for the Data Science Track

First Year				
First Semester				
Course ID	Course Name	Cr Hr	Prerequisites	Co-requisite
ENGL101	English III	1	ENGL099	
GERL101	German I	3		
CS116	Computing Fundamentals	3		
CS1160	Computing fundamentals lab	1		CS116
CS201	Discrete Structures	3	MATH099, ARB099, ENGL099	
ARB100	Arabic	3	ARB099	
MATH101	Calculus I	3	MATH099	
	University Elective	3		
		Total	20	

First Year				
Second Semester				
Course ID	Course Name	Cr Hr	Prerequisites	Co-requisite
ENGL102	English IV	1	ENGL101	
GERL102	German II	3	GERL101	
CS223	Data structures	3	CS116, CS1160, ARB099, ENGL099, MATH099	
NE101	National Education	3		
CS214	Object-Oriented Programming	3	CS116, CS1160, ARB099, ENGL099, MATH099	
CS2140	Object-Oriented Programming Lab	1	ARB099, ENGL099, MATH099	CS214
MATH102	Calculus II	3	MATH101	
CS222	Theory of Algorithms	3	CS116, CS1160, CS201	
		Total	20	

^cThe following study plan guide assumes having passed all placement tests

Second Year				
First Semester				
Course ID	Course Name	Cr Hr	Prerequisites	Co-requisite
ENGL201	English V	2	ENGL102	
GERL201	German III	3	GERL102	
CS363	Database Management Systems	3	CS223	
CS254	Visual Programming	3	CS214, CS2140	
CE212	Digital Systems	3	ARB099, ENGL099, MATH099	
CE2120	Digital Systems Lab	1	ARB099, ENGL099, MATH099	CE212
ECE317	Linear Algebra	3	MATH101	MATH102
CS416	Systems Programming	3	CS223	
Total		21		

Second Year				
Second Semester				
Course ID	Course Name	Cr Hr	Prerequisites	Co-requisite
GERL202	German IV	3	GERL201	
CS342	Software Engineering	3	CS254, CS363	
CE201	Computer Architecture and Organization	3	CE212, CE2120	
CS355	Web Technologies	3	CS254, CS363	
IE0121	Probability and Statistics	3	MATH101	
CS451	Artificial Intelligence	3	CS222, CS223	
	University Elective	3		
Total		21		

Third Year				
First Semester				
Course ID	Course Name	Cr Hr	Prerequisites	Co-requisite
GERL301	German V	3	GERL202	
CS323	Computational Theory	3	CS222, CS223	
CE352	Computer Networks	3	CS116, CE201	
CS460	Data Mining	3	CS363	
MILS100	Military Sciences	3		
CE357	Operating Systems	3	CE201	
CE3570	Operating Systems Lab	1		CE357
Total		19		

Third Year				
Second Semester				
Course ID	Course Name	Cr Hr	Prerequisites	Co-requisite
CS492	Senior Project	3	Completion of 90 C.H.	
CS356	Information Security	3	CS363	
ENGL202	English VI	2	ENGL201	
CE377	Machine Learning	3	CS363, IE0121	
CS391	Field Training	0	Completion of 90 C.H.	
CS330	Image Understanding	3	CS223, ECE317	
CS461	Big Data	3	CS363, CS214	
GERL302	German VI	3	GERL301	
Total		20		

Fourth Year				
First Semester				
Course ID	Course Name	Cr Hr	Prerequisites	Co-requisite
	elective course	3		
	elective course	3		
	elective course	3		
	elective course	3		
Total		12		

Fourth Year				
Second Semester				
Course ID	Course Name	Cr Hr	Prerequisites	Co-requisite
	International Internship ^d	12	CS391	
Total		12		

VII.C. Study Plan Guide for the Cybersecurity Track

First Year				
First Semester				
Course ID	Course Name	Cr Hr	Prerequisites	Co-requisite
ENGL101	English III	1	ENGL099	
GERL101	German I	3		
CS116	Computing Fundamentals	3		
CS1160	Computing fundamentals lab	1		CS116
CS201	Discrete Structures	3	MATH099, ARB099, ENGL099	
ARB100	Arabic	3	ARB099	
MATH101	Calculus I	3	MATH099	
	University Elective	3		
		Total	20	

First Year				
Second Semester				
Course ID	Course Name	Cr Hr	Prerequisites	Co-requisite
ENGL102	English IV	1	ENGL101	
GERL102	German II	3	GERL101	
CS223	Data structures	3	CS116, CS1160, ARB099, ENGL099, MATH099	
NE101	National Education	3		
CS214	Object-Oriented Programming	3	CS116, CS1160, ARB099, ENGL099, MATH099	
CS2140	Object-Oriented Programming Lab	1	ARB099, ENGL099, MATH099	CS214
MATH102	Calculus II	3	MATH101	
CS222	Theory of Algorithms	3	CS116, CS1160, CS201	
		Total	20	

^c The following study plan guide assumes having passed all placement tests

Second Year				
First Semester				
Course ID	Course Name	Cr Hr	Prerequisites	Co-requisite
ENGL201	English V	2	ENGL102	
GERL201	German III	3	GERL102	
CS363	Database Management Systems	3	CS223	
CS254	Visual Programming	3	CS214, CS2140	
CE212	Digital Systems	3	ARB099, ENGL099, MATH099	
CE2120	Digital Systems Lab	1	ARB099, ENGL099, MATH099	CE212
ECE317	Linear Algebra	3	MATH101	MATH102
CS416	Systems Programming	3	CS223	
Total		21		

Second Year				
Second Semester				
Course ID	Course Name	Cr Hr	Prerequisites	Co-requisite
GERL202	German IV	3	GERL201	
CS342	Software Engineering	3	CS254, CS363	
CE201	Computer Architecture and Organization	3	CE212, CE2120	
CS355	Web Technologies	3	CS254, CS363	
IE0121	Probability and Statistics	3	MATH101	
MILS100	Military Sciences	3		
CS356	Information Security	3	CS363	
Total		21		

Third Year				
First Semester				
Course ID	Course Name	Cr Hr	Prerequisites	Co-requisite
GERL301	German V	3	GERL202	
CS323	Computational Theory	3	CS222, CS223	
CE352	Computer Networks	3	CS116, CE201	
CS419	Compiler Construction	3	CS222, CS223	
CS455	Ethical Hacking	3	CS356	
CE357	Operating Systems	3	CE201	
CE3570	Operating Systems Lab	1		CE357
		Total	19	

Third Year				
Second Semester				
Course ID	Course Name	Cr Hr	Prerequisites	Co-requisite
CS492	Senior Project	3	Completion of 90 C.H.	
CS470	Cryptography	3	CE352, ECE317, CS222	
CS471	Digital Forensics	3	CS363, CE357, CE3570	
GERL302	German VI	3	GERL301	
ENGL202	English VI	2	ENGL201	
CS391	Field Training	0	Completion of 90 C.H.	
CS451	Artificial Intelligence	3	CS222, CS223	
	University Elective	3		
		Total	20	

Fourth Year				
First Semester				
Course ID	Course Name	Cr Hr	Prerequisites	Co-requisite
	elective course	3		
	elective course	3		
	elective course	3		
	elective course	3		
Total		12		

Fourth Year				
Second Semester				
Course ID	Course Name	Cr Hr	Prerequisites	Co-requisite
	International Internship ^d	12	CS391	
Total		12		

German year prerequisites are:

1. A minimum GPA of 61.0%
2. Successful completion of 90 credit hours excluding all German language courses
3. Passing GERL302 German VI and B1 German language test (all 4 language skills) conducted by Goethe Institute or another approved provider
4. ENGL201 English V, and Arabic 99
5. Passing four out of the five following courses:
 - CS222 Theory of Algorithms
 - CS223 Data Structures
 - CS342 Software Engineering
 - CS363 Database Management Systems
 - CS355 Web Technologies

^dCourses attended and/or passed during International Internship are not transferable

VIII. Compulsory Courses Offered by Computer Science

Department

CS116: Computing Fundamentals

3 Cr Hr (3,0)

Basic computer skills, programming concepts, algorithms, variables and data types; arithmetic, logical, relational, Boolean, and assignment operators; simple input and output statements, selection structures, loop structures, single and multidimensional arrays, character strings, functions, data structures, pointers, input/output file operations.

Prerequisites: -

CS1160: Computing Fundamentals Lab

1 Cr Hr (0,3)

Lab session every week to offer hands-on experience on the topics that are covered in CS116, which are: algorithms, variables and data types; arithmetic, logical, relational, Boolean, and assignment operators; simple input and output statements, selection structures, loop structures, single and multidimensional arrays, character strings, functions, data structures, pointers, input/output file operations.

Co-requisites: CS116

CS115: Computing Fundamentals

3 Cr Hr (3,0)

Basic information technology (IT) skills and concepts, the Internet and the web, electronic commerce, application software, system software, basics of computer hardware: the system unit, input and output devices, secondary storage; creating web-pages using HTML and cascading style sheets (CSS), database concepts, database management systems, basics of the structured query language (SQL), communications and networks, privacy, security, computer ethics, information systems, systems analysis and design, programming basics: variables, data types, arithmetic and logic expressions, input/output operations, selection structures, loop structures, arrays.

Prerequisites: -

CS1150: Computing Fundamentals Lab

1 Cr Hr (0,3)

Lab session every week to offer hands-on experience on the topics that are covered in CS115, which are: computer hardware, operating systems, web browsing, word processing programs, presentation programs, spreadsheet programs, creating web-pages using HTML and CSS, database management systems, database queries with SQL, programming basics: variables, data types, arithmetic and logic expressions, input/output operations, selection structures, loop structures, arrays.

Co-requisites: CS115

CS201: Discrete Structures

3 Cr Hr (3,0)

Fundamental structures: Functions (surjections, injections, inverses, composition); relations (reflexivity, symmetry, transitivity, equivalence relations); sets (Venn diagrams, complements, Cartesian products, power sets); Basic logic: Propositional logic; logical connectives; truth tables; predicate logic; universal and existential quantification; Proof techniques: Notions of implication, direct proofs; proof by counterexample; proof by contraposition; proof by contradiction; mathematical induction; recursive mathematical definitions; Basics of counting: pigeonhole principle; permutations and combinations. Discrete probability: Finite probability spaces; conditional probability, independence Bayes' rule; random events; random integer variables; mathematical expectation.

Prerequisites: MATH099, ARB099, ENGL099

CS214: Object-Oriented Programming**3 Cr Hr (3,0)**

Object Oriented Programming concepts, Classes, objects and data abstraction, constructors and destructors; object-oriented design, encapsulation and information hiding, abstraction and modularization, coupling and cohesion, sample design patterns; inheritance, class and type hierarchies, polymorphism, Abstract classes, Interfaces, Packages, Collection classes, Generics, streams and files, exception handling; unit testing and debugging, Application Programming Interfaces, Javadoc.

Prerequisites: CS116, CS1160, ARB099, ENGL099, MATH099

CS2140: Object-Oriented Programming Lab**1 Cr Hr (0,3)**

Lab session every week to enhance hands-on experience on topics that are theoretically covered in CS214, which are: Object Oriented Programming concepts, classes, objects and data abstraction, Constructors and destructors; object-oriented design; encapsulation and information hiding, abstraction and modularization, coupling and cohesion, sample design patterns, inheritance class and type hierarchies, polymorphism, Abstract classes, Interfaces, Packages, Collection classes, Generics, streams and files, exception handling, unit testing and debugging, Application Programming Interfaces, Javadoc.

Prerequisites: ARB099, ENGL099, MATH099. Co-requisites: CS214

CS222: Theory of Algorithms**3 Cr Hr (3,0)**

Complexity bounds and asymptotic analysis, standard complexity classes, empirical measurements of performance, time and space tradeoffs in algorithms, mathematical analysis of recursive and non-recursive algorithms, algorithm design strategies, backtracking algorithms, dynamic programming, sorting algorithms, string matching, graph algorithms, optimization algorithms.

Prerequisites: CS116, CS1160, CS201

CS223: Data Structures**3 Cr Hr (2,2)**

Advanced C language applications (Structures, Pointers), Lists, stacks and queues; hash tables; binary search trees; balanced trees, B-Trees, graphs; depth- and breadth-first traversals; shortest- path algorithms; transitive closure; minimum spanning tree; topological sort; implementation strategies for data structures; strategies for choosing the right data structure.

Prerequisites: CS116, CS1160, ARB099, ENGL099, MATH099

CS332: Computer Graphics**3 Cr Hr (2,2)**

Basic concepts of computer graphics, general features of graphics hardware, raster graphics versus vector graphics, drawing primitive objects: lines, poly-lines, polygons, circles, ellipses, curves; filling methods: scan-line fill and flood fill; Basic two-dimensional (2D) geometric transformations: translation, rotation, scaling and reflection; 2D composite transformations, 2D viewing: clipping window and windowing transformation; basic three-dimensional (3D) geometric transformations: translation, scaling, rotation and reflection; composite 3D geometric transformations, viewing a 3D scene: setting a 3D viewing-coordinate reference, transformation from world to viewing coordinates; projection transformations, 3D object representations: lines, planes, polyhedral, curved surfaces, spheres, ellipsoids; visible-surface detection methods, illumination models and surface-rendering methods, shadow mapping, transparency and surface rendering, interactive graphics.

Prerequisites: CS223, ECE317

CS342: Software Engineering**3 Cr Hr (3,0)**

The product and the process, Software project management: Basic concepts, Software process and project metrics, Software project Planning, Risk management, Project scheduling and tracking, Quality assurance, Configuration management; Classical approaches: Waterfall and Spiral models; Object-oriented approach; Unified Modeling Language (UML); Concepts and notations of object-oriented analysis: Base concepts; Static concepts; Dynamic concepts; Object-oriented analysis: Analytical process; Analysis patterns; Static model; Dynamic model; Design notations and diagram; Design patterns.

Prerequisites: CS254, CS363

CS363: Database Management Systems**3 Cr Hr (2,2)**

DBMS Architecture, Storage Hierarchy, Indexes, Entity-relationship (E-R) modeling, The relational model, Relational Query Language (SQL), Query processing and optimization, Creation and manipulation of databases; Indices and views; Access rights management; Programming in SQL; Transaction Processing (Transactional properties, Concurrency control, Locking, and Crash recovery); Data dictionaries; Required software tools: A main-stream commercial DBMS such as MS SQL, Oracle.

Prerequisites: CS223

CS416: Systems Programming**3 Cr Hr (2,2)**

System-level UNIX API's: Process manipulation; IO operations; Use of OS functionality; System-level programming in C; Shell programming; Unix system services: file system, process and thread management, inter-process communication: pipes, shared memory, and message queues, semaphores; Network programming, and synchronization; Microsoft Windows and UNIX TCP and UDP Communications; Connection-Oriented Client-Server Architecture; Remote procedure calls and COM overview.

Prerequisites: CS223

CS419: Compiler Construction**3 Cr Hr (3,0)**

Formal grammars; Context sensitive, context free, regular grammars; Phases of compilation; Lexical analysis and a review of parsing; Compiler-compilers and translator writing systems; top-down parsing and bottom-up parsing; Lexical scanners generators. Parser generators; Compilation of modern procedural languages; Scope rules; block structure; Symbol tables; Runtime stack management; Parameter passage mechanisms; Stack storage organization and templates; Heap storage management; Intermediate code generation. Machine code generation; Macros; Templates.

Prerequisites: CS223, CS222

CS323: Computational Theory**3 Cr Hr (3,0)**

Introduction to automata; languages and grammars; complexity theory and computability; Base mathematics and theoretical concepts behind computing: Finite automata; Regular expressions; Grammars; Stack machines; Turing machines; Decidability and reducibility; Complexity Classes; Denotational Semantics.

Prerequisites: CS222, CS223

CS451: Artificial Intelligence**3 Cr Hr (3,0)**

Mathematical principles of AI; introducing several AI approaches and techniques and their underlying mathematical/algorithmic structure. Problems; problem spaces, and search. Heuristic search techniques, simulated annealing, genetic algorithms and Tabu search. Knowledge representation and logic; Constraint logic programming; Statistical reasoning; Fuzzy set theory and reasoning; Neural networks.

Prerequisites: CS222, CS223

CS330: Image Understanding**3 Cr Hr (2,2)**

This course explores several algorithms for extracting useful semantic content from image data. In general, the course theme spans over three main topics: image processing, features and matching, and image analysis. In particular, the course will include algorithms and techniques related to feature extraction, edge detection, SIFT, Harris Corner detection, feature selection, camera models, homography, stereo vision, image search, image classification, objection detection, HOG detector, and image segmentation. The course enables students to work with real applications including real images, e.g., urban street images and medical images.

Prerequisites: CS223, ECE317

CS254: Visual Programming**3 Cr Hr (2,2)**

This course explores topics in Visual programming fundamentals; This course aims to introduce the students who have built a solid background in console systems to the concepts of Visual/GUI design using structured and OO programming skills acquired in previous courses. Topics include Windows Forms and Controls, Event-Driven Programming, Error Handling, Files, Multi-threading; Animation and graphics; Database connectivity. The practical part of this course will focus on training the students on various visual programming development kits, e.g., .NET framework. The course also includes a project, which brings together students coding, and user-interface design principles.

Prerequisites: CS214, CS2140

CS355: Web Technologies**3 Cr Hr (2,2)**

This course explores topics in Internet and Web technology; Mobile components; Event handling: detection, notification, and response; Web applications development; Standard web services and protocols: WSDL, and UDDI, and SOAP; Design of web services and applications within a service-oriented architecture; Web application languages: HTML, XML, and scripting languages; Programming techniques for consumption and implementation of web services; Server web applications; Java servlets, and Java Server Pages; PHP basics; PHP forms and sessions; Databases connection with SQL and PHP. The practical part of this course will focus on training the students on various web development tools, like HTML, XML, and PHP.

Prerequisites: CS254, CS363

CS356: Information Security**3 Cr Hr (3,0)**

This course covers fundamental issues surrounding information security and privacy. Course topics include confidentiality, integrity, availability; authentication models, protection models, security kernels, secure programming, audit, intrusion detection and response, operational security issues, physical security issues, personnel security, policy formation and enforcement, access controls, information flow; legal and social issues, identification and authentication in local and distributed systems, classification and trust modeling, risk assessment, data aggregation, behavioral advertising, privacy-preserving data mining, privacy-preserving data publishing, website privacy policies and practices, and anonymous communication.

CS477: Mobile Computing

3 Cr Hr (2,2)

An introduction to mobile computing with a strong emphasis on application development for the Android operating system. Topics will include Introduction to Android IDE, Layout & Activity, Preference and Service Menu, Thread (message), Thread (progress, post, broadcast, & Intent filter), Notification, Dynamic layouts, TTS, and clocks SQLite. This course will cover mobile phone programming components like UI programming, data management, localization, and programming sensors like the accelerometer and compass, and mobile OS services. The course will focus on the Android platform and how to use cloud services in applications. Android tablets will also be given.

Prerequisites: CS254, CS363

CS61: Big Data

3 Cr Hr (3,0)

The key objective of this course is to familiarize the students with most important information technologies used in manipulating, storing, and analyzing big data. The course includes introducing students to the basic tools for statistical analysis (e.g., R and Python) and also mastering big data processing frameworks (e.g., Hadoop and Spark). Furthermore, students will learn so-called NoSQL storage solutions exemplified by Cassandra for their critical features: speed of reads and writes, and ability to scale to extreme volumes. Students will learn about memory resident databases (VoltDB, SciDB) and graph databases (Ne4J).

Prerequisites: CS363, CS214

CS455: Ethical Hacking

3 Cr Hr (3,0)

This course introduces the students to the various techniques of ethical hacking. The student will learn in a safe environment (sandbox) how to find network and IT systems vulnerabilities, reporting these vulnerabilities, and how to mitigate their effects. The students will also learn about the legal and ethical aspects of such testing.

Prerequisites: CS356

CS471: Digital Forensics

3 Cr Hr (3,0)

This course introduces a theoretical and practical knowledge on the principles and practices of digital forensics. It covers the sources of digital evidence, digital investigation, and fundamentals of computer forensics. Coverage includes disk examination, memory acquisition, and logging analysis. The course also includes registry, e-mail, and database forensics.

Prerequisites: CS363, CE357, CE3570

CS470: Cryptography

3 Cr Hr (3,0)

This course introduces the students to the classical and modern cryptographic techniques and their applications. Extensive study of required mathematical techniques is introduced including number theory, modular arithmetic, prime numbers, Fermat's and Euler's theorems, and testing for primality. The students then will be thoroughly exposed to different cryptographic techniques and algorithms: Block and Stream ciphers, Symmetric and Asymmetric Key encryption, Public Key encryption, One-time padding. The students will also learn about the different Key Creation and Exchange techniques, Digital Signatures, Message Authentication Codes, and Hash Algorithms.

Prerequisites: CE352, ECE317, CS222

CS391: Field Training**0 Cr Hr (0,0)**

Eight consecutive weeks of training where students must complete 160 hours of field training in approved industries in Jordan.

Prerequisites: completion of 90 credit hours

CS491: International Internship**12 Cr Hr 36H/W**

Field training is a period of six month to be spent in the industry in Germany, under supervision of the academic faculty in Jordan and in Germany. Periodic reports and a final report need to be submitted for evaluation and an oral examination is required.

Prerequisites: CS391

CS492: Senior Project**3 Cr Hr (0,9)**

Theoretical investigation and practical implementation of a special project under the supervision of an academic faculty member, detailed report as well as an oral examination are required.

Prerequisites: Completion of 90 credit hours

IX. Elective Course Offered by the Computer Science Department

CS371: Bioinformatics

3 Cr Hr (3,0)

history of bioinformatics; implications of bioinformatics on biology and computer science; principles, concepts, methods, techniques, algorithms, tools, and strategies to transform and process the masses of information from biological experiments, focusing particularly on biological sequence data. It covers topics such as: DNA and protein sequence alignment and analysis, sequence analysis software, database searching, database search heuristic algorithms, sequence alignment dynamic programming algorithms, RNA folding, and multiple sequence alignment and analysis.

Prerequisites: CS222, CS223

CS333: Game Programming

3 Cr Hr (3,0)

This course is a comprehensive introduction to the wide variety of topics within game programming, physics of games and AI in games. Primary learning outcomes of this course include a) using the Unity Editor to create exciting game levels, b) understanding the fundamentals of using 2D and 3D graphics, c) creating game scripts (e.g., using C++ and the Unity API), d) becoming acquainted with advanced topics such as shaders, physics, AI, and Network based games, and c) understanding the process of game development from idea to beta version.

Prerequisites: CS254

CS439: Computer Animation

3 Cr Hr (3,0)

Fundamentals of Computer Animation; Applications of Computer Animation; Animation principles and types; Interpolation; Differential equations; Key frame animation; Particle dynamics and systems; Body dynamics and systems; Procedural animation; Physics-based methods; Motion capture techniques; Image morphing; Object deformation; Controlling groups of objects; Data- driven motion synthesis; Character Animation: basic motion (reaching, grasping, walking), facial animation, fluid animation, inverse kinematics, inverse dynamics; Lighting, shading, and anti- aliasing; Space-time constraints; Mathematics optimization; High-level control; Hierarchical and articulated models; Statistical models; Advanced modeling and rendering.

Prerequisites: CS332

CS358: Multimedia Systems Design

3 Cr Hr (3,0)

This course covers the state-of-the-art technology for multimedia systems. This course introduces students to different media types (e.g., images, video, audio, graphics) and how they are used to create multimedia content and systems, algorithms and standards to compress and distribute them via networked systems to a variety of end clients. In general, the course includes issues related to a) content creation: media capture and representation, methods to assemble media types to create multimedia content; b) compression / Storage: students will study algorithms, protocols architectures related to compression; and c) distribution: Aspects of wired and wireless network distribution, Quality of Service, as well as digital rights management of distributed multimedia (watermarking & encryption). For each of the above ISO and ITU standards will also be addressed - JPEG, MPEG1, MPEG2, MPEG4, H.261, H.263, H.264, G.711, G.722, mp3, AAC, Dolby AC3, THX, surround sound, etc. We will also study applications and systems around multimedia – such as database applications with metadata (MPEG-7, MPEG-21). The course's goal will also be to explain modern distributed multimedia systems that take some or all of the above components to create practical applications, e.g., multimedia authoring, digital cinema, content management, multimedia databases, etc.

Prerequisites: CS223, ECE317

CS457: Decision Support Systems and Intelligent Systems**3 Cr Hr (3,0)**

This course explores topics in fundamentals of organizational information analysis OIS and executive information systems EIS; Management support systems; Solutions to the decision-making problems in real world; Decision making strategies and models; Design, development, and evaluation of decision support systems; Intelligent decision support technologies such as expert systems, neural network systems, data and text mining, and decision tree. The practical part of this course will focus on training the students on various DSS tools and enriching their skills towards developing different DSS solutions for real world applications.

Prerequisites: CS222

CS462: Database Design**3 Cr Hr (3,0)**

Three-level information architecture: External schema; Conceptual schema; Logical data model; DB server/user toolkit architecture: Query languages; Report writers; Query and application development tools; Data-modeling: CASE tools; Relational technology fundamentals; Components of a relational DBMS; Relational Database design; Developing the logical data model; Mapping the data model to the relational model; Entity-relationship modeling; Normalizing data to design tables: Identifying functional dependencies; Applying rules for normalization; Implementing relational databases using a CASE tool; Physical database design; Manipulating and controlling a database using SQL; Creating views; Enforcing business rules for data integrity; Modeling in analysis and design; Creating an intelligent server; Creating informative data visualizations; Transactions and Database Security.

Prerequisites: CS363

CS365: Systems Analysis and Design**3 Cr Hr (3,0)**

Introduction to systems development; Development life cycle; System Development feasibility; Development of fact-finding methods; Context diagram; Data flow diagram; Decision tables and trees; Data dictionary; Installation; Training; Development Tools: Documentation, Maintenance, Conceptual design, DB design, Reverse engineering, Graphical user interface, Systems life cycle, System conversion, System charts and flow of control; Case study.

Prerequisites: CS222, CS223

CS364: Information Retrieval**3 Cr Hr (3,0)**

Introduction to Information Retrieval and Information Management from a user and design perspectives. The course covers formal models, evaluation and performance measurement, implementation structures and algorithms, and automatic organization of information including indexing, clustering, and NLP. Advanced topics include knowledge representation, semantic nets, fuzzy, and rough sets, web search, and internet technologies.

Prerequisites: CS363

CS357: Cybersecurity**3 Cr Hr (3,0)**

This course covers an essential range of topics for securing modern enterprises. Course topics include Cryptographic Tools, user authentication, database and cloud Security, malicious software, denial of service attacks, intrusion detection, firewalls and intrusion prevention systems, IT security management and risk assessment, human resources security, legal and ethical aspects, enterprise roles, security metrics, risk management, standards and regulations, physical security, and cybercrime issues and investigation.

Prerequisites: CS363

CS359: Internet of Things**3 Cr Hr (3,0)**

Application areas of Internet of Things (IoT), Internet in Mobile Devices, Cloud and Sensor Networks,

building blocks of Internet of Things and characteristics, design and program IoT-based devices and prototypes, Security of IoT devices, IoT with cloud computing, wireless technologies used in IoT systems, such as Wi-Fi, 6LoWPAN, Bluetooth and ZigBee.

Prerequisites: CS214, CS2410

CS353: Natural Language Processing

3 Cr Hr (3,0)

Introduction to language: words, symbols, sentences, documents, corpus. Variation in languages & dialects. Information retrieval. Words: Stemming, Lemmatization. Sentences: Syntactic parsing, Chunking. Named entity recognition (NER). Word sense disambiguation (WSD). Classification: Sentiment Analysis, Spam detection. Applications: Question Answering, Dialogue Systems, Summarization, Information Extraction.

Prerequisites: CS222

CS430: Virtual and Augmented Reality

3 Cr Hr (2,2)

VR systems: Discipline, features, Architecture. VR hardware: tracking systems, motion capture systems, visual displays. Fundamentals of the human visual system. Haptic rendering: Haptic sense. Haptic devices. Algorithms for haptic rendering. VR software development: Challenges in VR software development. Windowing, viewing, input/output, networking. Master/slave and Client/server architectures. Cluster rendering. Game Engines. Publically available SDK for different hardware (HTC VIVE, Oculus, Google VR). AR software development: AR software. Camera parameters and camera calibration. Marker-based augmented reality. Pattern recognition. AR Toolkits.

Prerequisites: CS214, CS2410

CS450: Operations Optimization

3 Cr Hr (3,0)

Linear Programming, Simplex Method, Integer Linear Programming, Transportation Models, Network Models, Queuing Systems, Inventory Models, Game Theory, Dynamic Programming, Decision Theory, Nonlinear Programming.

Prerequisites: CS222

CS458: Wireless Networks:

3 Cr Hr (3,0)

introduction to wireless network devices, protocols and architectures; wireless networking standards, wireless local/wide area networks protocols, mobile internet protocols, ad hoc networks, wireless sensors networks.

Prerequisites: CE352

CS460: Data Mining

3 Cr Hr (3,0)

The course introduces students to data mining, by studying their principles, algorithms, implementation methodology, and applications. It provides a comprehensive introduction to data mining, including data selection, cleaning, coding, using different pattern recognition techniques, and reporting; and introduce students to the applications of data mining by using commercial tools for creating business applications.

Prerequisites: CS363

CS452: Data Privacy

3 Cr Hr (3,0)

The course introduces the core issues surrounding privacy, security, data storage and analysis and the technologies that have been developed to address those issues. The plan is to understand the theoretical concept of secure computation, using data mining to give an application-oriented view. The course discusses the important regulations in force today including HIPAA, Sarbanes-Oxley, EU GDPR, etc. and

considers what comprises compliance. Moreover, the courses discuss how to benefit of information sharing, including managerial impacts, and how to enable it in a secure manner.

Prerequisites: CS356

CS452: Security Analytics

3 Cr Hr (3,0)

Techniques from data mining, machine learning, statistics and natural language processing (NLP) are increasingly being applied to computer security problems. For example, phishing email and web site detection uses machine learning, statistics and NLP techniques. Intrusion Detection uses machine learning and data mining techniques. Denial of service attacks on the Internet have been tackled using statistics. However, there are some unique challenges posed by the application domain of security. The goal of this course is to give undergraduate students with a broad understanding of the main ideas of these fields with their applications to computer security problems and issues, the unique challenges posed by security, and the work that has been done to address these challenges.

Prerequisites: CS356, CS451

CS470: Blockchain Technologies

3 Cr Hr (3,0)

This course will be on the fundamentals of Blockchain and Blockchain Technology. The most well-known example of Blockchain Technology in wide use today is as the storage and transaction mechanism for the cryptocurrency Bitcoin. The course includes topics related to: blockchain and distributed ledger systems in a business environment, important concepts and key use cases of blockchain for business, and how assets can be transferred in a blockchain network.

Prerequisites: CS356

CS472: Quantum Computing

3 Cr Hr (3,0)

This course provides an introduction to the theory and practice of quantum computation. Topics covered include: enough quantum mechanics to understand quantum computation, Quantum algorithms. Simon's algorithm, the prime factorization algorithm, Grover's search algorithm, Mathematical models of quantum computation, their relationships to each other, and to physical systems, Quantum error correcting codes, Quantum cryptography, Quantum fault tolerance.

Prerequisites: CE352, CE201

CS372: Steganography

3 Cr Hr (3,0)

Introduction to Steganography, steganography types including text steganography, image steganography, audio steganography, and video steganography. Steganography techniques including Spatial domain methods, Statistical techniques, Transform domain techniques, and Masking and filtering. Applications of Steganography in different fields such as E-commerce, digital watermarking, and data storing. Introduction to tools for hiding and extraction of data.

Prerequisites: CS330, CS356

CS374: Hardware Security

3 Cr Hr (3,0)

This course exposes the students to the different aspects of Hardware security including secure hardware design and the different types of attacks targeting Hardware. The course includes access control, secure key storage, authentication techniques, hardware root of trust design, and IC supply chain risks.

Prerequisites: CE201

CS370: Web Security

3 Cr Hr (3,0)

This course is a comprehensive overview of web security. The goal is to build an understanding of the most common web attacks and their countermeasures. Given the pervasive insecurity of the modern web landscape, there is a pressing need for programmers and system designers to improve their understanding of web security issues. The course covers the fundamentals as well as the state-of-the-art in web security. Topics include principles of web security, attacks and countermeasures, the browser security model, web app vulnerabilities, injection, denial-of-service, TLS attacks, privacy, fingerprinting, same-origin policy, cross site scripting, authentication, JavaScript security, emerging threats, defense-in-depth, and techniques for writing secure code. Course projects include writing security exploits, defending insecure web apps, and implementing emerging web standards.

Prerequisites: CS355, CS356

CS373: Database Security

3 Cr Hr (3,0)

This course will provide an overview of database security concepts and techniques and discuss new directions of database security in the context of Internet information management. The topics will cover database application security models, privileges, passwords, roles, database and data auditing, XML access control, trust management and privacy protection, multilevel secure relational model and poly-instantiation, auditing in relational databases, The course also covers advanced topics such as SQL injection, database management security issues such as securing the DBMS, enforcing access controls, and related issues.

Prerequisites: CS363

CS459: Scientific Visualization

3 Cr Hr (3,0)

Scientific visualization is concerned with the visual representation of numerical datasets obtained through measurements or computational simulations of natural phenomena. Visualization creates interactive graphical interfaces to datasets of ever-increasing size and complexity that affords scientists and engineers a powerful and intuitive basis for interpretation, assessment, and decision making. The course covers the fundamental principles of this discipline and describes the most prominent visualization techniques used in practice. In particular, the course presents basic and more advanced visualization algorithms for 2D, 3D, and time-dependent datasets corresponding to scalar, vector, and tensor attributes, as well as high-dimensional and non-spatial data. The lectures emphasize the practical applications of these techniques in science, engineering, and medicine.

Prerequisites: CS222, CS223, CS363

CS456: Cloud Computing

3 Cr Hr (3,0)

This class will introduce the benefits of cloud computing as well as the challenges associated with it. The course will introduce different models of services that are common in cloud computing, namely: Infrastructure as a Service (IaaS), Platform as a Service (PaaS), and Software as a Service (SaaS). The course will discuss the types of clouds and benefits of each one as well as its cost model. The course includes studying current commercial offerings from major providers of cloud computing solutions like Amazon, Google, Microsoft, and others.

Prerequisites: CS363, CS214, CE352

CS481: Special Topics in Computer Graphics

3 Cr Hr (3,0)

Selected state-of-the-art topics in computer graphics, animation and their applications.

Prerequisites: CS332

CS482: Special Topics in Software Engineering

3 Cr Hr (3,0)

Selected state-of-the-art topics in software engineering

Prerequisites: CS342

CS4833: Special Topics in Applied Computer Science 3 Cr Hr (3,0)

Selected state-of-the-art topics in areas of applied computer science.

Prerequisites: CS222, CS223

CS4832: Special Topics in Applied Computer Science 2 Cr Hr (2,0)

Selected state-of-the-art topics in areas of applied computer science.

Prerequisites: CS222, CS223

CS4831: Special Topics in Applied Computer Science 1 Cr Hr (1,0)

Selected state-of-the-art topics in areas of applied computer science.

Prerequisites: CS222, CS223

CS484: Special Topics in Database Technologies and Applications 3 Cr Hr (3,0)

Selected state-of-the-art topics in database technologies and applications.

Prerequisites: CS363

CS489: Special Topics in Algorithms 3 Cr Hr (3,0)

Selected state-of-the-art topics in the field of data structures, algorithms, theoretical foundations of computing and their applications.

Prerequisites: CS222, CS223

CS480: Special Topics in Data Science Technologies and Applications 3 Cr Hr (3,0)

Selected state-of-the-art topics in the field of big data analysis techniques and their applications.

Prerequisites: IE0121, CS201

CS487: Special Topics in Cybersecurity 3 Cr Hr (3,0)

Selected state-of-the-art topics in the field of cybersecurity.

Prerequisites: CS356

CS485: Special Topics in Artificial Intelligence 3 Cr Hr (3,0)

Selected state-of-the-art topics in artificial intelligence.

Prerequisites: CS451

X. Course Offered by Other Departments at SEEIT

CE201: Computer Architecture and Organization

3 Cr Hr (3,0)

Basic computer organization, central processing unit, micro-program control and control unit, arithmetic processor, memory units, bus structures, interrupt structures. Taxonomies of computer architectures; addressing methods, programs control, processing units, I-O organization, arithmetic, main-memory organization, peripherals, microprocessor families, RISC architectures and multiprocessors. Von Neumann; Baseline of processor architecture; Memory organization; Parallel computing;

Prerequisites: CS212, CS2120

CE212: Digital Systems

3 Cr Hr (3,0)

Fundamentals of digital electronics, Binary number system; Boolean algebra, logic operations, algebra and gates, digital circuits analysis, gate-level and block level design of digital circuits, adders, subtractors, comparators, multiplexers, decoders, analysis, design and applications of sequential circuits: flip-flops, registers, counter, and their design procedures, RAM and ROM memory elements.

Prerequisites: ARB099, ENGL099, MATH099

CE2120: Digital Systems Lab

1 Cr Hr (0,3)

The course also includes 3-hours lab session every week to enhance hands-on experience on topics that are theoretically covered in the CE212 course, including basic logic gate experiments, combinational logic circuits experiments, and sequential logic circuits experiments. The experiments on all topics vary from functional troubleshooting to gate and block level design implementation.

Prerequisites: ARB099, ENGL099, MATH099. CO-requisites: CE212

CE357: Operating Systems

3 Cr Hr (3,0)

Operating system structures, process concept, hierarchy of processes, semaphores, inter-process communication, CPU scheduling, deadlocks, memory management, virtual memory, secondary storage management, file systems, I/O systems. 3-hours lab covers hands-on-experience on a study development of a sample operating system and alternative designs of operating systems: programming language development, advanced commands, shell programming, and design principles. The focus of the sample operating system will be on the Linux Open Source to equip students with the right skills to work with open sources software.

Prerequisites: CE201

CE3570: Operating Systems Lab

1 Cr Hr (0,3)

The course also includes 3-hours lab session every week to enhance hands-on experience on topics that are theoretically covered in the CE357 course.

Co-requisites: CE357

CE352: Computer Networks

3 Cr Hr (3,0)

Study of computer network architectures, protocols, and interfaces. The OSI reference model and Internet architecture. Network models: LAN and WAN; Networking techniques such as multiple access, packet/cell switching, internetworking, end-to-end protocols, and congestion control; IP, UDP and TCP protocols; Internet application protocols and applications: http; DNS; Web services; email protocols: SMTP, POP3; Network security. The students are expected to implement a project in the field of computer networks and to use open-source network simulators such as NS2.

Prerequisites: CS116, CE201

ECE317: Linear Algebra

3 Cr Hr (3,0)

Systems of linear equations. Vector spaces and linear transformations. Independence, bases and dimensions, bases transformation. The fundamental four spaces. Understand a matrix as a linear transformation relative to a bases of a vector space. Orthogonality and Gram-Schmidt process. Projection and projection matrices. Linear models and least squares problems. Determinants and their properties. Eigenvalues and eigenvectors. Matrix decompositions such as LU decomposition, Eigen-decomposition, Singular Value Decomposition. Vector and matrix derivatives. Applying these tools in a wide range of engineering applications.

Prerequisites: MATH 101, Co-requisites: MATH102

IE0121: Probability and Statistics

3 Cr Hr (3,0)

Descriptive statistics, probability concepts, discrete and continuous random variables and distributions, joint probability distributions, covariance and correlation of random variables, point and interval estimation for single sample, sampling distributions, and statistical inference for single sample.

Prerequisites: MATH101

CE377: Machine Learning

3 Cr Hr (3,0)

This course focuses on statistical pattern recognition and machine learning techniques. The main topics of the course include: Bayesian decision theory, parametric density estimation (Maximum likelihood estimation (MLE) and non-parametric density estimation (Density Estimation, Parzen Window, K- Nearest Neighbor estimation, PNN, k-Nearest Neighbor classification rule), Bayesian parameter estimation, Hidden Markov models (HMM)), Linear Discriminant Analysis(Linear discriminant functions, generalized discriminant analysis, Support vector machines), probabilistic graphical models, Multilayer Neural Networks (Perceptron Model, Artificial Neural Networks ANN's, Feed-forward NN, Error Back-propagation Algorithm), deep learning, and feature reduction and selection. This course involves several programming assignments in which students will use Matlab and/or Python to build various machine learning and pattern classification models that can be used to solve real-world problems.

Prerequisites: CS363, IE0121

XI. Courses offered by Other Schools

ARB099: Arabic 99

0 Cr Hr (3,0)

This course aims to develop student's ability to read, comprehend, literary analyze, grammatically analyze, linguistically analyze, poetically analyze, and rhetorically analyze texts properly. The course also includes a selection of Arabic literature in poetry and prose representing different literary ages, in addition to several common forms of writing such as scientific article, news article, and others.

Prerequisites: -

ARB100: Arabic

3 Cr Hr (3,0)

This course aims to improve the student's competence in the various linguistic skills in terms of reading, comprehension, and taste. This is achieved through the study of selected texts with many implications that raise issues in spelling, grammar, composition, meaning, and inference, and the use of an old and modern thesaurus.

Prerequisites: ARB099

ENGL099: English II

0 Cr Hr (3,0)

Students will focus on English at a pre-intermediate level concentrating on the receptive skills of reading and listening and the productive skills of writing and speaking. These will include such things as comparatives and superlatives, quantifiers, possessive adjectives and pronouns, vocabulary building, role-play activities for speaking, reading comprehension and writing short descriptive paragraphs.

Prerequisites: -

ENGL101: English III

1 Cr Hr (3,0)

Students will focus on English at an intermediate level concentrating on the receptive skills of reading and listening and the productive skills of writing and speaking. These will include collocations, tense review, affirmative, negative statements, synonyms and antonyms, time clauses, conditionals, active and passive forms, reported speech, phrasal verbs, reading comprehension with detailed questions, vocabulary and writing developed descriptive and opinion essays.

Prerequisites: ENGL099

ENGL102: English IV

1 Cr Hr (3,0)

Students will focus on English at an upper-intermediate level concentrating on the receptive skills of reading and listening and the productive skills of writing and speaking. Model verb review, silent letters and proper pronunciation, jobs and careers, requests and offers, more phrasal verbs with vocabulary building, relative clauses and relative pronouns, narrative tenses for writing exercises, wishes and regrets, reading and comprehending longer passages with direct and inference questions of medium difficulty, hypothesizing, and writing fully developed descriptive, argumentative and analytical essays of 350 words.

Prerequisites: ENGL101

ENGL 201: English V

2 Cr Hr (3,0)

Students will focus on English at an Advanced level. Students will analyze and produce 2 – 3 page essays with an emphasis on argumentation and persuasion working both independently and cooperatively to gather, evaluate, and synthesize necessary information. Class activities include interactive lectures, small group and class discussions, informal debates, peer feedback, individual presentations, focused listening

exercises and focused viewing exercises as well as assorted reading, writing, and grammar assignments. There will be some poetry analysis together with reading and understanding a short story and a drama using basic literary terms and concepts.

Prerequisites: ENGL102

ENGL 202: English VI

2 Cr Hr (3,0)

Students will continue to focus on English at an Advanced level. Students will analyze and produce 4 – 5 page essays emphasizing argumentative, persuasive and discursive styles of writing, working both independently and cooperatively to gather, evaluate, and synthesize necessary information. Students will integrate the practice of critical thinking and reading into the writing process. Class activities include interactive lectures, small group and class discussions, informal debates, mini-conferences, peer feedback, individual presentations, focused listening exercises and focused viewing exercises as well as assorted reading, writing, and grammar assignments. There will be some poetry analysis together with reading and understanding a short story and a drama using stronger and more intensive literary terms and concepts than in 201.

Prerequisites: ENGL 201

ENGL 202: English VI

2 Cr Hr (3,0)

Students will continue to focus on English at an Advanced level. Students will analyze and produce 4 – 5 page essays emphasizing argumentative, persuasive and discursive styles of writing, working both independently and cooperatively to gather, evaluate, and synthesize necessary information. Students will integrate the practice of critical thinking and reading into the writing process. Class activities include interactive lectures, small group and class discussions, informal debates, mini-conferences, peer feedback, individual presentations, focused listening exercises and focused viewing exercises as well as assorted reading, writing, and grammar assignments. There will be some poetry analysis together with reading and understanding a short story and a drama using stronger and more intensive literary terms and concepts than in 201.

Prerequisites: ENGL 201

GERL101B1: German I B1 track

3 Cr Hr (9,0)

By the end of this module, the student will be able to:

- Comprehend very familiar, everyday expressions and very simple sentences and structures related to areas of most immediate relevance according to the discretionary standards in the *Common European Framework of Reference for Languages* (CEFR) at the Level A1.1 (beginners without pre-knowledge).
- Introduce herself/himself and others, express likes and dislikes, fill out a personal form, ask questions and give answers in present and partially in past tense, set private and semi-official appointments, describe people and things and express frequency and quantity in a very basic way both orally and in writing.
- Communicate with native speakers on a very basic level if those involved in the conversation speak slowly and clearly and are willing to support the non-native speaker.

Prerequisites: Intensive pre-course (only for 1st semester of an academic year)

GERL102B1: German II B1 track

3 Cr Hr (9,0)

By the end of this module, the student will be able to:

- Understand and use familiar, everyday expressions and very simple sentences and structures related to areas of most immediate relevance according to the discretionary standards in the *Common European Framework of Reference for Languages* (CEFR) at the level A1.2 (basic users).
- Introduce herself/himself and others, express likes and dislikes, fill out a personal form, ask questions and give answers in present and past tense, set private and official appointments, describe people and things, ask for directions, express frequency and quantity in a basic way both orally and in writing.
- Communicate with native speakers on a very basic level if those involved in the conversation speak slowly and clearly and, if need be, are willing to support the non-native speaker.

Prerequisites: **GERL101B1**

GERL201B1: German III B1 track

3 Cr Hr (6,0)

By the end of this module, the student will be able to:

- Understand and use familiar, frequently used expressions and simple sentences and structures related to areas of a wider immediate relevance according to the discretionary standards in the *Common European Framework of Reference for Languages* (CEFR) at the level A2.1 (basic users).
- Talk about their academic and/or professional background, describe their living conditions, express likes and dislikes, ask questions and give answers in present and past tense, ask for help and support, make suggestions and give advice, describe health problems and talk with medical doctors and nurses, express pity, sorrow and hopes, express frequency and quantity in a basic way both orally and in writing.
- Communicate with native speakers within simple and familiar tasks requiring a simple and direct exchange of information on familiar and routine matters.

Prerequisites: **GERL102B1**

GERL202B1: German IV B1 track

3 Cr Hr (9,0)

By the end of this module, the student will be able to:

- Distinguish between familiar expressions, sentences and structures related to areas of immediate relevance and more elaborated components like the main points of clear standard input on familiar matters regularly encountered in work, school, leisure etc. according to the discretionary standards in the *Common European Framework of Reference for Languages* (CEFR) at the level A2.2 (basic users) and, partially, at the level B1.1 (independent user).
- Talk about personal experiences with languages, express feelings of happiness, joy and discomfort, describe own media consumption habits, describe travel experiences, convince others, describe and report in official situations, describe statistics, write formal invitations and short emails, make suggestions and talk about future events and situations, describe dreams hopes and ambitions and briefly give reasons or explanations for opinions and plans.
- Communicate with native speakers about essential points and ideas in familiar contexts.
- Understand the characteristics of the official B1 exam according to the CEFR and use strategies to overcome obstacles while solving said exam.

Prerequisites: **GERL201B1**

GERL301B1: German V B1 track

3 Cr Hr (9,0)

By the end of this module, the student will be able to:

- Understand the main points of clear standard input on familiar matters regularly encountered in work, school, leisure etc. according to the discretionary standards in the *Common European Framework of Reference for Languages* (CEFR) at the level B1.1 and B1.2 (independent user).
- Deal with most situations likely to arise whilst traveling in an area where German is spoken, produce simple connected texts on topic which are familiar or of personal interest, describe experiences and

events, dreams, hopes and ambitions, statistics, and briefly give reasons and explanations for opinions and plans.

- Understand the main point of many radio or TV programmes on current events and topics, understand the description of events, feelings and wishes in personal letters, write personal letters/texts describing experiences and impressions, write straightforward connected texts on topics which are familiar or of personal interest.
- Communicate with native speakers about essential points and ideas in familiar contexts and about topics of personal or partially professional interest.
- Follow a lecture or talk within her/his field, provided the subject matter is familiar and the presentation straightforward and clearly structured.
- Understand simple technical information, such as operating instructions for everyday equipment.
- Understand all characteristics of the official B1 exam according to the CEFR and use a variety of strategies to overcome obstacles while solving said exam and all its components.

Prerequisites: GERL202B1

GERL302REG: German VI Regular

3 Cr Hr (6,0)

By the end of this module, the student will be able to:

- Successfully manage the application process for a six months internship in Germany which is part of the obligatory 'German Year' for all GJU students. The process consists of finding and understanding a suitable add in accordance with the students' major, writing a convincing CV and cover letter, and mastering an effective and mostly fluent interview, departing spontaneously, taking initiatives, expanding ideas with little help or prodding from the interviewer.
- Successfully manage the most significant situations which the student, in accordance with the currently studied major, encounters during her/his theoretical and practical semester in Germany. This process is being achieved within a technical language training focussing on action orientated and communicative scenarios like following lectures, taking notes, summarizing academic and technical texts, writing official emails and texts related to academic and vocational encounters, holding presentations, communicating both verbally and in writing with professors, university staff, students as well as with colleagues and customers during an internship.
- Understand the concept of general intercultural phenomena, reflect and understand the differences between culture and cultural standards in Jordan and in Germany, understand the concept of 'culture shock' and potentially cope with its different stages, reflect about appropriate and inappropriate behaviour in Germany as well as understand the concepts of open-mindedness and 'culture clash'.

Prerequisites: GERL301B1

GERL302INT: German VI Intensive

3 Cr Hr (9,0)

By the end of this module, the student will be able to:

- Successfully manage the application process for a six months internship in Germany which is part of the obligatory 'German Year' for all GJU students. The process consists of finding and understanding a suitable add in accordance with the students' major, writing a convincing CV and cover letter, and mastering an effective and mostly fluent interview, departing spontaneously, taking initiatives, expanding ideas with little help or prodding from the interviewer.
- Successfully manage the most significant situations which the student, in accordance with the currently studied major, encounters during her/his theoretical and practical semester in Germany. This process is being achieved within a technical language training focussing on action orientated and communicative scenarios like following lectures, taking notes, summarizing academic and technical texts, writing official emails and texts related to academic and vocational encounters, holding presentations, communicating both verbally and in writing with professors, university staff, students as well as with colleagues and customers during an internship.

- Understand the concept of general intercultural phenomena, reflect and understand the differences between culture and cultural standards in Jordan and in Germany, understand the concept of 'culture shock' and potentially cope with its different stages, reflect about appropriate and inappropriate behaviour in Germany as well as understand the concepts of open-mindedness and 'culture clash'.
- Understand all characteristics of the official B1 exam according to the CEFR and use different strategies to overcome obstacles while solving said exam and its different components.

Prerequisites: GERL301B1

GERL102B2: German II B2 track

3 Cr Hr (9,0)

By the end of this module, the student will be able to:

- Understand and use familiar, everyday expressions and simple sentences and structures related to areas of most immediate relevance according to the discretionary standards in the *Common European Framework of Reference for Languages* (CEFR) at the level A1.2 and, partially, A2.1 (basic users).
- Talk about their academic and/or professional background, describe their living conditions, express likes and dislikes, ask questions and give answers in present and past tense, ask for help and support, make suggestions and give advice, express pity, sorrow and hopes, express frequency and quantity in a basic way both orally and in writing.
- Introduce herself/himself and others, express likes and dislikes, fill out a personal form, ask questions and give answers in present and past tense, set private and official appointments, describe people and things, ask for directions, express frequency and quantity in a basic way both orally and in writing.
- Communicate with native speakers on a basic level if those involved in the conversation speak slowly and clearly and, if need be, are willing to support the non-native speaker.

Prerequisites: GERL101B1

GERL201B2: German III B2 track

3 Cr Hr (6,0)

By the end of this module, the student will be able to:

- Distinguish between familiar expressions, sentences and structures related to areas of immediate relevance and more elaborated components like the main points of clear standard input on familiar matters regularly encountered in work, school, leisure etc. according to the discretionary standards in the *Common European Framework of Reference for Languages* (CEFR) at the level A2.1 and A2.2 (basic users).
- Talk about their academic and/or professional background, describe their living conditions, express likes and dislikes, ask questions and give answers in present and past tense, ask for help and support, make suggestions and give advice, describe health problems and talk with medical doctors and nurses, express pity, sorrow and hopes, describe simple statistics, express frequency and quantity in a basic way both orally and in writing, express feelings of happiness, joy and discomfort and write personal emails and letters, understand and produce comments, blogs and reports.
- Communicate with native speakers in simple and familiar tasks requiring a simple and direct exchange of essential information on familiar and routine matters.

Prerequisites: GERL102B2

GERL202B2: German IV B2 track

3 Cr Hr (9,0)

By the end of this module, the student will be able to:

- Understand the main points of clear standard input on familiar matters regularly encountered in work, school, leisure etc. according to the discretionary standards in the *Common European Framework of Reference for Languages* (CEFR) at the level B1.1 and B1.2 (independent user).

- Deal with most situations likely to arise whilst traveling in an area where German is spoken, produce simple connected texts on topic which are familiar or of personal interest, describe experiences and events, dreams, hopes and ambitions and briefly give reasons and explanations for opinions and plans.
- Understand the main point of many radio or TV programmes on current events and topics, understand the description of events, feelings and wishes in personal letters, write personal letters/texts describing experiences and impressions, write straightforward connected texts on topics which are familiar or of personal interest.
- Communicate with native speakers about essential points and ideas in familiar contexts and about topics of personal or partially professional interest.
- Follow a lecture or talk within her/his field, provided the subject matter is familiar and the presentation straightforward and clearly structured.
- Understand simple technical information, such as operating instructions for everyday equipment.
- Understand all characteristics of the official B1 exam according to the CEFR and use different strategies to overcome obstacles while solving said exam and all its components.

Prerequisites: **GERL201B2**

GERL301B2: German V B2 track

3 Cr Hr (9,0)

By the end of this module, the student will be able to:

- Largely understand and produce rather complex texts on both concrete and abstract topics, including technical discussions in her/his field of specialisation and according to the discretionary standards in the *Common European Framework of Reference for Languages* (CEFR) at the level B2.1 (independent user).
- Interact with an initial degree of fluency and spontaneity that makes regular interaction with native speakers quite possible without strain for either party.
- Largely understand standard spoken language, live or broadcast, on both familiar and unfamiliar topics normally encountered in personal, social, academic or vocational life.
- Show a relatively high controlled degree of grammatical control without making errors which cause misunderstanding and with the growing ability to correct most of her/his mistakes.
- Largely follow essentials of lectures, talks, reports and other forms of academic/professional presentation which are propositionally and linguistically complex.
- Understand announcements and messages on concrete and abstract topics spoken in standard dialect at normal speed.
- Scan quickly through long texts, locating relevant details and understand and exchange complex information and advice on the full range of matters related to her/his occupational role.
- Understand the main characteristics of the official B2 exam according to the CEFR and use different strategies to overcome obstacles while solving said exam and its different components.

Prerequisites: **GERL202B2**

GERL302B2: German VI B2 track

3 Cr Hr (6,0)

By the end of this module, the student will be able to:

- Understand and produce rather complex texts on both concrete and abstract topics, including technical discussions in her/his field of specialisation and according to the discretionary standards in the *Common European Framework of Reference for Languages* (CEFR) at the level B2.2 (independent user).
- Interact with a degree of fluency and spontaneity that makes regular interaction with native speakers quite possible without strain for either party.
- Understand standard spoken language, live or broadcast, on both familiar and unfamiliar topics normally encountered in personal, social, academic or vocational life.
- Show a highly controlled degree of grammatical control without making errors which cause misunderstanding and with the growing ability to correct most of her/his mistakes.

- Follow essentials of lectures, talks, reports and other forms of academic/professional presentation which are propositionally and linguistically complex.
- Understand announcements and messages on concrete and abstract topics spoken in standard dialect at normal speed.
- Scan quickly through long texts, locating relevant details and understand and exchange complex information and advice on the full range of matters related to her/his occupational role.
- Understand all characteristics of the official B2 exam according to the CEFR and use different strategies to overcome obstacles while solving said exam and its different components.
- Successfully manage the application process for a six months internship in Germany which is part of the obligatory 'German Year' for all GJU students. The process consists of finding and understanding a suitable add in accordance with the students' major, writing a convincing CV and cover letter, and mastering an effective and mostly fluent interview, departing spontaneously, taking initiatives, expanding ideas with little help or prodding from the interviewer.
- Successfully manage the most significant situations which the student, in accordance with the currently studied major, encounters during her/his theoretical and practical semester in Germany. This process is being achieved within a technical language training focussing on action orientated and communicative scenarios like following lectures, taking notes, summarizing academic and technical texts, writing official emails and texts related to academic and vocational encounters, holding presentations, communicating both verbally and in writing with professors, university staff, students as well as with colleagues and customers during an internship.
- Understand the concept of general intercultural phenomena, reflect and understand the differences between culture and cultural standards in Jordan and in Germany, understand the concept of 'culture shock' and potentially cope with its different stages, reflect about appropriate and inappropriate behaviour in Germany as well as understand the concepts of open-mindedness and 'culture clash'.

Prerequisites: GERL301B2

BE302: Business Entrepreneurship

3 Cr Hr (3,0)

The course focuses on critical skills necessary to develop appropriate financing strategies for new venture creation and growth. Students will use case studies and team projects in course studies. Three primary topics are covered: first, an overview of the entrepreneurial finance process and involved players; second, performing business valuations; and third, securities law with emphasis on developing term sheets and private placement memorandums. Student teams will complete a valuation and mock securities offering for an existing small to mid-size business. Financial valuations and terms sheets developed by student teams will be presented to a panel of venture capital professionals for evaluation and critique

Prerequisites: ENGL101

DES101: Arts Appreciation

3 Cr Hr (3,0)

An introductory course designed for non-art students to give them the basic knowledge of arts and simple approaches to the understanding of the history, development, elements, criticism, esthetics and materials of different art forms (visual, aural and performing arts). A comparative approach between the different arts is given to enhance the students' global understanding of arts and to give them the ability to look at art works and form their own opinions. The course is combined with examples of audio and visual arts.

Prerequisites: ARB099, ENGL101

IC101: Intercultural Communication

3 Cr Hr (3,0)

This course is designed to provide prospective students (whose majors have an international flavor) with tools that offer powerful possibilities for improving the communication process. We will examine the process of sending and receiving messages between people whose cultural background could lead them to interpret verbal and nonverbal signs differently. We will learn about the diversity of these cultural differences and at the same time learn how we might overcome them. Our efforts to recognize and surmount cultural differences will hopefully open up business opportunities throughout the world and

maximize the contribution of all the employees in a diverse workforce

Prerequisites: ENGL101

MILS100: Military Science **3 Cr Hr (3,0)**

History of the Jordanian Arab Army. United Nations Peace Keeping Forces. Preparation of the nation for defense and liberation. History of the Hashemite Kingdom of Jordan and its development

Prerequisites:

NE101: National Education **3 Cr Hr (3,0)**

In a context of striving towards democracy like the one Jordan enjoys today, the meaning and practice of active and responsible citizenship becomes more crucial. It is often argued that democracy requires “democrats” to flourish, and become well established. Democrats are those women and men who recognize pluralism, inclusion, positive engagement, and participation as the main values that govern their interaction with the state as citizens and with each other as diverse people of different interests. In this course you will be able to understand your rights and responsibilities as Jordanian citizen expand your knowledge about the frameworks, and processes that regulates citizen-state relationships as well as the basic necessary skills for you to practice your citizenship rights in a civic manner.

Prerequisites:

SE301: Social Entrepreneurship and Enterprises **3 Cr Hr (3,0)**

This course will serve as an introduction to the field of social entrepreneurship and social enterprises. Through lectures, field visits, analyses of relevant literature, case studies and exercises, this course will explore social entrepreneurship’s potentials, opportunities and limitations. The topics will cover Defining Social Entrepreneurship. Contextualizing Social Entrepreneurship (need, motives, forms, criteria). Role of Leadership, Creativity and Innovation. Locating SE on the profit/non-profit continuum. SE in the larger fields of development, social change, community activism. Social Enterprises (Missions, Markets, Finances). Ethical business and corporate social responsibility.

Prerequisites: ENGL101

SFTS101: Soft Skills **3 Cr Hr (3,0)**

This course is designed to help develop strong oral and written communication skills. The student will be given opportunities to practice writing and editing professional correspondence and technical reports. Additionally, the student will compose and deliver oral presentations. Assignments will include the use of inductive and deductive approaches to conveying a variety of messages. The course emphasis the use of software tools to prepare presentations, stress management, confidence, and sensitivity to others. It also stresses on resume writing and conducting interviews.

Prerequisites: ENGL101

MATH101: Calculus 1 **3 Cr Hr (3,0)**

This course introduces the student to the calculus of single-valued functions. Topics include: limits, continuity, rates of change, rules for differentiating, differentials and local linear approximations, maxima and minima problems, L’Hôpital’s rule, related rates, logarithmic and implicit differentiation, inverse trigonometric and hyperbolic functions, Rolle ’s Theorem, the mean-value theorem, and applications of derivatives and integrals. An overview of integration, basic techniques for integration, algebraic techniques of integration and applications of integrations are also included.

Prerequisites: MATH099

MATH102: Calculus 2 **3 Cr Hr (3,0)**

Sequences and series, power series, convergence theorems: integral, ratio, and alternating - series tests, Polar coordinates, and functions, integration and differentiation of polar functions, Vectors in three-

dimensional space, spherical and cylindrical coordinates, Vector-valued functions, Partial derivatives, Multiple integrals, Topics in vector calculus.

Prerequisites: MATH101

GERL 301: German V

3 Cr Hr (9,0)

Can understand and also seize implicit meanings of a broad spectrum of demanding, longer texts. Can express oneself spontaneously and fluidly, recognizing words without having to search for words frequently. Can use the language effectively and flexibly in social and vocational life or in training and study. Can express oneself clearly, structured and detailed, to complex subjects and use appropriate different means for linkage of texts.

Prerequisites: GERL 202

GERL 202: German IV

3 Cr Hr (9,0)

Can understand the main contents of complex texts, as well as concrete and abstract topics; even discussions between specialists in his/ her own special field. Can communicate spontaneously and fluidly a normal discussion with native speakers, without larger effort on both sides. Can express oneself clearly and in detail in a broad spectrum of topics, describe a point of view to a current question and indicate the pro and cons of different possibilities.

Prerequisites: GERL 201

GERL 201: German III

3 Cr Hr (9,0)

Can understand the main points if no dialect is used and if it concerns familiar things about work, school, spare time etc. Can master most situations which one encounters on journeys in a German speaking area. Can express oneself simply and coherently about familiar topics and areas of personal interest. Can report experiences and events, describe dreams, hopes and goals and give short reasons or explanations about plans and opinions.

Prerequisites: GERL 102