



**Jordan University of Science and Technology**  
**Faculty of Computer and Information Technology**  
**Department of Computer Science**

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**Study Plan of Bachelor Degree in Computer Science**

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**(2017)**

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### Course Numbering Convention:

Digit	Meaning	Explanation	
Hundreds	Course Level	1	First year
		2	Second year
		3	Third year
		4	Forth year
Tens	Course Subject	0	Basic Principles
		1	Programming
		2	Database
		3	-
		4	Networks
		5	Hardware
		6	Artificial Intelligence
		7	Systems and Systems Software
		8	Miscellaneous
9	Special Topics and Training		
Ones	Course Sequence	Course sequence number within subject area	

## Study Plan for the Computer Science 2017

The Bachelor Degree in Computer Science is awarded at Jordan University of Science & Technology after the successful completion of 132 credit hours distributed as follows:-

**Table 1:** Distribution of credit hours

Requirements	Credit hours		
	Mandatory	Elective	Total
University Requirements	16	9	25
Faculty Requirements	27	0	27
Departmental Requirements	71	9	80
<b>Total</b>	<b>114</b>	<b>18</b>	<b>132</b>

and after fulfilling the terms and conditions for awarding the bachelor's degree at Jordan University of Science & Technology .

### 1. University Requirements (25 CHs):

1-a) University Mandatory Courses (16 CHs) as shown in table 2:

**Table 2:** University compulsory courses

Course Number	Course Title	Credit Hours	Lecture	Practical	Prerequisite
MS 100 <sup>(1)</sup>	Military Sciences	3	3	0	-
ARB 101	Arabic Language	3	3	0	-
HSS 110	Social Responsibility	3	2	1	-
LG 112	English Language II	3	3	0	Passing LG 99 or Passing the English Skills exam with a grade of 50% or more
HSS 119	Entrepreneurship and innovation	2	2	0	-
HSS 129	General Skills	2	2	0	LG 112

**NOTE:** Non-Arabic speaking students register for the following courses instead of (ARB 101), HSS 110:

Courses for non-Arabic Speaking Students

Course Number	Course Title	Credit Hours	Lecture	Lab
ARB 101A	Fundamentals of Arabic language <i>(for Non-Arabs)</i>	3	3	0
HSS 110 A	The Social Responsibility	3	3	0

<sup>1</sup>- The grade for this course is a Pass/Fail grade. Non-Jordanian students can take a substitute course from the elective courses, and the grade for the elective course goes into the calculation of the grade point average.

**1-b) University Elective Courses (9 CHs):** the student selects one course from each of the three groups in table (3).

**Table (3):** University Elective Courses

Course No.	Course title	Credit hours	Theoretical	Lab
<b>Group 1: Humanities Field</b>				
ARB 200	Appreciation of literary texts	3	3	0
HSS 103	The Palestinian Issue	3	3	0
HSS 115	Islam and recent problems	3	3	0
HSS 116	Economic system in Islam	3	3	0
HSS 121	Principles of sociology	3	3	0
HSS 126	Principles of psychology	3	3	0
HSS 127	Educational technology	3	3	0
HSS 131	Islamic civilization	3	3	0
HSS 132	The history of the city of Jerusalem	3	3	0
HSS 133	Civilization and recent cultures	3	3	0
HSS 135	Islamic culture	3	3	0
HSS 137	Human rights	3	3	0
HSS 153	Islam and Contemporary Challenges	3	3	0
HSS 161	Contemporary problems	3	3	0
HSS 211	Sociology (in English)	3	3	0
HSS 213	Individual and society	3	3	0
HSS 221	Introduction to psychology ( <i>in English</i> )	3	3	0
HSS 231	History of science in Islam	3	3	0
HSS 251	Music Tasting	3	3	0
<b>Group 2: Science and Agriculture Field</b>				
ES 103	Environment protection ( <i>for non environmental sciences students</i> )	3	3	0
ME 102	Introduction to renewable energy	3	3	0
CHE 191	Introduction to the Nanotechnology	3	3	0
NF 177	Food preservation ( <i>in English</i> )	3	3	0
AP 200	Farm animal products and production ( <i>for non-agriculture &amp; veterinary students</i> )	3	3	0
PP 200	Home gardens ( <i>for non-agriculture students</i> )	3	3	0
PP 201	Bee keeping ( <i>for non-agriculture students</i> )	3	3	0
PP 202	Natural Plants of Jordan ( <i>for non-agriculture students</i> )	3	3	0
NR 200	Natural resources and man ( <i>for non-agriculture students</i> )	3	3	0
NR 207	Planet earth problems & solutions ( <i>for non-agriculture students</i> )	3	3	0
NE 200	Principles in Nuclear Energy and its Peaceful Applications ( <i>for non-nuclear students</i> )	3	3	0
<b>Group 3: Health Field</b>				
NUR100	Health promotion	3	3	0
NUR109	Family Health	3	3	0
ADS 100	Oral and dental health ( <i>for non-dentistry and non-dentistry sciences students</i> )	3	3	0
PH 104	Community health and nutrition ( <i>for non-medicine, non-nursing, and non-midwifery students</i> )	3	3	0
VM 211	Animal health ( <i>not for veterinary medical and agriculture students</i> )	3	3	0
VM 212	Pet Animal Care	3	3	0
VM 213	Animal Behaviour and Welfare	3	3	0
VM 214	Animal Products and Public Health ( <i>for non-veterinary &amp; agriculture students</i> )	3	3	0
PT 100	Wellness and life styles ( <i>for non-physical therapy students</i> )	3	3	0
O.T 100	Disability and the Society ( <i>for non Rehabilitation Science students</i> )	3	3	0

## 2. Mandatory Faculty Requirements (27 CHs) shown in table (4):

**Table (4):**

Course Number	Course Title	Credit Hours	Weekly Hours		Prerequisite
			Lecture	Lab	
MATH 101	Calculus I	3	3	0	-
MATH 102	Calculus II	3	3	0	MATH 101
MATH 241	Discrete Mathematics	3	3	0	-
CS 101	Introduction to Programming	3	Online+traditional		-
CS 102	Programming Lab	1	Online+traditional		CS 101 or Concurrent
CS 112	Introduction to Object-Oriented Programming	3	Online+traditional		Passing CS 102
CS 113	Object-Oriented Programming Lab	1	Online+traditional		CS 112 or Concurrent
CS 211	Data Structures	3	3	0	MATH 241+passing CS 112
CIS 200	Professional & Ethical Issues in Computing	1	1	0	-
CIS 201	Introduction to Web Design	1	0	3	CS 113
CIS 202	Communication Skills	2	2	0	CIS 200 or Concurrent
CIS 221	Fundamentals of Database Systems	3	3	0	CS 211

## 3. Department Requirements (80 CHs) distributed as follow:

3-a) Mandatory Departmental Courses (71 CHs) shown in table 5.

3-b) Elective Department Courses (9 CHs) (\*) shown in table 6.

**Table (5): Mandatory Department Courses**

Course Number	Course Title	Credits Hours	Weekly Hours		Prerequisite
			Lecture	Lab	
CS 181	Linear Algebra	3	3	0	MATH 101
CS 216	Object-Oriented Software Modeling Lab	1	0	3	CS 112
CS 282	Theory of Computing	3	3	0	MATH 241 + CS 112
CS 284	Analysis and Design of Algorithms	3	3	0	CS 211
CS 318	Human-Computer Interaction	3	3	0	CS 211
CS 342	Computer Networks	3	Online+traditional		CS 284
CS 362	Artificial Intelligence	3	3	0	CS 284
CS 375	Operating Systems	3	3	0	CS 284 + CPE 252
CS 385	Fundamentals of Multimedia	3	3	0	CS 181 + CS 211
CS 391	Practical Training	3	0	0	Completion of (90 CHs)
CS 442	Wireless Networks	3	3	0	CS 342
CS 451	Computer Architecture	3	3	0	CPE 252
CS 475	Distributed Computer Systems	3	3	0	CS 451 + CS 375
CS 477	Web Technologies	3	3	0	CIS 201 + CS 318
CS 484	Computer and Network Security	3	3	0	CS 342 + CS 375
CS 491	Graduation Project I	3	0	0	Completion of (90 CHs)
CS 492	Graduation Project II	3	0	0	CS 491
SE 230	Fundamentals of Software Engineering	3	3	0	CS 216
SE 320	System Analysis and Design	3	3	0	SE 230 + CIS 221
CPE 231	Digital Logic Design	3	3	0	-
CPE 232	Digital Logic Design Lab	1	0	3	CPE 231
CPE 252	Computer Organization and Design	3	3	0	CPE 231
MATH 233	Probability & Statistics (For CS Students)	3	3	0	MATH 102
PHY 102	General Physics 2	3	3	0	-
PHY 106	General Physics Lab (2)	1	0	3	PHY 102
BT 401	Computational Biology	2	1	2	CS 101

(\*) Students who are trained in academy or professional training programs in the Faculty of Computer and Information Technology with at least 150 training hours and pass the corresponding international certification exam are exempted from 3 CHs from table (6).

**Table (6): Elective Department Courses**

Course Number	Course Title	Credits Hours	Weekly Hours		Prerequisite
			Lecture	Lab	
CS 411	Mobile Applications Design and Development	3	3	0	CS 318
CS 412	Advanced Topics in Programming	3	3	0	CS 211
CS 415	Contemporary Programming Techniques	3	3	0	CS 211
CS 422	Information Retrieval Systems	3	3	0	CIS 221
CS 441	Network Programming	3	3	0	CS 342
CS 463	Knowledge Engineering	3	3	0	CS 318 + CS 362
CS 464	Game Design and Development	3	2	3	CS 362 + CS 385
CS 472	Compiler Design	3	3	0	CS 282
CS 476	High Performance Computing	3	3	0	CS 475 or Concurrent
CS 481	Computer Graphics	3	3	0	CS 284 + CS 385
CS 482	Image Processing	3	3	0	CS 385
CS 483	Fundamentals of Bioinformatics	3	3	0	CS 284 + MATH 233
CS 486	Simulation and Modeling	3	3	0	MATH 233 + CS 211
CS 496	Special Topics in Computer Science 1	3	3	0	Department Approval
CS 497	Special Topics in Computer Science 2	3	3	0	Department Approval
CS 498	Special Topics in Computer Science 3	3	3	0	Department Approval
-	Courses form other departments in the faculty (400 level and above)	3	-	-	Department Approval

**Recommended Study Plan/ Computer Science**

**1<sup>st</sup> Year**

<b>First Semester</b>			
<b>Course Number</b>	<b>Course Name</b>	<b># CH</b>	<b>Prerequisite</b>
MATH 101	Calculus I	3	-
CS 101	Introduction to Programming	3	-
CS 102	Programming Lab	1	CS 101 or concurrent
MS 100	Military Science	3	-
LG 112	English Language 2	3	Passing LG 99 or Passing the English Skills exam with a grade of 50% or more
PHY 102	General Physics 2	3	-
<b>Total</b>		<b>16</b>	
<b>Second Semester</b>			
<b>Course Number</b>	<b>Course Name</b>	<b># CH</b>	<b>Prerequisite</b>
MATH 102	Calculus II	3	MATH 101
MATH 241	Discrete Mathematics	3	-
ARB 101	Arabic Language	3	-
HSS 110	The Social Responsibility	3	-
PHY 106	General Physics Lab (2)	1	PHY 102
CS 112	Introduction to Object-Oriented Programming	3	Passing CS 102
CS 113	Object-Oriented Programming Lab	1	CS 112 or concurrent
<b>Total</b>		<b>17</b>	



Recommended Study Plan/ Computer Science

**2<sup>nd</sup> Year**

<b>First Semester</b>			
<b>Course Number</b>	<b>Course Name</b>	<b># CH</b>	<b>Prerequisite</b>
CS 181	Linear Algebra I	3	MATH 101
CIS 200	Professional and Ethical Issues in Computing	1	-
CIS 202	Communication Skills	2	CIS 200 or concurrent
CS 211	Data Structures	3	MATH 241 + Passing CS 112
CS 216	Object-Oriented Software Modeling Lab	1	CS 112
HSS 119	Entrepreneurship and innovation	2	
HSS 129	General Skills	2	LG 112
-	University Elective	3	-
<b>Total</b>		<b>17</b>	
<b>Second Semester</b>			
<b>Course Number</b>	<b>Course Name</b>	<b># CH</b>	<b>Prerequisite</b>
MATH 233	Probability & Statistics <i>(for CS Students)</i>	3	MATH 102
CS 282	Theory of Computing	3	MATH 241 + CS 112
CS 284	Analysis and Design of Algorithms	3	CS 211
CIS 201	Introduction to Web Design	1	CS 113
CIS 221	Fundamentals of Database Systems	3	CS 211
CPE 231	Digital Logic Design	3	-
<b>Total</b>		<b>16</b>	

**Recommended Study Plan/ Computer Science**

**3<sup>rd</sup> Year**

<b>First Semester</b>			
<b>Course Number</b>	<b>Course Name</b>	<b># CH</b>	<b>Prerequisite</b>
CS 318	Human Computer Interaction	3	CS 211
CS 342	Computer Networks	3	CS 284
<b>CPE 252</b>	<b>Computer Organization and Design</b>	<b>3</b>	<b>CPE 231</b>
CPE 232	Digital Logic Design Lab	1	CPE 231
SE 230	Fundamentals of Software Engineering	3	CS 216
-	University Elective	3	-
<b>Total</b>		<b>16</b>	
<b>Second Semester</b>			
<b>Course Number</b>	<b>Course Name</b>	<b># CH</b>	<b>Prerequisite</b>
CS 385	Fundamentals of Multimedia	3	CS 181 + CS 211
CS 362	Artificial Intelligence	3	CS 284
CS 375	Operating Systems	3	CS 284 + CPE 252
SE 320	System Analysis and Design	3	SE 230 + CIS 221
-	University Elective	3	-
<b>Total</b>		<b>15</b>	
<b>3<sup>rd</sup> Semester (Summer)</b>			
<b>Course Number</b>	<b>Course Name</b>	<b># CH</b>	<b>Prerequisite</b>
CS 391	Practical Training	3	Completion of (90 CHs)
<b>Total</b>		<b>3</b>	

**Recommended Study Plan/ Computer Science**

**4<sup>th</sup> Year**

<b>First Semester</b>			
<b>Course Number</b>	<b>Course Name</b>	<b># CH</b>	<b>Prerequisite</b>
BT 401	Computational Biology	2	CS101
CS 451	Computer Architecture	3	CPE 252
CS 484	Computer and Network Security	3	CS 342 + CS 375
CS 491(*)	Graduation Project I	3	Completion of 90 (CHs)
-	Department Elective	3	-
-	Department Elective	3	-
<b>Total</b>		<b>17</b>	
<b>Second Semester</b>			
<b>Course Number</b>	<b>Course Name</b>	<b># CH</b>	<b>Prerequisite</b>
CS 477	Web Technologies	3	CIS 201 + CS 318
CS 442	Wireless Networks	3	CS 342
CS 475	Distributed Computer Systems	3	CS 375 + CS 451
CS 492	Graduation Project II	3	CS 491
-	Department Elective	3	-
<b>Total</b>		<b>15</b>	

(\*) Students must register "CS 491" before the graduation semester (Semester 1 or Semester 2).

# **Computer Science**

## **Course Description** (C, T, L) ♦

### **CS 101: Introduction to Programming** **(3C, online+traditional, 0L)**

This course introduces the student to object-oriented programming through a study of the concepts of program specification and design, algorithm development, and coding and testing using a modern software development environment. Students learn how to write programs in an object-oriented high-level programming language. Topics covered include fundamentals of algorithms, flowcharts, problem solving, programming concepts, classes and methods, control structures, arrays, and strings. Throughout the semester, problem solving skills will be stressed and applied to solving computing problems. Weekly laboratory experiments will provide hands-on experience in topics covered in this course.

### **CS 102: Programming Lab** **(1C, online+traditional, 3L)**

*Prerequisite: CS 101 or concurrent*

This course consists of a set of laboratory experiments and projects that provide hands-on experience in programming. The student is expected to achieve and demonstrate satisfactory individual programming skills.

### **CS 112: Introduction to Object-Oriented Programming** **(3C, online+traditional, 0L)**

*Prerequisite: Passing CS 102*

Using a language that supports object-oriented programming concepts, the following topics are covered: classes, objects, properties, indexers, attribute encapsulation, data abstraction, inheritance, polymorphism, generalization, specialization, exception handling, aggregation, and associations. Weekly laboratory experiments will provide hands-on experience in topics covered in this course.

### **CS 113: Object-Oriented Programming Lab** **(1C, online+traditional, 3L)**

*Prerequisite: CS 112 or concurrent*

This course consists of a set of laboratory experiments and projects that provide hands-on experience in object-oriented programming. The student is expected to achieve and demonstrate satisfactory individual as well as group-level object-oriented programming skills.

### **CS 181: Linear Algebra** **(3C, 3T, 0L)**

*Prerequisite: MATH 101*

Matrices, basic algebraic operations, reduced forms, rank and inverse solutions of systems of linear equations. Determinants and their properties. Vector spaces, subspaces, intersection and sum of subspaces, linear independence, spanning set, bases and dimension, line transformations and matrices of linear transformations, eigenvalues and eigenvectors.

## **CS 211: Data Structures** **(3C, 3T, 0L)**

*Prerequisite: MATH 241 and Passing CS 112*

Introduction to data structures using an object-oriented programming language. Logical and physical representation of data structures, collection types, array-based lists, linked lists, stacks, queues, basics of algorithm analysis, binary trees, binary search trees, hashing, and heaps. Applications and algorithms based on data structures are covered in this course. Weekly laboratory experiments will provide hands-on experience in topics covered in this course.

## **CS 216: Object-Oriented Software Modeling Lab** **(1C, 0T, 3L)**

*Prerequisite: CS 112*

Introduction to the concepts of object-oriented software modeling (techniques and methodologies). A general modeling language (e.g., UML), structure modeling, behavior modeling, domain modeling, architecture modeling, model checking, limitations of modeling, validation of models, comparison of different approaches considering their advantages and disadvantages.

## **CS 282: Theory of Computing** **(3C, 3T, 0L)**

*Prerequisite: MATH 241 and CS 112*

Formal languages' types and representations, grammars that generate formal languages, machines that accept formal languages. Regular languages and regular expressions, regular grammars, finite automata (deterministic and non-deterministic). Moore and Mealy machines. Context free languages. Context free grammars. Deterministic and non-deterministic pushdown automata. Phrase structure languages. Phrase structure grammars. Turing machine. Chomsky machine. Chomsky's normal form. Parsing tree. Chomsky's hierarchy computer.

## **CS 284: Analysis and Design of Algorithms** **(3C, 3T, 0L)**

*Prerequisite: CS 211*

This course is an introductory course to the design, implementation and analysis of computer algorithms. Topics covered include the growth of functions, the time complexity of algorithms, recurrence relations and their solutions, the design and analysis of various sorting algorithms (insertion, merge, quick, and heap sort), graph searching algorithms (breadth-first and depth-first search), and spanning trees. Programming projects.

## **CS 318: Human-Computer Interaction** **(3C, 3T, 0L)**

*Prerequisite: CS 211*

Various human-computer interaction topics, including tools and skills for user interface design, user experience design (UxD), Emotional Interaction, user interface software architecture, rapid prototyping and iterative design, Wireframes, evaluation techniques, and computer-supported cooperative work. The course focuses on User-centered design approach (UCD).

## **CS 342: Computer Networks** **(3C, online+traditional, 0L)**

*Prerequisite: CS 284*

Introduction to the concepts and architecture of computer networks using the OSI and TCP/IP models. The physical and data link layers, LANs, high-speed networking; fundamentals of TCP/IP, congestion control, presentation layer. Introduction to distributed processing, security, and data compression.

## **CS 362: Artificial Intelligence** **(3C, 3H, 0L)**

*Prerequisite: CS 284*

Introduction to the types of Artificial Intelligence problems and techniques. Problem-Solving methods. Major structures used in Artificial Intelligence programs. Study of knowledge representation techniques such as predicate logic, non-monotonic logic, and probabilistic reasoning. Application areas such as game playing, expert systems, natural language understanding and robotics. Projects using one of the Artificial Intelligence programming languages.

## **CS 375: Operating Systems** **(3C, 3T, 0L)**

*Prerequisite: CS 284 + CPE 252*

Introduction to fundamental issues in design and development of parallel programs for various types of parallel computers. Various programming models according to both machine type and application area. Cost models, debugging, and performance evaluation of parallel programs with actual application examples. Emphasis will be on MPI parallel programming language.

## **CS 385: Fundamentals of Multimedia** **(3C, 3H, 0L)**

*Prerequisite: CS 181 and CS 211*

Introduction to the principles and to the current technologies of multimedia system design and gain hands-on experience in this area. Topics include multimedia systems design, multimedia hardware and software, issues in effectively representing, processing, and transmitting multimedia data such as text, graphics, sound and music, image and video.

## **CS 391: Practical Training** **(3C, 0T, 0L)**

*Prerequisite: Completion of (90 CHs)*

Students will train in companies, factories, governmental agencies, and private establishments in a preapproved computer-related activity for a period of twelve weeks under the supervision of a faculty member. Approval of the training topic is carried out by the department head upon recommendation of the supervising faculty member.

## **CS 411: Mobile Applications Design and Development** **(3C, 3T, 0L)**

*Prerequisite: CS 318*

Mobile application development frameworks; Architecture, design and engineering issues, techniques, methodologies for mobile application development. It focuses on Web-based mobile applications, and thus covers issues of Web service design (RESTful service design), mobile platforms (iPhone, Android, Symbian/S60, WebOS, Windows Mobile, BlackBerry OS, BREW, JavaME/JavaFX, Flash Light), and the specific constraints and requirements of user interface design for limited devices. The course combines a conceptual overview, design issues, and practical development issues.

## **CS 412: Advanced Topics in Programming** **(3C, 3T, 0L)**

*Prerequisite: CS 211*

This course covers advanced programming skills and how they can be used to solve the basic material for competitive programming and exciting problems that have appeared in international programming contests. It presents a diverse and interesting set of topics in programming, algorithms, discrete mathematics and artificial intelligence through puzzles.

## **CS 415: Contemporary Programming Techniques** **(3C, 3T, 0L)**

*Prerequisite: CS 211*

Contemporary programming techniques using a language or languages suitable for exploring such techniques. Topics include exception handling, multithreading, introduction to Windows programming, programming based on events, basics of network programming, and database access. Programming projects and lab assignments.

## **CS 422: Information Retrieval Systems** **(3C, 3T, 0L)**

*Prerequisite: CIS 221*

Functional view of information retrieval, types of information retrieval systems, design issues: keyword-based retrieval, file structures, and thesaurus construction. Information retrieval data structures and algorithms: lexical analysis, stemming, term weighting, associative indexing, Boolean operations, and string searching and matching techniques. Relevance feedback and query modification. Applications and case studies.

## **CS 441: Network programming** **(3C, 3T, 0L)**

*Prerequisite: CS 342*

Introduction to various aspects of computer network programming. Fundamental concepts are covered, including host TCP/IP configuration, TCP/IP addressing, socket programming, data presentation issues, the client/server programming model, and HTTP. This course is directed at developing traditional and multithreaded client/server applications in both the TCP/IP and UDP/IP domains. Weekly lab sessions.

## **CS 442: Wireless Networks** **(3C, 3T, 0L)**

*Prerequisite: CS 342*

Motivation, wireless network architectures and wireless network devices, wireless standards, mobile computing issues, wireless local area networks and satellite-based networks, sensor networks, mobile Internet protocol, extending the client-server model for mobility, mobile data access, language support for mobile and wireless computing, and technologies such as infrared devices and Bluetooth.

## **CS 451: Computer Architecture** **(3C, 3T, 0L)**

*Prerequisite: CPE 252*

The role of performance, essential notions of computer systems design, datapath and control of processor, memory hierarchies, control units, registers, data transfer and buses. The characteristics of instruction sets, pipeline techniques, high-speed memories like cache, and multiprocessors.

## **CS 463: Knowledge Engineering** **(3C, 3T, 0L)**

*Prerequisite: CS 318 and CS 362*

This course enables learners to gain the fundamentals of Semantic Web technologies and how they are applied for knowledge representation in the World Wide Web. Learners will learn how to represent knowledge with ontologies and how to access and benefit from semantic data on the Web (e.g. SPARQL).

## **CS 464: Game Design and Development** **(3C, 2T, 3L)**

*Prerequisite: CS 362 and CS 385*

An introduction to the fundamental concepts of computer game programming such as: game memory management, GUI programming for games, differing game types, modes, & perspectives, game & level design, and gaming industry issues. Students design and develop original games for PCs applying proven game design and software engineering principles.

## **CS 472: Compiler Design** **(3C, 3T, 0L)**

*Prerequisite: CS 282*

Basic concepts, compiler components, lexical analysis, symbol tables, parsing techniques, error handling and recovery, syntax-directed translation, type checking, run-time organization, intermediate code generation, code generation, and code optimization. The students will write a parser according to specified grammar rules.

## **CS 475: Distributed Computer Systems** **(3C, 3T, 0L)**

*Prerequisite: CS 375 and CS 451*

Definition and characteristics of distributed computer systems, architectural and software models, remote procedure calls, distributed objects, processes and threads, logical clocks and ordering of events, distributed algorithms (e.g., mutual exclusion, consensus and election, termination detection), pervasive computing, distributed multimedia systems, distributed file systems, replication, and transactions and concurrency control.

## **CS 476: High Performance Computing** **(3C, 3T, 0L)**

*Prerequisite: CS 475 or concurrent*

Definition and characteristics of distributed computer systems, architectural and software models, remote procedure calls, distributed objects, processes and threads, logical clocks and ordering of events, distributed algorithms (e.g., mutual exclusion, consensus and election, termination detection), pervasive computing, distributed multimedia systems, distributed file systems, replication, and transactions and concurrency control.

## **CS 477: Web Technologies** **(3C, 3T, 0L)**

*Prerequisite: CIS 201 + CS318*

Learners will learn how to develop Web applications using HTML5, Client-Server Technologies, and JavaScript MVC frameworks, such as backbone.js, ember.js, AngularJS, Sencha, Kendo UI, and more. Moreover, learners will also learn how to make use of Linked Data and the Web of Data, as the most popular applications based on Semantic Web technologies.

## **CS 481: Computer Graphics** **(3C, 3T, 0L)**

*Prerequisite: CS 284 + CS 385*

Types of graphics, hardware-point plotting, vector and raster technologies, techniques for defining image-point, vector and raster based approaches, graphical data and program structure, two- and three-dimensional transformations, techniques for producing perspective, hidden line removal, shading, clipping, windowing, and graphical art and animation. Demos using software packages.



## **CS 482: Image Processing** **(3C, 3T, 0L)**

*Prerequisite: CS 385*

Review of image formation and acquisition; image transformation; image enhancement and restoration; image compression; morphological image processing; edge detection and segmentation; architecture for image processing.

## **CS 483: Fundamentals of Bioinformatics** **(3C, 3T, 0L)**

*Prerequisite: CS 284 and MATH 233*

Detailed study of bioinformatics with a significant concentration on understanding and analysis of bioinformatics algorithms, including hands-on practice using computational tools to solve a variety of biological problems. Topics include: database searching, sequence alignment, gene prediction, RNA and protein structure prediction, construction of phylogenetic trees, and comparative and functional genomics.

## **CS 484: Computer and Network Security** **(3C, 3T, 0L)**

*Prerequisite: CS 342 and CS 375*

This course is intended to give the students the principles and concepts of computer security. The students should be able to understand what it means for a system to be secure. Furthermore, the students will get to know about computing systems vulnerabilities, threats, and security controls. The course includes the following topics: Introduction to cryptography, confidentiality, authentication, digital signatures, program security, operating systems security, and network security.

## **CS 486: Simulation and Modeling** **(3C, 3T, 0L)**

*Prerequisite: CS 211 and MATH 233*

This course discusses different topics in simulation and modeling, such as the uses, advantages and disadvantages of simulation, types of models, the steps in discrete-event system simulation, statistical models, simple queuing models, random numbers and random variates, input modeling, model verification and validation, and its use in input-output analysis. Sample implementations for queuing system simulations are discussed using selected languages.

## **CS 491: Graduation Project I** **(3C, 3T, 0L)**

*Prerequisite: Completion of (90 CHs)*

Provides the senior student with the opportunity to undertake a substantial graduation project under the supervision of a faculty member. At least two weeks prior to registration, an interested student must submit to the department chair a written request for permission to select a project. The request is to include a preliminary description of the proposed project and the name of the supervising faculty member. During this course, the student is expected to specify and design the proposed system or software.

## **CS 492: Graduation Project II** **(3C, 3T, 0L)**

*Prerequisite: CS 491*

This is a continuation of CS 491, where the student implements, tests and presents the proposed system or software to a 3-member faculty committee that includes the project's supervisor. A written report is to be submitted to the department and committee.

**CS 496: Special Topics in Computer Science 1** **(3C, 3T, 0L)**

*Prerequisite: Department Approval*

The department chooses a topic related to the field of computer science.

**CS 497: Special Topics in Computer Science 2** **(3C, 3T, 0L)**

*Prerequisite: Department Approval*

The department chooses a topic related to the field of computer science.

**CS 498: Special Topics in Computer Science 3** **(3C, 3T, 0L)**

*Prerequisite: Department Approval*

The department chooses a topic related to the field of computer science.

**BT 401: Computational Biology** **(2C, 1T, 2L)**

*Prerequisite: CS 101*

This course provides a general introduction to computational tools for biology. The course covers basic concepts in computational biology topics emphasizing in describing basic theoretical concepts of wet-lab experimentation. This course covers several tools to work with DNA and RNA sequence analysis, Sequence databases, Gene expression analysis, Genome assembly, Binding site prediction, NGS, Differential equation-based biological models, and Biological image analysis. Besides, this lab covers principle methods and tools used for Sequence alignment, Motif finding, Structural modeling, Structure prediction and Network modeling, as well as current emerging research areas.