German Jordanian University

School of Electrical Engineering and Information Technology
Department of Computer Science
Bachelor of Science in Computer Science

Study Plan 2023-2024

I. Program Objectives

Computer Science program emphasizes the application of technologies and tools in the short term, and the ability to discover, acquire, and adapt new knowledge and skills in the long term, such that our graduates are prepared 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.

II. Learning Outcomes

Computer Science program provides bachelor's students with an understanding of fundamental computer science and management 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 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 to be competitive in the computing job market and/or being admitted to a good graduate program in computing.

Course Delivery Methods

Courses are in one of the following three methods:

- **Face-to-Face (F2F) Method**
  Courses that are taught through face-to-face learning are delivered at the university campus.

- **Blended (BLD) Method**
  Courses in which teaching consists of face-to-face learning and asynchronous E-learning. The face-to-face learning takes place at the university campus. Asynchronous E-learning takes place through activities, tasks, educational duties, and assignments through the virtual E-learning platforms (Moodle and MyGJU) without direct meetings with course instructors.

- **Online (OL) Method**
  Courses in which teaching consists of synchronous E-learning and asynchronous E-learning. Synchronous E-learning takes place through interactive virtual meetings between instructors and students directly through the virtual E-learning platform (MS Teams). Asynchronous E-learning takes place through activities, tasks, educational duties, and assignments through the virtual E-learning platforms (Moodle and MyGJU) without direct meetings with course instructors.

III. Admission Requirements

To apply for admission, the following minimum requirements must be met:

a. A minimum grade of 75% in high school degree.

Placement Tests

Applicants must sit for placement tests in the Arabic Language, the English Language, and Mathematics to determine whether the applicant may be required to take remedial courses in the mentioned subjects. Depending on or the applicant scores in the placement tests, some of the following 3-credit-hour remedial courses are required:

Course ID	Course Name	Credit Hours	ECTS	Contact Hours		Type	Prerequisites / Corequisites
				Lect.	Prac.		
ARB0099	Elementary Arabic	3	3	3	-	OL	Placement test
ENGL0098	Elementary English	3	3	3	-	F2F	Placement test
ENGL0099	Intermediate English	3	3	3	-	F2F	ENGL0098
MATH0099	Pre-Math	3	3	3	-	OL	Placement test
	Total	**12**	**12**	**12**	**0**		

- Remedial courses are to be completed and passed within the first year of enrollment and are prerequisites for all 200 level courses.
- Passing grade of remedial courses is 60%.
- ECTS (B.Sc.): is the European Credit Transfer and Accumulation, One ECTS is equivalent to 30 actual workload hours.

IV. Degree Requirements

The requirements to obtain a B.Sc. degree in computer science are the following:

a. A minimum of 12 credit hours of elective courses are to be taken at a partner university in Germany.
b. A minimum of 12 credit hours of International Training to be conducted at an industrial company in Germany.
c. Passing all credit hours.

V. Framework for B.Sc. Degree (145 credit hours)

Classification	Credit Hours			ECTS		
	Compulsory	Elective	Total	Compulsory	Elective	Total
University Requirements	21	6	27			
School Requirements	27	0	27			
Program Requirements	79	12	91			
Total	**127**	**18**	**145**			

Course Delivery Method	Credit Hours	Percentage
Online Courses	15	10 %
Blended Courses	52	36 %
Face-to-Face Courses	78	54 %
Total	**145**	**100%**

1. University Requirements: (27 credit hours)

1.1. Compulsory: (21 credit hours)

Course ID	Course Name		Credit Hours	ECTS	Contact Hours		Type	Prerequisites / Corequisites
					Lect.	Prac.		
ARB100	Arabic		3	3	3	-	OL	ARB0099
ENGL1001	Upper-Intermediate English		3	3	3	-	F2F	ENGL0099
ENGL1002	Advanced English		3	3	3	-	F2F	ENGL1001
GERL101B1	German I B1-Track		3	6	9	-	F2F	-
GERL102B1	German II	B1-Track	3	6	9	-	F2F	GERL101B1
GERL102B2		B2-Track						
MILS100	Military Science		3	2	3	-	OL	-
NE101	National Education		3	2	3	-	OL	ARB0099, ENGL0099
NEE101	National Education in English							
		Total	**21**	**25**	**33**	**0**		

1.2. Elective: (6 credit hours) (Two courses out of the following)

Course ID	Course Name	Credit Hours	ECTS	Contact Hours		Type	Prerequisites / Corequisites
				Lect.	Prac.		
DES101	Arts' Appreciation	3	3	3	-	OL	ENGL0098, ARB0099
EI101	Leadership and Emotional Intelligence	3	3	3	-	F2F	ENGL0098
IC101	Intercultural Communications	3	3	3	-	F2F	ENGL0098
PE101	Sports and Health	3	3	3	-	F2F	ARB0099
SE301	Social Entrepreneurship and Enterprises	3	3	3	-	F2F	ENGL0098
SFTS101	Soft Skills	3	3	3	-	OL	ENGL0098
BE302	Business Entrepreneurship	3	3	3	-	OL	ENGL0098
TW303	Technical and Workplace Writing	3	3	3	-	OL	ENGL0098
	Minimum required	**6**	**6**	**6**	**0**		

F2F: Face-to-face BLD: Blended OL: Online co: Corequisite

2. School Requirements: (27 credit hours)

Course ID	Course Name		Credit Hours	ECTS	Contact Hours		Type	Prerequisites / Corequisites
					Lect.	Prac.		
GERL201B1	German III	B1-Track	3	4	6	-	F2F	GERL102B1 or GERL102B2
GERL201B2		B2-Track						GERL102B2
GERL202B1	German IV	B1-Track	3	6	9	-	F2F	GERL201B1 or GERL201B2
GERL202B2		B2-Track						GERL201B2
MATH101	Calculus I		3	5	3	-	BLD	MATH0099
MATH102	Calculus II		3	5	3	-	F2F	MATH101
CS116	Computing fundamentals		3		3	-	F2F	-
CS1160	Computing fundamentals lab		1		-	3	BLD	CS116^{co}
CS117	Object-Oriented Programming		3		3	-	F2F	CS116, CS1160^{co}
CS1170	Object-Oriented Programming Lab		1		-	3	BLD	CS116, CS1160^{co}, CS117^{co}
CE212	Digital Systems		3		3	-	F2F	CS116, MATH0099, ARB0099, ENGL0099
CE2120	Digital Systems Lab		1		-	3	BLD	CS116, CE212^{co}, MATH0099, ARB0099, ENGL0099
EE317	Linear Algebra		3		3	-	BLD	MATH101, MATH102^{co}
		Total	**27**		**33**	**9**		

3. Program Requirements (91 credit hours)

3.1. Program Requirements (Compulsory): (79 credit hours)

The program's 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 (67 credit hours):

Course ID	Course Name		Credit Hours	ECTS	Contact Hours		Type	Prerequisites / Corequisites
					Lect.	Prac.		
GERL301B1	German V	B1-Track	3	6	9	-	F2F	GERL202B1 or GERL202B2
GERL301B2		B2-Track						GERL202B2
GERL302B1	German VI	B1-Track	3	6	6	-	F2F	GERL301B1 or GERL301B2
GERL302B2		B2-Track						GERL301B2
IE0121	Probability and Statistics		3		3	-	F2F	MATH101
CS201	Discrete Structures		3		3	-	F2F	MATH0099, ARB0099, ENGL0099
CE201	Computer Architecture and Organization		3		3	-	F2F	CE212, ARB0099, ENGL0099, MATH0099
CS222	Theory of Algorithms		3		3	-	F2F	CS116, CS201, ARB0099, ENGL0099, MATH0099
CS223	Data Structures		3		2	2	F2F	CS116, ARB0099, ENGL0099, MATH0099
CS264	Visual Programming		3		2	2	F2F	CS117, CS263, ARB0099, ENGL0099, MATH0099
CS263	Database Management Systems		3		2	2	BLD	CS117, ARB0099, ENGL0099, MATH0099
CS323	Computational Theory		3		3	-	F2F	CS222, CS223
CS342	Software Engineering		3		3	-	BLD	CS117, CS263
CE352	Computer Networks		3		3	-	BLD	CE201
CS355	Web Technologies		3		2	2	BLD	CS117, CS263
CS356	Information Security		3		3	-	F2F	CS263
CE357	Operating Systems		3		3	-	F2F	CE201
CE3570	Operating Systems Lab		1		-	3	BLD	CE201, CE357[co]
CS391	Field Training		0		160 hours		F2F	Dept. Approval
CS416	Systems Programming		3		2	2	F2F	CS223
CS451	Artificial Intelligence		3		3	-	F2F	CS222, CS223
CS491	International Internship 20 weeks		12		20 weeks		F2F	CS391
CS492	Senior Project		3		-	9	BLD	Dept. Approval
		Total	**67**		**55**	**22**		

F2F: Face-to-face BLD: Blended OL: Online co: Corequisite

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

Course ID	Course Name	Credit Hours	ECTS	Contact Hours		Type	Prerequisites / Corequisites
				Lect.	Prac.		
CS330	Image Understanding	3		2	2	F2F	CS223, EE317
CS332	Computer Graphics	3		2	2	F2F	CS223, EE317
CS419	Compiler Construction	3		3	-	F2F	CS222, CS223
CS477	Mobile Computing	3		2	2	BLD	CS117, CS263
	Total	**12**		**9**	**6**		

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

Course ID	Course Name	Credit Hours	ECTS	Contact Hours		Type	Prerequisites / Corequisites
				Lect.	Prac.		
CS330	Image Understanding	3		2	2	F2F	CS223, EE317
CE377	Machine Learning	3		3	-	F2F	CS263, IE0121
CS460	Data Mining	3		3	-	BLD	CS263
CS4611	Big Data	3		3	-	F2F	CS117, CS263
	Total	**12**		**11**	**2**		

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

Course ID	Course Name	Credit Hours	ECTS	Contact Hours		Type	Prerequisites / Corequisites
				Lect.	Prac.		
CS419	Compiler Construction	3		3	-	F2F	CS222, CS223
CS470	Cryptography	3		3	-	F2F	CS222, CE352, EE317
CS4713	Ethical Hacking	3		3	-	BLD	CS356
CS4714	Digital Forensics	3		3	-	F2F	CS263, CE357
	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 select 12 credits of 300 level and above from required/elective courses of Cybersecurity or Data Science tracks that are not listed in the table below to fulfill the elective requirements.
- 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	Contact Hours		Type	Prerequisites / Corequisites
				Lect.	Prac.		
CS333	Game Programming	3		2	2	BLD	BSC001
CS357	Cybersecurity	3		3	-	BLD	BSC001
CS358	Multimedia Systems Design	3		3	-	BLD	BSC001
CS359	Internet of Things	3		3	-	BLD	BSC001
CS364	Information Retrieval	3		3	-	BLD	BSC001
CS365	Systems Analysis and Design	3		3	-	BLD	BSC001
CS371	Bioinformatics	3		3	-	BLD	BSC001
CS430	Virtual and Augmented Reality	3		2	2	BLD	BSC001
CS432	Scientific Visualization	3		3	-	BLD	BSC001
CS439	Computer Animation	3		3	-	BLD	BSC001
CS450	Operations Optimization	3		3	-	BLD	BSC001
CS457	Decision Support Systems and Intelligent Systems	3		2	2	BLD	BSC001
CS458	Wireless Networks	3		3	-	BLD	BSC001
CS460	Data Mining	3		3	-	BLD	BSC001
CS462	Database Design	3		3	-	BLD	BSC001
CS481	Special Topics in Computer Graphics	3		3	-	BLD	BSC001
CS482	Special Topics in Software Engineering	3		3	-	BLD	BSC001
CS484	Special Topics in Database Technologies and Applications	3		3	-	BLD	BSC001
CS489	Special Topics in Algorithms	3		3	-	BLD	BSC001
CS4512	Natural Language Processing	3		3	-	BLD	BSC001
CS4811	Special Topics in Data Science Technologies and Applications	3		3	-	BLD	BSC001
CS4831	Special Topics in Applied Computer Science	1		1	-	BLD	BSC001
CS4832	Special Topics in Applied Computer Science	2		2	-	BLD	BSC001
CS4833	Special Topics in Applied Computer Science	3		3	-	BLD	BSC001

[b] All elective courses are to be taken at a partner university at Germany

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

Students are required to take 12 credits as elective courses. In addition to the courses listed in the following table:

- Students may select 12 credits of 300 level and above from required/elective courses of General or Cybersecurity tracks that are not listed in the table below to fulfill the elective requirements.
- 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.

Course ID	Course Name	Credit Hours	ECTS	Contact Hours		Type	Prerequisites / Corequisites
				Lect.	Prac.		
CS358	Multimedia Systems Design	3		3	-	BLD	BSC001
CS359	Internet of Things	3		3	-	BLD	BSC001
CS364	Information Retrieval	3		3	-	BLD	BSC001
CS371	Bioinformatics	3		3	-	BLD	BSC001
CS432	Scientific Visualization	3		3	-	BLD	BSC001
CS450	Operations Optimization	3		3	-	BLD	BSC001
CS456	Cloud Computing	3		3	-	BLD	BSC001
CS457	Decision Support Systems and Intelligent Systems	3		2	2	BLD	BSC001
CS462	Database Design	3		3	-	BLD	BSC001
CS484	Special Topics in Database Technologies and Applications	3		3	-	BLD	BSC001
CS4512	Natural Language Processing	3		3	-	BLD	BSC001
CS4811	Special Topics in Data Science Technologies and Applications	3		3	-	BLD	BSC001
CS4813	Special Topics in Artificial Intelligence	3		3	-	BLD	BSC001
CS4831	Special Topics in Applied Computer Science	1		1	-	BLD	BSC001
CS4832	Special Topics in Applied Computer Science	2		2	-	BLD	BSC001
CS4833	Special Topics in Applied Computer Science	3		3	-	BLD	BSC001

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

Students are required to take 12 credits as elective courses. In addition to the courses listed in the following table:

- Students may select 12 credits of 300 level and above from required/elective courses of General or Data Science tracks that are not listed in the table below to fulfill the elective requirements.
- 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.

Course ID	Course Name	Credit Hours	ECTS	Contact Hours		Type	Prerequisites / Corequisites
				Lect.	Prac.		
CS354	Computer and Networks Security	3		3	-	BLD	BSC001
CS357	Cybersecurity	3		3	-	BLD	BSC001
CS359	Internet of Things	3		3	-	BLD	BSC001
CS370	Web Security	3		3	-	BLD	BSC001
CS372	Steganography	3		3	-	BLD	BSC001
CS373	Database Security	3		3	-	BLD	BSC001
CS374	Hardware Security	3		3	-	BLD	BSC001
CS458	Wireless Networks	3		3	-	BLD	BSC001
CS4511	Quantum Computing	3		3	-	BLD	BSC001
CS4711	Blockchain Technologies	3		3	-	BLD	BSC001
CS4712	Data Privacy	3		3	-	BLD	BSC001
CS4715	Security Analytics	3		3	-	BLD	BSC001
CS4812	Special Topics in Cybersecurity	3		3	-	BLD	BSC001
CS4831	Special Topics in Applied Computer Science	1		1	-	BLD	BSC001
CS4832	Special Topics in Applied Computer Science	2		2	-	BLD	BSC001
CS4833	Special Topics in Applied Computer Science	3		3	-	BLD	BSC001

Study Plan[c] Guide for a B.Sc. Degree in Computer Science

A. Study Plan Guide for the General Track

First Year							
First Semester							
Course ID	**Course Name**	**Credit Hours**	**ECTS**	**Contact Hours**		**Type**	**Prerequisites / Corequisites**
				Lect.	**Prac.**		
ENGL1001	Upper-Intermediate English	3	3	3	-	F2F	ENGL0099
GERL101B1	German I B1-Track	3	6	9	-	F2F	-
CS116	Computing fundamentals	3		3	-	F2F	-
CS1160	Computing fundamentals lab	1		-	3	F2F	CS116[co]
ARB100	Arabic	3	3	3	-	OL	ARB0099
MATH101	Calculus I	3	5	3	-	BLD	MATH0099
	University Elective	3					
	Total	**19**		**21**	**3**		

First Year							
Second Semester							
Course ID	**Course Name**		**Credit Hours**	**ECTS**	**Contact Hours**		**Type**	**Prerequisites / Corequisites**
					Lect.	**Prac.**		
GERL102B1	German II	B1-Track	3	6	9	-	F2F	GERL101B1
GERL102B2		B2-Track						
NE101	National Education		3	2	3	-	OL	ARB0099, ENGL0099
MATH102	Calculus II		3	5	3	-	F2F	MATH101
CS117	Object-Oriented Programming		3		3	-	F2F	CS116, CS1160[co]
CS1170	Object-Oriented Programming Lab		1		-	3	BLD	CS116, CS1160[co], CS117[co]
CS201	Discrete Structures		3		3	-	F2F	MATH0099, ARB0099, ENGL0099
CE212	Digital Systems		3		3	-	F2F	CS116, MATH0099, ARB0099, ENGL0099
CE2120	Digital Systems Lab		1		-	3	BLD	CS116, CE212[co], MATH0099, ARB0099, ENGL0099
	Total		**20**		**24**	**6**		

[c] The following study plan guide does not take into account possible remedial courses.

Second Year								
First Semester								
Course ID	**Course Name**		**Credit Hours**	**ECTS**	**Contact Hours**		**Type**	**Prerequisites / Corequisites**
					Lect.	**Prac.**		
GERL201B1	German III	B1-Track	3	4	6	-	F2F	GERL102B1 or GERL102B2
GERL201B2		B2-Track						
CE201	Computer Architecture and Organization		3		3	-	F2F	CE212, ARB0099, ENGL0099, MATH0099
CS222	Theory of Algorithms		3		3	-	F2F	CS116, CS201, ARB0099, ENGL0099, MATH0099
CS223	Data Structures		3		2	2	F2F	CS116, ARB0099, ENGL0099, MATH0099
CS263	Database Management Systems		3		2	2	BLD	CS117, ARB0099, ENGL0099, MATH0099
EE317	Linear Algebra		3		3	-	BLD	MATH101, MATH102^{co}
	University Elective		3					
		Total	**21**		**19**	**4**		

Second Year								
Second Semester								
Course ID	**Course Name**		**Credit Hours**	**ECTS**	**Contact Hours**		**Type**	**Prerequisites / Corequisites**
					Lect.	**Prac.**		
GERL202B1	German IV	B1-Track	3	6	9	-	F2F	GERL201B1 or GERL201B2
GERL202B2		B2-Track						
MILS100	Military Science		3	2	3	-	OL	-
IE0121	Probability and Statistics		3		3	-	F2F	MATH101
CS264	Visual Programming		3		2	2	F2F	CS117, CS263, ARB0099, ENGL0099, MATH0099
CS342	Software Engineering		3		3	-	BLD	CS117, CS263
CS355	Web Technologies		3		2	2	BLD	CS117, CS263
CS451	Artificial Intelligence		3		3	-	F2F	CS223, CS222
		Total	**21**		**25**	**4**		

Third Year								
First Semester								
Course ID	**Course Name**		**Credit Hours**	**ECTS**	**Contact Hours**		**Type**	**Prerequisites / Corequisites**
					Lect.	**Prac.**		
GERL301B1	German V	B1-Track	3	6	9	-	F2F	GERL202B1 or GERL202B2
GERL301B2		B2-Track						
CS323	Computational Theory		3		3	-	F2F	CS222, CS223
CS332	Computer Graphics		3		2	2	F2F	CS223, EE317
CE352	Computer Networks		3		3	-	BLD	CE201
CE357	Operating Systems		3		3	-	F2F	CE201
CS419	Compiler Construction		3		3	-	F2F	CS222, CS223
CE3570	Operating Systems Lab		1		-	3	BLD	CE201, CE357[co]
	Total		**19**		**23**	**5**		

Third Year								
Second Semester								
Course ID	**Course Name**		**Credit Hours**	**ECTS**	**Contact Hours**		**Type**	**Prerequisites / Corequisites**
					Lect.	**Prac.**		
GERL302B1	German V	B1-Track	3	6	9	-	F2F	GERL301B1 or GERL301B2
GERL302B2		B2-Track						GERL301B2
ENGL1002	Advanced English		3	3	3	-	F2F	ENGL1001
CS330	Image Understanding		3		2	2	F2F	CS223, EE317
CS356	Information Security		3		3	-	F2F	CS263
CS391	Field Training 160 hours		0		160 hours		F2F	Dept. Approval
CS416	Systems Programming		3		2	2	F2F	CS223
CS477	Mobile Computing		3		2	2	BLD	CS117, CS263
CS492	Senior Project		3		-	9	BLD	Dept. Approval
	Total		**21**		**18**	**15**		

Fourth Year							
First Semester							
Course ID	Course Name	Credit Hours	ECTS	Contact Hours		Type	Prerequisites / Corequisites
				Lect.	Prac.		
	elective course	3					
	elective course	3					
	elective course	3					
	elective course	3					
	Total	**12**	**0**	**0**	**0**		

Fourth Year							
Second Semester							
Course ID	Course Name	Credit Hours	ECTS	Contact Hours		Type	Prerequisites / Corequisites
				Lect.	Prac.		
CS491	International Internship 20 weeks	12		20 weeks		F2F	CS391
	Total	**12**	**0**	**0**	**36**		

B. Study Plan Guide for the Data Science Track

First Year							
First Semester							
Course ID	**Course Name**	**Credit Hours**	**ECTS**	**Contact Hours**		**Type**	**Prerequisites / Corequisites**
				Lect.	**Prac.**		
ARB100	Arabic	3	3	3	-	OL	ARB0099
MATH101	Calculus I	3	5	3	-	BLD	MATH0099
ENGL1001	Upper-Intermediate English	3	3	3	-	F2F	ENGL0099
GERL101B1	German I B1-Track	3	6	9	-	F2F	-
CS116	Computing fundamentals	3		3	-	F2F	-
CS1160	Computing fundamentals lab	1		-	3	F2F	CS116[co]
	University Elective	3					
	Total	**19**		**21**	**3**		

First Year							
Second Semester							
Course ID	**Course Name**		**Credit Hours**	**ECTS**	**Contact Hours**		**Type**	**Prerequisites / Corequisites**
					Lect.	**Prac.**		
GERL102B1	German II	B1-Track	3	6	9	-	F2F	GERL101B1
GERL102B2		B2-Track						
NE101	National Education		3	2	3	-	OL	ARB0099, ENGL0099
MATH102	Calculus II		3	5	3	-	F2F	MATH101
CS117	Object-Oriented Programming		3		3	-	F2F	CS116, CS1160[co]
CS1170	Object-Oriented Programming Lab		1		-	3	BLD	CS116, CS1160[co], CS117[co]
CS201	Discrete Structures		3		3	-	F2F	MATH0099, ARB0099, ENGL0099
CE212	Digital Systems		3		3	-	F2F	CS116, MATH0099, ARB0099, ENGL0099
CE2120	Digital Systems Lab		1		-	3	BLD	CS116, CE212[co], MATH0099, ARB0099, ENGL0099
	Total		**20**		**24**	**6**		

[c] The following study plan guide does not take into account possible remedial courses.

Second Year								
First Semester								
Course ID	**Course Name**		**Credit Hours**	**ECTS**	**Contact Hours**		**Type**	**Prerequisites / Corequisites**
					Lect.	**Prac.**		
GERL201B1	German III	B1-Track	3	4	6	-	F2F	GERL102B1 or GERL102B2
GERL201B2		B2-Track						
CE201	Computer Architecture and Organization		3		3	-	F2F	CE212, ARB0099, ENGL0099, MATH0099
CS222	Theory of Algorithms		3		3	-	F2F	CS116, CS201, ARB0099, ENGL0099, MATH0099
CS223	Data Structures		3		2	2	F2F	CS116, ARB0099, ENGL0099, MATH0099
CS263	Database Management Systems		3		2	2	BLD	CS117, ARB0099, ENGL0099, MATH0099
EE317	Linear Algebra		3		3	-	BLD	MATH101, MATH102^{co}
	University Elective		3					
		Total	**21**		**19**	**4**		

Second Year								
Second Semester								
Course ID	**Course Name**		**Credit Hours**	**ECTS**	**Contact Hours**		**Type**	**Prerequisites / Corequisites**
					Lect.	**Prac.**		
GERL202B1	German IV	B1-Track	3	6	9	-	F2F	GERL201B1 or GERL201B2
GERL202B2		B2-Track						
ENGL1002	Advanced English		3	3	3	-	F2F	ENGL1001
IE0121	Probability and Statistics		3		3	-	F2F	MATH101
CS264	Visual Programming		3		2	2	F2F	CS117, CS263, ARB0099, ENGL0099, MATH0099
CS342	Software Engineering		3		3	-	BLD	CS117, CS263
CS355	Web Technologies		3		2	2	BLD	CS117, CS263
CS451	Artificial Intelligence		3		3	-	F2F	CS223, CS222
		Total	**21**		**25**	**4**		

Third Year								
First Semester								
Course ID	**Course Name**		**Credit Hours**	**ECTS**	**Contact Hours**		**Type**	**Prerequisites / Corequisites**
					Lect.	**Prac.**		
GERL301B1	German V	B1-Track	3	6	9	-	F2F	GERL202B1 or GERL202B2
GERL301B2		B2-Track						
MILS100	Military Science		3	2	3	-	OL	-
CS323	Computational Theory		3		3	-	F2F	CS222, CS223
CE352	Computer Networks		3		3	-	BLD	CE201
CE357	Operating Systems		3		3	-	F2F	CE201
CS460	Data Mining		3		3	-	BLD	CS263
CE3570	Operating Systems Lab		1		-	3	BLD	CE201, CE357[co]
		Total	**19**		**24**	**3**		

Third Year								
Second Semester								
Course ID	**Course Name**		**Credit Hours**	**ECTS**	**Contact Hours**		**Type**	**Prerequisites / Corequisites**
					Lect.	**Prac.**		
GERL302B1	German VI	B1-Track	3	6	6	-	F2F	GERL301B1 or GERL301B2
GERL302B2		B2-Track						GERL301B2
CS330	Image Understanding		3		2	2	F2F	CS223, EE317
CS356	Information Security		3		3	-	F2F	CS263
CE377	Machine Learning		3		3	-	F2F	CS263, IE0121
CS391	Field Training		0		160 hours		F2F	Dept. Approval
CS416	Systems Programming		3		2	2	F2F	CS223
CS4611	Big Data		3		3	-	F2F	CS263, CS117
CS492	Senior Project		3		-	9	BLD	Dept. Approval
		Total	**21**		**19**	**13**		

Fourth Year							
First Semester							
Course ID	**Course Name**	**Credit Hours**	**ECTS**	**Contact Hours**		**Type**	**Prerequisites / Corequisites**
				Lect.	**Prac.**		
	elective course	3					
	elective course	3					
	elective course	3					
	elective course	3					
	Total	**12**		**0**	**0**		

Fourth Year							
Second Semester							
Course ID	**Course Name**	**Credit Hours**	**ECTS**	**Contact Hours**		**Type**	**Prerequisites / Corequisites**
				Lect.	**Prac.**		
CS491	International Internship 20 weeks	12		20 weeks		F2F	CS391
	Total	**12**		**0**	**36**		

C. Study Plan Guide for the Cybersecurity Track

First Year							
First Semester							
Course ID	**Course Name**	**Credit Hours**	**ECTS**	**Contact Hours**		**Type**	**Prerequisites / Corequisites**
				Lect.	**Prac.**		
ARB100	Arabic	3	3	3	-	OL	ARB0099
MATH101	Calculus I	3	5	3	-	BLD	MATH0099
ENGL1001	Upper-Intermediate English	3	3	3	-	F2F	ENGL0099
GERL101B1	German I B1-Track	3	6	9	-	F2F	-
CS116	Computing fundamentals	3		3	-	F2F	-
CS1160	Computing fundamentals lab	1		-	3	F2F	CS116[co]
	University Elective	3					
	Total	**19**		**21**	**3**		

First Year							
Second Semester							
Course ID	**Course Name**		**Credit Hours**	**ECTS**	**Contact Hours**		**Type**	**Prerequisites / Corequisites**
					Lect.	**Prac.**		
GERL102B1	German II	B1-Track	3	6	9	-	F2F	GERL101B1
GERL102B2		B2-Track						
NE101	National Education		3	2	3	-	OL	ARB0099, ENGL0099
MATH102	Calculus II		3	5	3	-	F2F	MATH101
CS117	Object-Oriented Programming		3		3	-	F2F	CS116, CS1160[co]
CS1170	Object-Oriented Programming Lab		1		-	3	BLD	CS116, CS1160[co], CS117[co]
CS201	Discrete Structures		3		3	-	F2F	MATH0099, ARB0099, ENGL0099
CE212	Digital Systems		3		3	-	F2F	CS116, MATH0099, ARB0099, ENGL0099
CE2120	Digital Systems Lab		1		-	3	BLD	CS116, CE212[co], MATH0099, ARB0099, ENGL0099
	Total		**20**		**24**	**6**		

[c] The following study plan guide does not take into account possible remedial courses.

Second Year								
First Semester								
Course ID	**Course Name**		**Credit Hours**	**ECTS**	**Contact Hours**		**Type**	**Prerequisites / Corequisites**
					Lect.	**Prac.**		
GERL201B1	German III	B1-Track	3	4	6	-	F2F	GERL102B1 or GERL102B2
GERL201B2		B2-Track						
CE201	Computer Architecture and Organization		3		3	-	F2F	CE212, ARB0099, ENGL0099, MATH0099
CS222	Theory of Algorithms		3		3	-	F2F	CS116, CS201, ARB0099, ENGL0099, MATH0099
CS223	Data Structures		3		2	2	F2F	CS116, ARB0099, ENGL0099, MATH0099
CS263	Database Management Systems		3		2	2	BLD	CS117, ARB0099, ENGL0099, MATH0099
EE317	Linear Algebra		3		3	-	BLD	MATH101, MATH102[co]
	University Elective		3					
		Total	**21**		**19**	**4**		

Second Year								
Second Semester								
Course ID	**Course Name**		**Credit Hours**	**ECTS**	**Contact Hours**		**Type**	**Prerequisites / Corequisites**
					Lect.	**Prac.**		
GERL202B1	German IV	B1-Track	3	6	9	-	F2F	GERL201B1 or GERL201B2
GERL202B2		B2-Track						
MILS100	Military Science		3	2	3	-	OL	-
IE0121	Probability and Statistics		3		3	-	F2F	MATH101
CS264	Visual Programming		3		2	2	F2F	CS117, CS263, ARB0099, ENGL0099, MATH0099
CS342	Software Engineering		3		3	-	BLD	CS117, CS263
CS355	Web Technologies		3		2	2	BLD	CS117, CS263
CS451	Artificial Intelligence		3		3	-	F2F	CS223, CS222
		Total	**21**		**25**	**4**		

Third Year								
First Semester								
Course ID	**Course Name**		**Credit Hours**	**ECTS**	**Contact Hours**		**Type**	**Prerequisites / Corequisites**
					Lect.	**Prac.**		
GERL301B1	German V	B1-Track	3	6	9	-	F2F	GERL202B1 or GERL202B2
GERL301B2		B2-Track						
CS323	Computational Theory		3		3	-	F2F	CS222, CS223
CE352	Computer Networks		3		3	-	BLD	CE201
CE357	Operating Systems		3		3	-	F2F	CE201
CS419	Compiler Construction		3		3	-	F2F	CS222, CS223
CS4713	Ethical Hacking		3		3	-	BLD	CS356
CE3570	Operating Systems Lab		1		-	3	BLD	CE201, CE357[co]
	Total		**19**		**24**	**3**		

Third Year								
Second Semester								
Course ID	**Course Name**		**Credit Hours**	**ECTS**	**Contact Hours**		**Type**	**Prerequisites / Corequisites**
					Lect.	**Prac.**		
GERL302B1	German VI	B1-Track	3	6	6	-	F2F	GERL301B1 or GERL301B2
GERL302B2		B2-Track						GERL301B2
CE377	Machine Learning		3		3	-	F2F	CS263, IE0121
CS391	Field Training		0		160 hours		F2F	Dept. Approval
CS416	Systems Programming		3		2	2	F2F	CS223
CS451	Artificial Intelligence		3		3	-	F2F	CS223, CS222
CS470	Cryptography		3		3	0	F2F	CE352, EE317, CS222
CS492	Senior Project		3		-	9	BLD	Dept. Approval
CS4714	Digital Forensics		3		3	-	F2F	CS263, CE357
	Total		**21**		**20**	**11**		

Fourth Year							
First Semester							
Course ID	Course Name	Credit Hours	ECTS	Contact Hours		Type	Prerequisites / Corequisites
				Lect.	Prac.		
	elective course	3					
	elective course	3					
	elective course	3					
	elective course	3					
	Total	**12**	**0**	**0**	**0**		

Fourth Year							
Second Semester							
Course ID	Course Name	Credit Hours	ECTS	Contact Hours		Type	Prerequisites / Corequisites
				Lect.	Prac.		
CS491	International Internship 20 weeks	12		20 weeks		F2F	CS391
	Total	**12**	**0**	**0**	**36**		

Prerequisite courses for the German year

Passing four of the following courses:

- CS222 Theory of Algorithms
- CS223 Data Structures
- CS342 Software Engineering
- CS263 Database Management Systems
- CS355 Web Technologies

[d] Courses attended and/or passed during International Internship are not transferable

VI. Compulsory Courses Offered by Computer Science Department for General, Cybersecurity, and Data Science Tracks

CS116: Computing Fundamentals **3 Cr Hr (3,0)** **- ECTS**

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)** **- ECTS**

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.

Prerequisites: CS116^{co}

CS115: Computing Fundamentals **3 Cr Hr (3,0)** **- ECTS**

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)** **- ECTS**

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.

Prerequisites: CS115^{co}

CS201: Discrete Structures **3 Cr Hr (3,0)** **- ECTS**

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: MATH0099, ARB0099, ENGL0099

CS117: Object-Oriented Programming **3 Cr Hr (3,0)** **- ECTS**

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^{co}

CS1170: Object-Oriented Programming Lab **1 Cr Hr (0,3)** **- ECTS**

Lab session every week to enhance hands-on experience on topics that are theoretically covered in CS117, 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: CS116, CS1160^{co}, CS117^{co}

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

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, CS201, ARB0099, ENGL0099, MATH0099

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

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, ARB0099, ENGL0099, MATH0099

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

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, EE317

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

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: CS117, CS263

CS263: Database Management Systems **3 Cr Hr (2,2)** **- ECTS**

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: CS117, ARB0099, ENGL0099, MATH0099

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

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)** **- ECTS**

Formal grammar; 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)** **- ECTS**

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; De-notational Semantics.

Prerequisites: CS222, CS223

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

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)** **- ECTS**

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, EE317

CS264: Visual Programming **3 Cr Hr (2,2)** **- ECTS**

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: CS117, CS263

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

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: CS117, CS263

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

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.

Prerequisites: CS263

CS477: Mobile Computing **3 Cr Hr (2,2)** **- ECTS**

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 SQLlite. 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: CS117, CS263

CS4611: Big Data **3 Cr Hr (3,0)** **- ECTS**

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: CS117, CS263

CS4713: Ethical Hacking **3 Cr Hr (3,0)** **- ECTS**

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

CS4714: Digital Forensics **3 Cr Hr (3,0)** **- ECTS**

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: CS263, CE357

CS470: Cryptography **3 Cr Hr (3,0)** **- ECTS**

This course introduces the students to 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: CS222, CE352, EE317

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

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

Prerequisites: Dept. Approval

CS491: International Internship 20 weeks **12 Cr Hr 36H/W** **- ECTS**

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)** **- ECTS**

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: Dept. Approval

VII. Elective Course Offered by Computer Science Department for General, Cybersecurity, and Data Science Tracks

CS371: Bioinformatics **3 Cr Hr (3,0)** **- ECTS**

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: BSC001

CS333: Game Programming **3 Cr Hr (3,0)** **- ECTS**

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: BSC001

CS439: Computer Animation **3 Cr Hr (3,0)** **- ECTS**

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: BSC001

CS358: Multimedia Systems Design **3 Cr Hr (3,0)** **- ECTS**

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: BSC001

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

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: BSC001

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

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: BSC001

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

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: BSC001

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

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: BSC001

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

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: BSC001

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

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: BSC001

CS4512: Natural Language Processing **3 Cr Hr (3,0)** **- ECTS**

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: BSC001

CS430: Virtual and Augmented Reality **3 Cr Hr (2,2)** **- ECTS**

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: BSC001

CS450: Operations Optimization **3 Cr Hr (3,0)** **- ECTS**

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

Prerequisites: BSC001

CS458: Wireless Networks: **3 Cr Hr (3,0)** **- ECTS**

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: BSC001

CS460: Data Mining **3 Cr Hr (3,0)** **- ECTS**

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: BSC001

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CS4712: Data Privacy **3 Cr Hr (3,0)** **- ECTS**

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: BSC001

CS4715: Security Analytics **3 Cr Hr (3,0)** **- ECTS**

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: BSC001

CS4711: Blockchain Technologies **3 Cr Hr (3,0)** **- ECTS**

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: BSC001

CS4511: Quantum Computing **3 Cr Hr (3,0)** **- ECTS**

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: BSC001

CS372: Steganography **3 Cr Hr (3,0)** **- ECTS**

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: BSC001

CS374: Hardware Security **3 Cr Hr (3,0)** **- ECTS**

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: BSC001

CS370: Web Security **3 Cr Hr (3,0)** **- ECTS**

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: BSC001

CS373: Database Security **3 Cr Hr (3,0)** **- ECTS**

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: BSC001

CS432: Scientific Visualization **3 Cr Hr (3,0)** **- ECTS**

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: BSC001

CS456: Cloud Computing **3 Cr Hr (3,0)** **- ECTS**

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: BSC001

CS481: Special Topics in Computer Graphics **3 Cr Hr (3,0)** **- ECTS**

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

Prerequisites: BSC001

CS482: Special Topics in Software Engineering **3 Cr Hr (3,0)** **- ECTS**

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

Prerequisites: BSC001

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

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

Prerequisites: BSC001

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

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

Prerequisites: BSC001

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

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

Prerequisites: BSC001

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

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

Prerequisites: BSC001

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

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

Prerequisites: BSC001

CS4811: Special Topics in Data Science Technologies and Applications **3 Cr Hr (3,0)** **- ECTS**

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

Prerequisites: BSC001

CS4812: Special Topics in Cybersecurity **3 Cr Hr (3,0)** **- ECTS**

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

Prerequisites: BSC001

CS4813: Special Topics in Artificial Intelligence **3 Cr Hr (3,0)** **- ECTS**

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

Prerequisites: BSC001

VIII. Course Offered by Other SEEIT School Departments

CE201: Computer Architecture and Organization **3 Cr Hr (3,0)** **- ECTS**

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: CE212, ARB0099, ENGL0099, MATH0099

CE212: Digital Systems **3 Cr Hr (3,0)** **- ECTS**

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: CS116, ARB0099, ENGL0099, MATH0099

CE2120: Digital Systems Lab **1 Cr Hr (0,3)** **- ECTS**

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: CS116, CE212co, ARB0099, ENGL0099, MATH0099

CE357: Operating Systems **3 Cr Hr (3,0)** **- ECTS**

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)** **- ECTS**

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.

Prerequisites: CE201, CE357^{co}

CE352: Computer Networks **3 Cr Hr (3,0)** **- ECTS**

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: CE201

EE317: Linear Algebra **3 Cr Hr (3,0)** **- ECTS**

Systems of linear equations. Vector spaces and linear transformations. Independence, bases and dimensions, bases transformation. The fundamental fours 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, MATH102^{co}

IE0121: Probability and Statistics **3 Cr Hr (3,0)** **- ECTS**

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)** **- ECTS**

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: CS263, IE0121

IX. Courses offered by Other GJU Departments

ARB0099: Arabic 99 **3 Cr Hr (3,0)** **3 ECTS**

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)** **3 ECTS**

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: **ARB0099**

ENGL0098: English III Elementary English **3 Cr Hr (3,0)** **3 ECTS**

Students will focus on English at an elementary level through the receptive skills of reading and listening and the productive skills of writing and speaking. English III is aimed at students who have achieved a grade of between 0 and 60 on the English Placement Test. This course is zero credit hours. This course enables students to contribute their own knowledge or experience in speaking activities, and use the language correctly. The exposure to a wide variety of listening material with a variety of accents, including some non-native speakers of English improves their level. English III integrates the focus on individual sounds of word and sentence stress where students are encouraged to copy the rhythm of English. Pronunciation is also integrated into Grammar and Vocabulary activities.

Prerequisites:-

ENGL0099: English IV Intermediate English **3 Cr Hr (3,0)** **3 ECTS**

Students will focus on English at an intermediate level through the receptive skills of reading and listening and the productive skills of writing and speaking. English IV is aimed at students who have successfully passed English III or achieved a grade of between 61-80 on the English Placement Test. This course is zero credit hours. Attendance: Students are required to attend regularly according to the regulations of GJU and should provide the instructor with official excuses in case they are absent for a long time. Participation and homework: Students are required to participate in the group discussion in class. Interaction is necessary as well as oral presentations will be given to measure how fluent students are and to improve their skill of speaking. Medium of communication: GJU email, face to face (on campus) and during office hours. Teaching method: Explaining, discussing and doing the exercises given to students.

Prerequisites: **ENGL0098**

ENGL1001: English V Upper Intermediate English **3 Cr Hr (3,0)** **3 ECTS**

"Education is the ability to listen to almost anything without losing your temper or your self-confidence." Robert Frost (1874 - 1963) English V is aimed at students who have achieved a passing grade in English IV or a grade between 81 and above on the English Placement Test. English V is equal to three credit hours. Students will focus on English at an upper intermediate level. Students will analyze and produce 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. Note: The process of argumentation enables us to clarify and develop our own responses to important issues, and a significant part of that process involves dialogue with both those who share our opinions and those who do not. In order to participate responsibly and effectively in meaningful dialogue, we must maintain an attitude characterized by openness, responsibility, rationality, and respect for all participants. Upon finishing this level, all students are eligible to receive an English language proficiency letter indicating their level according to the Common European Framework Reference for Languages (CEFR) varying between B1 and B2 according to the grade they get upon finishing this level.

Prerequisites: **ENGL0099**

ENGL1002: English VI Advanced English **3 Cr Hr (3,0)** **3 ECTS**

English VI, is the last of the English levels at the German Jordanian University to arm graduates with the best command of the English language in its varied aspects: Reading, Writing, Speaking, Listening and Understanding. It is aimed at students who successfully pass English V and it is three credit hours. This level focuses on a higher level of enhancement of their language. Students can address any audience, through delivering a persuasive speech, making an informative presentation, or analyzing controversial News through News Analysis. The students' Thesis Statements are backed up with: mistake-free language, persuasive logic and verified statistics, numbers and facts to convince the audience with their points of

view. Other tools are enhanced involving their language, including specific terminology, tone, intonation and body language to make them acquire the best outcome. Students can also address any topic in writing. With the language skills provided in this level, GJU graduates become more equipped with outstanding abilities and get better chances in the work market, in addition to their knowledge and education in the major fields. The assessment of the students applies Bloom's Taxonomy where the learning objectives are classified according to the different domains including: learning (remembering), understanding, applying, analyzing, evaluating, the creating. Upon finishing this level, all students are eligible to receive an English language proficiency letter indicating their level according to the Common European Framework Reference for Languages (CEFR) varying between B2, C1 or C2 according to the grade they get upon finishing this level.

Prerequisites: **ENGL 1001**

GERL101B1: German I B1 track **3 Cr Hr (9,0)** **6 ECTS**

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)** **6 ECTS**

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)** **4 ECTS**

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)** **6 ECTS**

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)** **6 ECTS**

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)** **6 ECTS**

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)** **6 ECTS**

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)** **6 ECTS**

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)** **4 ECTS**

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)** **6 ECTS**

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)** **6 ECTS**

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)** **6 ECTS**

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)** **3 ECTS**

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: **ENGL0098**

DES101: Arts Appreciation **3 Cr Hr (3,0)** **3 ECTS**

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: **ARB0099,** ENGL0098

IC101: Intercultural Communication **3 Cr Hr (3,0)** **3 ECTS**

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: **ENGL0098**

MILS100: Military Science **3 Cr Hr (3,0)** **2 ECTS**

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)** **2 ECTS**

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: ARB0099, ENGL0099

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

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: **ENGL0098**

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

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: **ENGL0098**

MATH101: Calculus 1 **3 Cr Hr (3,0)** **5 ECTS**

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: MATH0099

MATH102: Calculus 2 **3 Cr Hr (3,0)** **5 ECTS**

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

GERL301: German V **3 Cr Hr (9,0)** **6 ECTS**

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: GERL202

GERL202: German IV **3 Cr Hr (9,0)** **6 ECTS**

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: GERL201

GERL201: German III **3 Cr Hr (9,0)** **4 ECTS**

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: GERL102