

COLLEGE OF COMPUTER SCIENCES AND INFORMATION TECHNOLOG ليـة علـوم الحـاسب وتقنية المعلومـات



COURSE CATALOG

Bachelor Degree in Computer Science

Curriculum-2019



College of Computer Sciences & Information Technology (CCSIT) at King Faisal University was established in 2003. It was started with 80 students, eight faculty members, five administrative and technical staff, and three labs. Over the years, the College has grown to over 80 faculty members with more than 800 students. It has two buildings at the KFU Main Campus; one for men and another for women.



King Faisal University initiated a new strategic plan in 2020. Based on this new plan, the mission and vision statement of the university was revised.

VISION

"A vibrant institution that is stimulated to enrich **knowledge of future** and develop **competitive human capabilities**"

MISSION

"Acting as a development engine and a major knowledge partner in supporting vital sectors; locally and regionally, by providing *futuristic education*, *research* driven by change and development, *community engagement* for mutual enrichment, and sustainable business



CCSIT VISION

An energetic college of excellence in teaching and research that promotes **national human capital development** in IT

CCSIT MISSION

Promoting **state-of-art** teaching and research in the field of IT; by capitalizing **resources**, creating a competitive **environment** for carrying out novel interdisciplinary **research** that serves the **university's identity** and **community**, establishing **partnerships** and **collaborations** nationally and internationally



PROGRAMS AT CCSIT

Demand for highly skilled graduates in Information Technology was the driving force behind the establishment of the College of Computer Science & Information Technology (CCSIT) at King Faisal University (KFU). CCSIT was established in the year 2003. The College branched out from the Department of Computer Information Systems at the School of Business. CCSIT currently has the following four departments:

- 1. Computer Science Department (CS)
- 2. Information Systems Department (IS)
- 3. Computer Networks & Communications Department (CN)
- 4. Computer Engineering Department (CE)

Currently, the CS, IS and CN departments offer separate programs leading to B.S. degree in Computer Science, Computer Information Systems, and Computer Networks & Communication respectively. The Computer Engineering Department currently does not offer its specific program. It offers computer engineering courses that are required by the above-mentioned three programs.

<u>COMPUTER SCIENCE</u> <u>PROGRAM</u>

The Computer Science (CS) program started in the academic year 2004-2005. The curriculum of the program was updated in 2009. The CS program was accredited by ABET in 2010.

Program Educational Objectives (PEOs) are characteristics that we expect our graduates to achieve within a few years of graduation. The four PEOs of the CS program are

The graduates of CS program will be:

- Strong technical contributors and leaders in practicing their profession in industry, academics, or government institutions both individually and as team members abiding by legal and ethical principles.
- 2. Highly motivated professionals pursuant to lifelong learning, higher-level studies, and professional growth.
- 3. Agents of change for the betterment by identifying and assimilating stateof-the-art computing solutions for the community.

Student Outcomes (SOs) are characteristics that we expect our students have and are able to do before they graduate. The SOs of the CS program are

- 1. Analyze a complex computing problem and to apply principles of computing and other relevant disciplines to identify solutions.
- 2. Design, implement, and evaluate a computing-based solution to meet a given set of computing requirements in the context of the program's discipline.
- 3. Communicate effectively in a variety of professional contexts.

- 4. Recognize professional responsibilities and make informed judgments in computing practice based on legal and ethical principles.
- 5. Function effectively as a member or leader of a team engaged in activities appropriate to the program's discipline.
- 6. Apply computer science theory and software development fundamentals to produce computing-based solutions.

The student outcomes of the program are directly mapped to the program educational objectives. Hence, the success in achievement of general program objectives can be assessed through measurement of the various student outcomes.

<u>COMPUTER SCIENCE</u> <u>CURRICULUM</u>

The CS program provides students with an educational program that ensures the ability of its graduates to handle current and future needs of the society. The CS program emphasizes on three aspects. First, courses in basic sciences such as mathematics, physics, and biology enable students to develop the necessary analytical ability and learn the underlying scientific principles. This aspect is complemented by subjects in humanities. Second, courses in computer sciences cover the basic background in computing as well as allow students to emphasize on certain disciplines through the choice of electives such as Mining of Massive Datasets, Advance Web Programming, Mobile Application Development and so on. Third, courses in Information Systems, Networking and Engineering provide exposure to business concepts and role of Information Systems in organizations, design and implementation of digital hardware systems, digital communication, and computer networks.

The BS curriculum in Computer Science is structured into **134 credit-hours** spanning over a period of **four academic years** (excluding the preparatory year, in which students are introduced to basic IT skills, Science, Mathematics and English language skills). King Faisal University has a clear academic structure to support the curriculum design, based on levels. The levels' structure also establishes the basis upon which each student's achievement can be measured and upon which progression through the program can be approved. Typically, a level represents a semester of study. A study level is the indicator of the stage within the programs study plan.

The CS program comprises of **eight levels**, and is delivered in a semester system. Each academic year consists of two main semesters of 15 weeks and a summer semester of twelve-week duration. The periods of registration and final examination are not considered part of the period which defines a semester.

Courses in the CS curriculum are divided into four main categories: University Requirement, College Requirement, Specialized Core Requirement and Electives. The courses in each of these categories, their pre-requisites and credit hours are included below.

BACHELOR OF SCIENCE IN COMPUTER SCIENCE





- College Requirement Mandatory Courses required by all programs in the college
- University Requirement Mandatory Courses required by the University for all Colleges
- Specialized Course requirement Mandatory Courses required by the Computer Science program
- Electives
 Courses that can be chosen from a number of electives offered by the College

UNIVERSITY REQUIREMENT

Course Code	Course Title	Pre-requisite	Credit-Hours
DEIC101	Creed and Doctrines	-	2
DEIC102	Islamic Culture	-	2

Two other courses for this requirement can be selected from the set of electives below.

Course Code	Course Title	Pre-requisite	Credit- Hours
DEIC 103	Islamic Morals and Occupational Ethics	-	2
DEIC 104	Studies in the Prophet's Biography	-	2
DEIC 105	Medical Jurisprudence	-	2
DEIC 106	Economy and Politics in Islam	-	2
DEIC 107	Social System and Family Behavior	-	2
DEIC 108	Management and Entrepreneurship	-	2
DEIC 109	Health and Fitness	-	2
DEIC 110	Research Skills	-	2
DEIC 111	Voluntary Work	-	2
DEIC 112	Medicine: Type and Usage	-	2
DEIC 113	Human Rights in Islam	-	2
DEIC 114	Food and Nutrition	-	2

COLLEGE REQUIREMENT

The college requirement courses are divided into five categories based on their area of coverage.

Basic Sciences & Mathematics Courses

Course Code Course Title Pre-requisite Credit-Hours 4 PHY132 Physics -Biology 3 BIO152 -MATH111 Calculus 3 -Probability and Statistics MATH111 3 MATH121

16 Credits

59 CREDITS

10 8 CREDITS

MATH122	Discrete Math	MATH111	3
Business Cou	rses		3 Credits
Course Code	Course Title	Pre-requisite	Credit-Hours
MGT103	Business and accounting	1722111	3
English Cour	ses		3 Credits
Course Code	Course Title	Pre-requisite	Credit-Hours
ENG 111	Academic English	-	3
Information S	Systems Courses		6 Credits
Course Code	Course Title	Pre-requisite	Credit-Hours
IS 312	Technical Reports	ENG 111	3
IS 322	Professional Responsibility	BIO152	3
		IS 312	

Computer Science Courses

19 Credits

Course Title	Pre-requisite	Credit-Hours
Introduction to Computing	-	4
Fundamentals of Programming	CS110	4
Data Structure and Algorithms	CS 120 MATH 122	4
Computer Security	CN 214	3
Operating Systems	CE 313	4
	Course TitleIntroduction to ComputingFundamentals of ProgrammingData Structure and AlgorithmsComputer SecurityOperating Systems	Course TitlePre-requisiteIntroduction to Computing-Fundamentals of ProgrammingCS110Data Structure and AlgorithmsCS 120 MATH 122Computer SecurityCN 214Operating SystemsCE 313

Computer Networks & Communication Courses

4 Credits

Course Code	Course Title	Pre-requisite	Credit-Hours
CN 214	Fundamentals of Computer Networks	CS 110	4

Computer Engineering Courses

8 Credits

11

Course Code	Course Title	Pre-requisite	Credit-Hours
CE 223	Digital Logic and Design	PHY 132	4
CE 313	Computer Organization and Architecture	CE 223	4

SPECIALIZATION CORE REQUIREMENT

58 CREDITS

Course Code	Course Title	Pre-requisite	Credit-Hours	
CS 210	Object Oriented Programming (1)	CS 120	4	
CS 212	Linear Algebra	MATH 122	3	
CS 220	Fundamentals of Software Engineering	CS 120	4	
CS 221	Language Theory and Finite Automata	CS 212	3	
IS 222	Database Concepts and Design	CS 211	4	
CS 224	Mathematics for CS	CS 212	3	
CS 310	Object Oriented Programming (2)	CS 210	4	
CS 311	Design and Analysis of Algorithms	CS 211	3	
CS 314	Fundamentals of Web Programming	CS 210 IS 222	4	
CS 323	Digital Image Processing	CS 224 CS 310	4	
CS 324	Artificial Intelligence	CS 311	4	
CS 330	Practical (Co-op) Training	IS 322, CS220 CS311, CS314 + 95 Cr.Hrs	3	
CS 410	Project Proposal	IS 322, CS220 CS311, CS314 + 95 Cr.Hrs	2	
CS 411	Advanced Software Engineering	CS 220, CS 310	3	
CS 412	Data Science	CS 224 IS 222	4	
CS 420	Project Implementation	CS 410	3	
CS 421	Selected Topics in Computer Science	CS 320 CS 321	3	

ELECTIVES

9 CREDITS

Course Code	Course Title	Pre-requisite	Credit-Hours
CS 413	Advanced Web Programming	CS 314	3
CS 414	Ubiquitous Computing	CS 321	3
05 11 1		CN 214	5
IS 414	Mining of Massive Datasets	IS 222	3
CS 415	Machine Learning	CS 324	3
IS 416	Web application Penetration Testing	CS 320	3
CS 422	Mobile Application Development	CS 210	3
CS 423	Software Project Management	CS 411	3
CS 424	Formal Methods in Software Engineering	CS 411	3
CS 425	Parallel Computing	CS 321	3
CS 426	Computer Vision	CS 323	3
CE 426	Computer Graphics	Math 122	3
CS 427	Software Security	CS 320	3

Three courses can be selected from the set of electives below.

The degree plan below shows the semester wise (level) course distribution for the four-year study plan for a student to obtain a bachelor's degree in computer science. LT refers to the lecture hours per week, LB refers to the lab hours per week and CR refers to the credit-hours for the course. A prerequisite structure flowchart is also included.

DEGREE P	LAN
----------	-----

COURS	SE	TITLE	LT	LB	CR	COURSE		TITLE	LT	LB	CR
First Year	– First	Semester (Level 1)				First Year	– Secoi	nd Semester (Level 2)			
CS	110	Introduction to Computing	3	3	4	CS	120	Fundamentals of Programming	3	3	4
MATH	111	Calculus	3	0	3	MATH	121	Probability and Statistics	3	0	3
PHY	132	Physics	3	2	4	MATH	122	Discrete Math	3	0	3
ENG	111	Academic English	3	0	3	MGT	103	Business and Accounting	3	0	3
DEIC	101	Creed and Doctrines	2	0	2	BIO	152	Biology	3	0	3
			14	6	16				15	3	16
Second Ye	ar – Fi	rst Semester (Level 3)				Second Ye	ear – Se	cond Semester (Level 4)			
CS	210	Objected Oriented Programming (1)	3	3	4	CS	220	Fundamentals of Software Engineering	3	3	4
CS	211	Data Structure and Algorithms	3	3	4	CS	221	Language Theory and Finite Automata	3	0	3
CS	212	Linear Algebra	3	0	3	IS	222	Database Concepts and Design	3	3	4
CN	214	Fundamentals of Computer Networks	3	3	4	CE	223	Digital Logic and Design	3	3	4
DEIC	102	Islamic Culture	2	0	2	CS	224	Mathematics for CS	3	0	3
			14	9	17				15	9	18
Third Year	- First	t Semester (Level 5)				Third Year	r – Seco	ond Semester (Level 6)			
CS	310	Object Oriented Programming (2)	3	3	4	CS	320	Computer Security	3	0	3
CS	311	Design and Analysis of Algorithms	3	0	3	CS	321	Operating Systems	3	3	4
IS	312	Technical Reports	3	0	3	IS	322	Professional Responsibility	3	0	3
CE	313	Computer Organization and Architecture	3	3	4	CS	323	Digital Image Processing	3	3	4
CS	314	Fundamentals of Web Programming	3	3	4	CS	324	Artificial Intelligence	3	3	4
			15	9	18				15	9	18

Sumn	ner Sem	ester (Between Level 6 and 7)	C	CS	330	Practical (Co	-op) Tra	ining	3 Crec	lit Hou	s
Fourth Y	ear – Fi	rst Semester (Level 7)				Fourth Y	ear – Fir	st Semester (Level 8)			
CS	410	Project Proposal	0	6	2	CS	420	Project Implementation	0	9	3
CS	411	Advanced Software Engineering	3	0	3	CS	421	Selected Topics in CS	3	0	3
CS	412	Data Science	3	3	4	DEIC	XX	University Elective	2	0	2
DEIC	XX	University Elective	2	0	2	XX	XX	Program Elective	3	0	3
XX	XX	Program Elective	3	0	3	XX	XX	Program Elective	3	0	3
			11	9	14				11	9	14



COURSE DESCRIPTIONS

How to read the course descriptions?

Each course description entry is divided into 5 sections. The first section contains basic information about the course. The course name is included in English and Arabic. Each course is assigned a unique number which indicates the college and the department that offers the course, level of the course, the semester during which it is offered and the course sequence number among other courses offered within the same semester (or level). The course number is a 7-digit number as defined below:

	Departmen	i Se	emester			
	<u>0921</u>	1	10			
	College Code	Year	Sequence			
	College Codes		Department Codes in CCSIT			
06	College of Science	21	Computer Science (CS)			
07	College of Arts	22	Information Systems (IS)			
08	College of Science	23	Computer Engineering (CE)			
09	College of Computer Sciences & IT	24	Network & Communications (CN)			
	Year Codes		Semester Codes			
1	First Year	1	First Semester			
2	Second Year	2	Second Semester			
3	Third Year					

The **course number**, 0921110, is equivalent to a more readable **course code** CS110 where 0921 is mapped to CS (the Computer Science Department) at CCSIT which is responsible for the course offering. Course level represents in which undergraduate semester students are generally required to register for this course. The normal duration of an undergraduate program is four years divided into eight semesters. Hence, a value between 1 and 8 is used.

Credit-hour is a measure of amount of effort required to achieve the intended learning outcomes as verified by the evidence of student's achievement. The majority of courses at CCSIT are worth either 2, 3 or 4 credits. The university requirement courses are 2 credit hours. A 3-credit course is generally delivered over two 75 minutes lectures per week over the entire semester. A 4-credit courses contain, in addition to two 75 minutes lectures per week, a weekly lab component of 150 minutes. We consider such lab sessions as part of guided study where lab equipment and necessary supervision is made available to help students gaining hands-on experience alongside their self-study. The credit-hour format used in this course catalog is as follows:



For lecture intensive 2 and 3 credit-hour courses, the credit-hours are 2(2-0-4) and 3(3-0-6), respectively. For a 3-credit course with a lab component of 3 hours where 1 credit is earned through the lab, the credit-hour is 3(3-3-3) assuming that student will be spending 3 hours preparing for the lab session each week.

Prerequisites are solely determined by the course content dependency. The prerequisite of a course could be one or more courses and are listed in this section. The course codes of the prerequisite courses needed to register for this course are listed in here. Courses in the CS curriculum are grouped into four major **course tracks** namely, University Requirement, College Requirement, Specialized Core Courses and Electives as mentioned earlier.

The next section is the **course description** that describes both the course contents and course objectives comprehensively. The **course outcomes** describe what a student must be able to do after completion of the course. Outcomes are measurable and mapped to one or more student outcomes. These student outcomes are listed in square brackets and should be between 1 to 6, which are the student outcomes described earlier for the CS program.

The **assessment policy** section lists out the key assessment components of the course and the percentage of grade that assessment contributes to the overall grade of the student. The **textbook** and **references** section lists the main text and reference books that will be used in the course.

Course Name	Introd	uction to Co	mputing	مقدمة علم الحاسب					
Course Information	Course Code	CourseCourseCodeNo.		Credit Hour	Prerequisite(s)				
	CS110	0921110	1 st	4 (3-3-3)	None				
Course Track	University Requirement College Requirement Specialized Core Electives								

The main objective of this course is to present basic concepts of information technology that motivates the study of different disciplines at the College of Computer Sciences and Information Technology. The overall course covers fundamentals concepts categorized in four main modules. The first module introduces the students to key concepts in computer hardware. This includes input, processing and output devices, data representation, analog and digital systems, and number systems. The second module introduces the concepts of data, information and their value to organizations. This module also includes overview of database systems and their role in structuring and organizing data. The third module covers basics of networking including network architecture, technology and the Internet. Finally, the fourth module covers computer software, programming languages and use of computers for problem solving. In this module, basic concepts of programming such as variables, data types, expressions, loops and decision structures are introduced. The course also provides a brief overview of computer security, professional and ethical issues of computers in society.

Course Outcomes

- 1. Describe basic functions of computer hardware and software components [3]
- 2. **Explain** fundamental concepts of information systems and its components including hardware, software, database and telecommunication [3]
- 3. **Describe** fundamental networking concepts including network topologies, intranet and internet technologies [3]
- 4. Analyze and design computing solutions using fundamental programming constructs [1, 2]
- 5. **Explain** key ethical, legal and social issues related to information technology and how to interpret and comply with ethical principles [4]

Assessment	Assignment	5%	Quiz	10%	Lab	25 %	Proiect	-	
Policy	Midterm	20%	Final	40%	Others	-	j		
Textbook	 Behrouz A 3rd Edition Ralph Stat Edition, 20 	 Behrouz A. Forouzan, Firouz Mosharraf, "Foundations of Computer Science", 3rd Edition, 2018, Cengage Learning. ISBN-13: 978-1473751040. Ralph Stair, George Reynolds, "Principles of Information Systems", 13th Edition, 2018, Cengage Learning, ISBN-13: 978-1305971776 							
References	 Joyce Farrell, "Just Enough Programming Logic and Design", 1st Edition, 2010, Cengage Learning. ISBN-13: 978-1439039571. G. Micheal Schneider and Judith L. Gersting, "Invitation to Computer Science", 7th Edition, 2016, Cengage Learning, ISBN-13: 978-1305075771. 								

Course Name		Calculus		التفاضل والتكامل						
Course Information	Course Code	Course No.	Course Level	Credit Hour	Prerequisite(s)					
	MATH111	0827111	1^{st}	1 st 3 (3-0-6) None						
Course Track	University Requirement College Requirement Specialized Core Electives									

The main purpose of this course is to introduce the students with methods and applications of differential and integral calculus. It will enable the students to establish the basic concepts of calculus, find the limit of univariate functions, know the continuity of functions, derivate the functions and apply the derivative tests to plot the functions. They will find the integrals and apply definite integrals to compute the area, solids, arc length, and surface of revolutions.

Course Outcomes

- 1. **Interpret** a function from an algebraic, numerical and graphical perspective and extract information relevant to the phenomenon modeled by the function. [1, 2]
- 2. Calculate the limit of a function at a point numerically and algebraically using appropriate methods. [1, 2]
- 3. Define derivative of functions and compute derivatives using the rules of differentiation. [1, 2]
- 4. Interpret differentiation and anti-differentiation as inverse operations. [1, 2]
- 5. Analyze the basic techniques of integration to compute integrals. [1, 2]
- 6. Evaluate the definite integral geometrically over the area under a curve. [1, 2]

Assessment Policy	Assignment	15%	Quiz	15%	Lab	1	Project			
	Midterm	30%	Final	40%	Others	-	TTOJECI	_		
Textbook	G. Thomas, M. Weir and J. Hass, " Thomas' Calculus Early Transcendentals ", 12 th Edition, 2010, Pearson. ISBN-13: 978-0321588760.									
References	 George B. Thomas, "Thomas' Calculus", 11th Edition, 2008, Pearson Education. ISBN-13: 9780321526793. 									

Course Name		Physics		الفيزياء					
Course Information	Course Code	Course No.	Course Level	Credit Hour	Prerequisite(s)				
	PHY132	0814132	1 st	st 4 (3-3-3) Non					
Course Track	University Requirement College Requirement Specialized Core Electives								

This course provides a conceptually-oriented exposure to the fundamental principles of electricity, magnetism and optics. Topics include basic concepts of charge, electric field, Coulomb's law, Gauss's theorem, electrostatic potential, resistors in series and parallel circuits, capacitors and inductors, dielectric material in alternating electric field, magnetic effect of an electric current, Biot-Savart law, electromagnetic induction, Faraday's Law, Lenz's law, energy stored in magnetic field, Properties of magnetic materials: diamagnetism, paramagnetism and ferromagnetism, properties of light: reflection, refraction and total internal reflection.

Course Outcomes

- 1. **Define** the fundamental concepts of electric charge, electrostatic force, electric potential, electric current, current density, magnetic field and magnetic flux. [3]
- **2.** Define capacitance and inductance and analyze the effects associated with capacitors and inductors of various symmetries, in series and parallel combination. [3]
- **3.** Outline the basic principles and mathematical expressions of Gauss's, Biot-Savart, Ampere's, Faraday's and Lenz's Laws. [3]
- 4. Calculate electric and magnetic fields from a distribution of charges or current. [1]
- 5. Estimate and explain the effects of static, non-uniform and uniform magnetic fields on moving charges and current-carrying wires, loops and the magnetic dipole. [1]

Assessment Policy	Assignment	10%	Quiz	10%	Lab	20 %	Proiect	-	
	Midterm	20%	Final	40%	Others	-			
Textbook	Douglas C. Giancoli, " Physics for Scientists and Engineers with Modern Physics ", Vol. 2, 2008, New Jersey: Pearson Education. ISBN-13: 978-0130215192.								
References	 Robert Re Wiley. ISI Raymond with Moo 11339540 Hugh D. Physics", 	snick, 1 BN-13: A. Serv lern Pl 57. Young 14 th Ed	David Hallid 978-047140 vay and Johr hysics", 9 th and Roger	lay, and 1 01940. n W. Jew Edition, A. Freed Pearson	Kenneth S. Kra ett, " Physics f a 2013, Cengag Iman, " Univer . ISBN-13: 978	ane, " P or Scie ge Lean rsity P 3-0321	Physics" V entists and ming. ISB hysics wit 973610.	ol. 2, 2001, Engineers N-13: 978- th Modern	

Course Name	A	cademic Engl	lish	اللغة الإنجليزية الأكاديمية						
Course Information	Course Code	Course No.	Course Level	Credit Hour	Prerequisite(s)					
	ENG111	1722111	1 st	3 (3-0-6)	None					
Course Track	Universit	University Requirement College Requirement Specialized Core								
	Electives									

This course aims to provide students with necessary competency in English for academic success. On top of the preparatory year English training, this course tries to enhance academic writing and reading skills in the context of computing and information technology through engaging activities and assignments in and outside the classroom. The course also develops learning skills including practice in listening to lectures, note-taking and group discussion. The course assessment would adopt IELTS-style exams for reading and writing skills along with vocabulary, punctuation, grammar and other academic writing essentials. Various aspects of academic writing including the writing process, grammar and punctuation, sentence and paragraph structure, rhetoric patterns in essays, paraphrasing, summarization, plagiarism and citations and references are covered in this course. After taking this course students will be able to read and write essays describing data or natural phenomenon as well as scientific arguments as found in computing related textbooks, magazines and blogs. This course is a pre-requisite of Technical Report course where students will further develop their English skills for graduation project report and scientific presentation.

Course Outcomes

- 1. Apply appropriate vocabulary, grammar and punctuation, sentence, paragraph and rhetorical structure in academic English. [3]
- 2. Practice proper process of writing: pre-writing (brainstorming, clustering, and outlining), revising, editing, and proofreading. [3]
- 3. **Perform** self-editing and peer-editing constructively to improve their own writings as well as the writings of the other. [3, 4, 5]
- 4. **Compose** focused and well-developed essays of approximately 250 words or more describing data, natural phenomenon and scientific arguments. [3, 4]
- 5. Demonstrate ability to follow university lectures and comprehend textbook materials to answer questions, taking notes and participate in effective group discussions. [3, 4, 5]

Assessment Policy	Assignment	20%	Quiz	10%	Lab	-	Proiect	-
	Midterm	30%	Final	40%	Others	-	110,000	
Textbook	 Alice Oshima and Ann Houge, "Introduction to Academic Writing", 3rd Edition, 2007, Pearson Longman. ISBN-13: 978-0131933958 Diana Hacker and Nancy Sommers, "Rules for Writers", 7th Edition, 2011, Bedford/St. Martin's, ISBN-13: 978-0312647360 							
References	• Natilene Bowker, "Academic Writing: A Guide to Tertiary Level Writing' 2007, Massey University. Available at: http://owll.massey.ac.nz/pdf/Academic Writing-Guide							Writing ", /Academic-

Course Name	Fundame	entals of Prog	gramming	مبادئ البر مجة			
Course Information	Course Code	Course Course Code No.		Credit Hour	Prerequisite(s)		
	CS120	0921120	2 nd	4 (3-3-3)	0921110 (Introduction to Computing)		
Course Track		y Requirement	Specialized Core				
	Electives						

This course aims to provide students with the basic concepts of computer programming. The course focuses on. developing problem solving skills and to design and develop computer programs. The course content includes: an overview of various and common programming paradigms and the difference in between compilers and interpreters. Concepts of variables, data types, operators, arrays & pointers are covered. It provides in depth knowledge of logic building using selection and iteration control structures. It introduces various operations including string operations, functions and along with methods of passing arguments by value or by reference, function overloading, function overriding and recursion. Concepts of classes and objects are also introduced in this course. The lab focuses on practical aspects of all the covered programming concepts through programs writing, compilation, execution, testing and debugging using C++ environment.

Course Outcomes

- 1. Analyze the requirements for solving basic computing problems and design suitable algorithmic solutions. [1, 2]
- 2. Design and implement programs that use fundamental programming constructs. [2]
- **3.** Analyze and explain the behavior and output of simple programs involving fundamental programming constructs. [1, 2]
- 4. Test and debug programs that use the fundamental programming constructs. [2]

Assessment Policy	Assignment	-	Quiz	10%	Lab	30%	Duciaat	10%			
	Midterm	20%	Final	30%	Others	-	Project	10%			
Textbook	Deitel and Deitel, "C++ How to Program", 10 th Edition, 2016, Pearson. ISBN-13: 978-0134448237.										
References	 D.S. Mal Design", 6 Stanley B 2012, Add 	 D.S. Malik, "C++ Programming: From Problem Analysis to Program Design", 6th Edition, 2013, Cengage Learning. ISBN–13: 978-1-133-62638-1 Stanley B. Lippman, Josee Lajoie, Barbara E. Moo, "C++ Primer", 5th Edition, 2012, Addison-Wesley. ISBN: 978-0321714114. 									

Course Name	Proba	bility and St	atistics	الاحتمالات والاحصاء						
Course Information	CourseCourseCodeNo.		Course Level	Credit Hour	Prerequisite(s)					
	MATH121	0827121	2 nd	3 (3-0-6)	0817111 (Calculus)					
Course Track	University Requirement 🛛 College Requirement 🗌 Specialized Core 🗌									
	Electives									

This course aims to introduce the students to the basic concepts of probability and statistics with applications in computer science and information technology. Topics include Sample space, events, and probabilities of outcomes, axioms of probability, conditional probability, random variables, discrete and continuous distributions, functions of random variables. In addition, it covers descriptive statistical measures and graphical display of data: sample mean, mode, median, range, variance, stem-and-leaf-diagram, frequency distribution, box-plots and histograms. The students will be introduced to the basics of estimation, test of hypotheses, regression analysis and correlation. Students will use a statistical software to analyze practical datasets.

Course Outcomes

- 1. Identify probability distributions. [1]
- 2. Compute probabilities by modeling sample spaces. [1, 2]
- 3. Summarize and present data numerically and graphically using descriptive statistics. [1, 2]
- 4. Use correlation and linear regression analysis. [1, 2]
- 5. Compute confidence intervals and test statistical hypotheses. [1, 2]
- 6. **Apply** the concepts of probability and statistics on sample datasets using a suitable statistical software. [1, 2]

Assessment Policy	Assignment	10 %	Quiz	15%	Lab	-	Ducient		
	Midterm	30 %	Final	45%	Others	-	Project	-	
Textbook	D.C. Montgomery and C. Runger, "Applied Statistics and Probability for Engineers", 6 th Edition, 2013, Wiley. ISBN-13: 978-1118539712								
References	Dekking, Probabilit Science &	Kraaik y and Busine	amp, Lopu Statistics: ess Media. I	haa, an Underst SBN-13	d Meester, " anding Why : 978-1852338	Mode and H 961	rn Introd Iow", 200	luction to 5, Springer	

Course Name	Disc	rete Mather	natics	الرياضيات المنفصلة							
Course Information	Course Code	Course No.	Course Level	Credit Hour	Prerequisite(s)						
	MATH122	0827122	2 nd	3 (3-0-6)	0817111 (Calculus)						
Course Track	University	University Requirement College Requirement Specialized Core Electives									

The main purpose of this course is to provide a foundation to think logically and employ these techniques in solving science and engineering problems. It will enable the students to reason mathematically about basic data types and structures, such as numbers, sets, functions, graphs, and trees used in computer algorithms and systems. Topics involving relations, recursive functions, combinatorial and counting methods are included to improve their relational, recursive, and quantitative skills.

Course Outcomes

- 1. Use logical notation to define and reason about fundamental mathematical concepts such as sets, relations, functions, and integers. [1]
- 2. Evaluate mathematical arguments and identify fallacious reasoning. [1, 2]
- 3. List and apply the operations of sets and use Venn diagrams to solve applied problems. [1, 2]
- 4. **Reconstruct** various recurrence functions and use them effectively in problem solving. [1]
- 5. **Calculate** numbers of possible outcomes of elementary combinatorial processes such as permutations and combinations. [1]
- 6. Apply graph theory models of data structures and state machines to solve problems of connectivity and constraint satisfaction. [2]

Assessment Policy	Assignment	15%	Quiz	10%	Lab	-	Project			
	Midterm	25%	Final	50%	Others	-	Troject	-		
Textbook	David J. Hunter, "Essentials of Discrete Mathematics", 3 rd Edition, 2015, Jones & Bartlett Learning. ISBN-13: 978-1284056242.									
References	• Kenneth Rosen, "Discrete Mathematics and its Applications", 7 th Edition, 2012, McGraw-Hill. ISBN: 978-0073383095.									

Course Name	Busin	ess and Acco	ounting	إدارة أعمال والمحاسبة						
Course	CourseCourseCodeNo.		Course Level	Credit Hour	Prerequisite(s)					
Information	MGT123	0603103	2 nd	3 (3-0-6)	-0-6) 1722111 (Academic English)					
Course Track	University	University Requirement College Requirement Specialized Core Electives								

This course presents a broad introduction to business and accounting principles for non-business students primarily focusing on accounting. First, the business portion focuses on the nature, structure and working of contemporary business organizations. Second, the accounting part provides a complete vision for recording (using double entry system), classifying and summarizing all the financial transactions by extracting a trial balance to present financial statements. This will cover topics including accounting principles, balance sheet equation, recording financial transactions in journal, posting entries to ledger, preparing trial balance, and financial statements.

Course Outcomes

- 1. Describe the basic concepts of Business Administration. [3]
- **2. Describe** the objectives of financial accounting, basic accounting terminologies, and Generally Accepted Accounting Principles (GAAP). [3]
- **3.** Identify the balance sheet equation, record financial transactions, and prepare financial statements. [1, 2]
- 4. **Evaluate** the accounting transactions according to the effect on balance sheet equation, and apply the double entry basis. [2]
- 5. **Prepare** recording in the journal, posting to the ledger, trial balance, final accounts, financial statements, and correcting accounting errors. [2]

Assessment Policy	Assignment	15%	Quiz	10%	Lab	-	Project		
	Midterm	30%	Final	45%	Others	-	TTOJECI	_	
Textbook	 Ronald E Pearson. I Jerry Wey Edition, 20 	 Ronald Ebert and Ricky Griffin, "Business Essentials", 11th Edition, 2016, Pearson. ISBN-13: 978-0134129969 Jerry Weygand, Paul Kimmel and Donald Kieso, "Accounting Principles", 12th Edition, 2015, Wiley & Sons. ISBN-13: 978-1119133018 							
References	 John Wild Principles 12595363 David Gu Internation 	d, Ken s", 23 ^r 59. rant ar nal Edit	Shaw and ^d Edition, 1 nd Robert tion, 2006, O	Barbara 2016, N McLarty xford Ui	Chiappetta, " IcGraw-Hill I 7, " Business niversity Press.	Funda Educat Basics ISBN	amental A ion. ISBN s", Busin -13:978-0	Accounting N-13: 978- ess Basics 194577793	

Course Name		Biology		علم الاحياء				
Course Information	CourseCourseCodeNo.		Course Level	Credit Hour	Prerequisite(s)			
	BIO152	0826152	2^{nd}	4 (3-3-3)	None			
Course Track	University Requirement College Requirement Specialized Core Electives							

Biology is a general science course with a lab component, which is designed for non-biology majors. The course covers the concepts of life, cell, and genetics; different cellular processes; and the forms and functions of human organ systems. The course emphasizes on biological phenomenon in our daily life that relates to human body functions, health and well-being. Students will be made aware of current advances and applications of biology in medicine, agriculture, environment and the society in general and computing in particular. After taking this course, students will also be aware of the challenges in biological research and how computing technologies can help in solving them, and vice versa.

Course Outcomes

- 1. **Recognize** the concepts of life, biological organization, evolution, cell, genetics and various cellular activities such as molecular transports, cell metabolism, reproduction and gene expression. [3]
- 2. Define the components, functions and organization of cell and human organ systems. [3]
- **3. Perform** basic scientific calculation. [1]
- **4. Apply** scientific methods to carry out experiments, interpret results and draw conclusions. [1, 2]
- 5. **Demonstrate** ability to work independently and as a team member to perform lab experiments. [2, 5]
- 6. **Collect**, **analyze**, **document**, and **report** biology and computing related information clearly, concisely, logically, and ethically using authentic source with proper citation, reference and acknowledgment. [3, 4]
- 7. **Operate** related equipment and perform laboratory experiments according to the instruction. [2]

Assessment Policy	Assignment	10%	Quiz	10%	Lab	20%	Project	-	
	Midterm	20%	Final	40%	Others	-	110jeet		
Textbook	Jane B. Reece, Martha R. Taylor, Eric J. Simon, Jean L. Dickey, " Campbell Biology – Concepts and Connections ", 8 th Edition (Global Edition), 2015, Pearson Benjamin Cummings. ISBN-13: 978-1292057804								
References	 Jane B. Reece, Lisa A. Urry, Michael L. Cain, Steven A. Wasserman, Peter V. Minorsky, Robert B. Jackson, "Campbell Biology", 9th Edition, 2011, Pearson. ISBN-13: 978-0321739759 								

Course Name	Object Or	iented Prog	ramming 1	البر مجة كائنية التوجه 1							
Course Information	Course Code	Course No.	e Course Level Credit H		Prerequisite(s)						
	CS210	0921210	3 rd	4(3-3-3)	0921120(Fundamenta ls of programing)						
Course Track	University Requirement College Requirement Specialized Core										

The purpose of this course is to provide students with concepts and practical introduction of object oriented programming (OOP) paradigm. Students will gain both theory and practical aspects of OOP using Java as target object oriented language. Student shall be able to translate problem into object oriented solution. Specific topics covered in this course includes: fundamental concepts of OOP which includes classes, objects, methods, constructors and object instantiation, encapsulation (using access modifiers and packages), inheritance, polymorphism, abstraction and interfaces; advanced OOP techniques such as using association, inheritance, aggregation relationships, strings, arrays, copying objects, exception handling, I/O file handling and Java built in sort and collections APIs. Objected oriented modelling concepts (mainly class diagram) will be introduced using Unified Modeling Language (UML). Specific details of Java language will also be introduced such as installing and configuring Java Virtual Machines (JVM) and Java memory model.

Course Outcomes

At the end of this course, students will be able to:

- 1. **Identify** basic object-oriented concepts such as class, instance variables, method, objects and strings. [1]
- 2. Explain object-oriented concepts such as encapsulation, inheritance, polymorphism and abstraction.[3]
- 3. Construct object-oriented code using object oriented UML model. [2]
- 4. **Design** and **develop** multiple-class application using OOP techniques such as exception handling, arrays, array lists, collections and File I/O handling.[2,6]

Assessment Policy	Assignments	10%	Quiz	10%	Lab	30%	Dusiast	-		
	Midterm	20%	Final	30%	Others	-	Project			
Textbook	Paul Deitel and Harvey Deitel, "Java How to Program Early Objects", 11 th Edition, 2018, Prentice Hall. ISBN-13: 978-0134743356.									
References	Herbert Schildt 1259589331 IS	Herbert Schildt, "Java: The Complete Reference", Tenth Edition ISBN-13: 978- 1259589331 ISBN-10: 1259589331								

Course Name	Data Stri	ucture and Al	gorithms	هيكلة البيانات والخوارز ميات			
Course Information	Course Code	Course No.	Course Level	Credit Hour	Prerequisite(s)		
	CS211	0921211	3 rd	4 (3-3-3)	0921120 (Fundamentals of Programming), 0817122 (Discrete Math)		
Course Track	University	Requirement	College Red	quirement 🗌 S	pecialized Core 🗌 Electives		

The aim of this course is to describe the concept of structuring data for use in solving problems by writing efficient algorithms. The concepts of algorithm analysis using flops and memory requirements, and their comparison based on best, worst and average case behavior is reviewed along with asymptotic notation. The concepts of data types, user defined data types, abstract data types are discussed along with methods of static and dynamic memory allocation. Some linear data structures like arrays, stacks and queues are introduced and their common applications using iterative and recursive methods are discussed. Dynamic data structures like linked Lists, Linked stacks and queues, trees and graphs are introduced along with their applications to searching and sorting. The data structures are implemented in lab sessions with a practical application as a team project.

Course Outcomes

- 1. Describe the concept of structuring various types of data. [3]
- 2. **Differentiate** between different types of data structures with respect to program efficiency. [1]
- 3. Use searching and sorting algorithms using suitable data structures. [2]
- 4. Analyze the complexity of various searching and sorting algorithms. [2]

Assessment	Assignment	-	Quiz	10%	Lab	20%	Project	10%		
Policy	Midterm	20%	Final	40%	Others	-	rroject	1070		
Textbook	Mark A. Weiss, " Data Structures & Algorithm Analysis in C++ ", 4 th Edition, 2013 Pearson. ISBN-13: 978-0132847377.									
References	 Michael T Algorithm Thomas H "Introduce 02620338 Robert Se Sorting, Se Wesley, IS 	C. Good ns in C I. Corr ction to 48. edgewi Search SBN-13	rich, Rober ++", 2 nd Ed nen, Charle Algorithe ck, "Algor ing, and (3: 978-0201	rto Tama ition, 20 es E. Le ns", 3 rd tithms Graph 2 726848	assia, David I 11, John Wile eiserson, Ron Edition, 200 in C: Fund Algorithms",	Mount, " y. ISBN- ald L. R 9, MIT 1 amental 3 rd Edi ^r	Data Stru 13: 978-04 Livest, Clif Press. ISB s, Data S tion, 2002	ctures and 70383278. Ford Stein, N-13: 978- Structures, , Addison-		

Course Name	1	Linear Algebr	a	الجبر الخطي						
Course Information	CourseCourseCodeNo.		Course Level	Credit Hour	Prerequisite(s)					
	CS212	0921212	3 rd	3 (3-0-6)	-6) 0817122 (Discrete Mathematics)					
Course Track	University Requirement College Requirement Specialized Core Electives									

Linear algebra covers systems of linear equations, properties of matrices, vector spaces, and linear transformations. Solving systems of linear equations is a basic tool of many mathematical procedures used for solving problems in computing. The aim of this course is to familiarize the students with the mathematical theory and methods of linear algebra. The course begins with fundamental properties of matrices including matrix algebra, operations, inverses and factorization. Systems of linear equations and basic concepts of the theory of vector spaces in the concrete setting of real linear n-space Rⁿ are also included. The course will enable students to solve linear equations, perform matrix decomposition, linear transformations, calculate determinants, and find eigenvalues and eigenvectors. Students will be able to apply the knowledge of linear algebra in applications related to computer graphics, computer vision and intelligent systems.

Course Outcomes

- 1. **Perform** the basic manipulations of vectors and matrices. [2, 3]
- 2. Use vectors and matrices to model and solve systems of linear equations. [2]
- 3. **Apply** Linear Algebra techniques in intelligent systems and computer graphics applications. [1, 2]
- 4. Solve optimization problems using eigenvalue and matrix decomposition techniques. [2]

Assessment Policy	Assignment	15%	Quiz	15%	Lab	-	Ducient			
	Midterm	30%	Final	40%	Others	-	Project			
Textbook	Steven R. Lay and Judi J. McDonald, "Linear Algebra and Its Applications", 5 th Edition, Pearson, 2015. ISBN-13 978-0321982384									
References	 Phillippe Optimiza 05213398 Phil Kein, Applicati 	G. Ci tion", 41 "Codi ons", 1	arlet, " Intr 1 st Edition, ng the Matı st Edition, 20	oductio 1989, C rix: Lin)13, Nev	n to Numeri ambridge Univ ear Algebra T vtonian Press. J	cal L versity hroug	inear Alg Pres. ISB h Comput 13: 978-06	gebra and N-13: 978- ter Science 15880990		

Course Name	Fundament	als of Comput	er Networks	أساسيات شبكات الكمبيوتر						
Course Information	Course Course Code No.		Course Level	Credit Hour	Prerequisite(s)					
	CN214	0924214	3 rd	4 (3-3-3)	0921110 (Introduction to Computing)					
Course Track	University Requirement College Requirement Specialized Core Electives									

The course covers the five layers of the computer networks layering model: TCP/IP focusing on the upper four layers Top-down approach is implemented in teaching this course. The course starts by an overview of computer networks: network edges concepts and network core concepts: network switching and packet switching, Shannon and Nyquist theorem. Then starting from the application layer towards the data link layer, the main functions and protocols in each layer is discussed in this course. The topics of the course includes: application layer protocols: HTTP, FTP, SMTP, DNS, Transport layer protocols: TCP and UDP, basics of network layer: Addressing, IP protocols (IPv6), circuit-switched networks, datagram networks, virtual-circuit networks, routing protocols, and data link layer concepts: framing, error detection and corrections, examples of flow control protocols, examples of MAC protocols. The course contains a laboratory component in which a network packet analyzer is used to understand network protocol internals.

Course Outcomes

- 1. **Define** the different computer networks layering models. [3]
- 2. Describe the main functions and protocols in the five layers of the TCP/IP model. [3]
- 3. **Compare** between different protocols in each layer of TCP/IP model. [1]
- 4. Analyze the performance of different protocols in each layer of TCP/IP model. [2]
- 5. Use a network packet analyzer to understand network protocol internals. [2]

Assessment Policy	Assignment	-	Quiz	10%	Lab	25%	Duciest	-		
	Midterm	25%	Final	40%	Others	-	Project			
Textbook	James Kurose and Keith Ross, "Computer Networking: A Top-Down Approach", 7 th Edition, 2017, Pearson Education. ISBN-13: 978-0133594140.									
References	 Behrouz A Revised), 2 William St Education. Andrew S. ISBN-13: 9 	. Forouz 2012, M allings, ¹ ISBN-1 Tanenb 078-013	zan, " Data C cGraw-Hill. " Data and C 3: 978-0133 aum, " Com 2126953	Commun ISBN-13 Compute 3506488 puter No	ications and N 3: 978-00713158 r Communicati etworks", 5 th Ec	etworki 869 ion ", 10 ^{ti} lition, 20	ng", 5 th Edi ^h Edition, 20 010, Pearson	tion (Global 013, Pearson n Education.		

Course Name	Fundamente	als of Softwar	e Engineering	أساسيات هندسة البر مجيات			
Course Information	CourseCourseCodeNo.		Course Level	Credit Hour	Prerequisite(s)		
	CS220	0921220	4 th	4 (3-3-3)	(3-3-3) 0921120 (Fundamentals of Programming)		
Course Track	University	Requirement	College Requi	rement 🖂 S	pecialized Core Electives		

This course aims to provide basic principles and practices of software engineering while emphasizing various phases of software development process. The course provides detailed overview about the system analysis and design while discussing software development processes to help students understand the key activities in systematic engineering of software systems. Concepts and related techniques are covered that are used in each phase of the software development process. This includes requirements elicitation and analysis for gathering and elaborating software requirements specification, system modeling and architectural design, detailed design – based on object-oriented concepts using the UML tools, implementation concerns and software testing methods to verify and validate the specifications. This course also introduces basic concepts of software project management, the importance of managing cost, schedule, and team management during a software development project. The course project aims to provide students with practical skills to analyze, design and develop real world software systems by exercising the software development process and project management techniques. The lab work is organized to enable the students to grasp the technical knowledge about using tools (e.g. Star UML, Gantt Charts, MS Project) and techniques required for conducting system analysis, design and testing of software systems.

Course Outcomes

- 1. **Recognize** system development life cycle phases and various software development process models. [1]
- 2. Analyze problems systematically to formulate software requirements specifications. [1]
- 3. **Design** software systems using requirements specification and software engineering principles. [2]
- 4. **Create** software systems while working in project teams and apply project management skills. [2, 5]

Assessment	Assignment	10%	Quiz	10%	Lab	15%	n • 4	15%			
Policy	Midterm	20%	Final	30%	Others	-	Project				
Textbook	Ian Sommerville, " Software Engineering ", 10 th Edition, 2015, Pearson Education Limited, ISBN-13: 978-0133943030										
References	 Roger Pre Edition, 20 Jeffry L. V Analysis a Inc. ISBN Stephen R 8th Edition Soren L., ' Addison-V 	ssman, 009, M Whitten and De -13: 97 Schac a, 2010, "Softwa Wesley	"Software I cGraw-Hill , Lonnie D. sign Metho 8- 00730523 h, "Object- McGraw-H are Require Professiona	Engineer Higher Ed Bentleg a ds", 7 th E 335. Oriented fill Educa ements: S 1. ISBN-1	ing: A Prad lucation. IS nd Kevin C dition, 2005 and Classi tion. ISBN- tyles and T 3: 978-020	ctitioner BN-13: 1 . Dittma 5, McGra ical Soft 13: 978- iechniqu 1745702	's Approa 978-0-073- n, "Systen w-Hill Co ware Engi 007337618 es", 1 st Ed	ch ", 7th -37597-7. ns mpanies ineering ", 89 ition, 2002,			

Course Name	Language Theory	& Finite A	Automata	نظرية اللغات والأتمته المحدودة							
Course Information	Course Code	Course No.	Course Level	Credit Hour	Prerequisit e(s)						
	$\begin{array}{c ccccccccccccccccccccccccccccccccccc$										
Course Track	University Require	□University Requirement □College Requirement ⊠Specialized Core□ Electives									

This course provide students with a theoretical base in formal language theory for understanding concepts related to programming, automata theory and compilation techniques. Topics covered include: Introduction to Computation Theory, Review of basic mathematics, Defining Languages, Regular Regular Finite Languages, Expressions, Deterministic Automata (DFA). Nondeterministic Finite Automata (NFA), Equivalence of DFAs and NFAs, Recognition, Transition Graphs, Generalized Transition Graphs, Closure Properties, Kleene's Theorem, Applications of DFAs and NFAs, Non regular Languages, Pumping Lemma for Regular Languages, Context Free Grammar (CFG), Context Free Languages (CFLs), Regular Grammar, Generation and Parsing, Ambiguous Grammars, Chomsky Normal Form, Pushdown Automata, Deterministic and Nondeterministic PDAs, Equivalence of Pushdown Automata and CFG, Non-Context Free Languages, Pumping Lemma for CFLs, Operations on CFLs, Decidability, Open Questions regarding Computation, CYK Algorithm for CFLs, Computability Theory, Introduction to Turing Machine and its Variants.

Course Outcomes

- 1. **Describe** the strength and limitations of computation models of language theory and finite automata [1,3]
- 2. **Design** regular expressions and automata for regular and context free languages [1,2]
- 3. Evaluate and optimize automata models and context-free grammars [2]
- 4. Apply various automata models for describing real world examples [1,2,6]

Assessment Policy	Assignment	10%	Quiz	20%	Lab	-	Project	_				
	Midterm	30%	Final	40%	Others	-	Trojece					
Textbook	Peter Linz, " Edition, 2011,	Peter Linz, "An Introduction to Formal Languages and Automata", 5th Edition, 2011, ISBN-13:978-1-133-18779-0										
References	 Michael S Edition C John C. computation 	 Michael Sipser, "Introduction to the Theory of Computation", 3rd Edition Cengage Learning, 2012. ISBN: 113318779X, 978-1133187790 John C. Martin, "Introduction to the Language and the theory of computation", McGraw-Hill, 2003, ISBN: 0071198547. 										

Course Name	Databas	e Concepts ar	nd Design	مفاهيم وتصميم قواعد البيانات			
Course Information	CourseCourseCodeNo.		Course Level	Credit Hour	Prerequisite(s)		
	IS222	0922222	4 th	4 (3-3-3)	0921211 (Data Structure and Algorithms)		
Course Track	University	Requirement	College Req	uirement 🔀 Sj	pecialized Core Electives		

This course provides in-depth understanding on how to design and implement database application. The course introduces students to basic relational database concepts, building data model using standard Entity Relationship Diagram (ERD), mapping ERDs into relational model, understand mathematical foundation of relational model, normalize relational model using Normalization theory, and manipulate data using Relational Algebra (RA) and interactive Structured Query Language (SQL). Oracle Application Express will be utilized to provide practical, hands-on experience with exercises and term project. The students will work on projects, which challenge them to analyze complex business scenario, design, implement and demonstrate a DBMS- backed application that addresses a realistic problem.

Course Outcomes

- 1. **Describe** and **apply** the major components of the relational database model to design and implement database application. [1, 2]
- 2. Analyze database requirements to model application's data requirements using conceptual data modeling concepts such as ER diagram. [1, 2]
- 3. **Develop** relational model by utilizing conceptual model and assess the quality of relational model using mathematical foundation of relational model and Normalization theory. [1]
- 4. **Apply** Structured Query Language (SQL) and write Relational Algebra (RA) expression to define and interact with database. [2]
- 5. **Design, implement** and **demonstrate** DBMS-backed application that addresses a realistic problem. [2, 6]

Assessment Policy	Assignment	-	Quiz	10%	Lab	10%	D • 4	209/		
	Midterm	20%	Final	40%	Others	-	Project	20%		
Textbook	Ramez Elmasri and Shamkant B. Navathe, " Fundamentals of Database Systems ", 7 th Edition, 2015, Pearson Education. ISBN-13: 978-013397077									
References	 Silberscha 2010, Mcc Jeffrey D. Pearson H 	 Silberschatz, Korth and Sudarshan, "Database System Concepts", 6th Edition, 2010, McGraw-Hill. ISBN-13: 978-0073523323 Jeffrey D. Ullman, "A First Course in Database Systems", 3rd Edition, 2013, Pearson Higher Ed USA. ISBN-13: 978-1292038247 								

Course Name	Digit	al Logic and .	Design	المنطق الرقمي والتصميم							
Course Information	Course Code	Course No.	Course Level	Credit Hour	Prerequisite(s)						
	CE223	0923223	4 th	4 (3-3-3)	0814132 (Physics)						
Course Track	University	University Requirement College Requirement Specialized Core Electives									

The main purpose of the course is to study the principles and techniques of modern digital systems. This course will focus on floating-point numbers, basic logic gates, logic expressions, simplification of logic functions using Boolean algebra rules and K-maps. The students will be able to analyze, design and implement various combinational and sequential circuits using logic gates and programmable logic devices.

Course Outcomes

- 1. **Define** and **describe** basic concepts of digital systems and logic circuits: adders, subtractors, decoders, encoders, multiplexers, de-multiplexers. [3]
- 2. Analyze Boolean expression to simplify logic circuits. [1]
- 3. **Design** and **develop** various types of combinational and sequential logic circuits. [2]
- 4. Reconstruct the logic circuits using Boolean Algebra and K-map. [2]
- 5. Develop and analyze synchronous and asynchronous counter circuit [1, 2]

Assessment Policy	Assignment	-	Quiz	10%	Lab	20%	D	1.00/		
	Midterm	20%	Final	40%	Others	-	Project	10%		
Textbook	Ronald J, Tocci, Neal S. Widmer, and Gregory L. Moss, "Digital Systems: Principles and Applications ", 11 th Edition, 2010, Prentice Hall. ISBN-13: 978-0135103821.									
References	 M. Morris Prentice F John F. W Pearson. I Norman E Edition, 2 Roger L. 7 McGraw I 	Mano, Iall. ISB akerly, SBN-13 Balabani 000, Wi Fokheim Hill Edu	"Logic Co N-13: 978 "Digital D : 978-0134 an, Bradle ley. ISBN- a, "Schaun cation: ISH	omputer 1 -0133760 esign Pri 4460093 ey Carlson -13: 978-0 n's Outlin 3N-13: 97	Design Fund 637. Inciples and h, "Digital 0471293514 he of Digital 78-00706505	damenta Practico Logic Do Princip 503	ls", 5 th Edi es", 5 th Edi esign Prin les" 3 rd Edi	ition, 2015, ition, 2017, ciples ", 1 st ition, 1994,		

Course Name	Mathematic	s for Compu	iter Science	الرياضيات لعلوم الحاسب						
Course	Course Code	Course No.	Course Level	Credit Hour	Prerequisite(s)					
Information	CS224	0921224	4 th	3 (3-0-3)	0921212(Linear Algebra)					
Course Track	University Requirement College Requirement Specialized Core Electives									

36

Course Description

This course aims to cover topics in advanced calculus and mathematics with emphasis on how to use them to solve problems related to Computer Science. Covered topics include trigonometric functions, logarithmic and exponential functions (such as laws of growth and decay), finite and infinite series and sequences, roots finding techniques, first order linear differential equations, numerical differentiation and integration, applications of integration such as finding centers of mass and moments, in addition to optimization methods such as gradient descent techniques.

Course Outcomes

- 1. List appropriate mathematical concepts to model computer science problems [2]
- 2. Apply advanced mathematical techniques to solve computer science problems [6]
- 3. Evaluate and use different techniques of numerical differentiation, integration and optimization [1, 3]
- 4. Build computer programs to perform numerical calculations [5]

Assessment Policy	Assignment	10%	Quiz	20 %	Lab	I	Ducient		
	Midterm	30%	Final	40%	Others	I	Froject	-	
Textbook	 Earl W. Swokowski, "Calculus: The Classic Edition" 5th Edition, Publisher: Newtonian Press, 2013, ISBN-10: 0534435386 ISBN-13: 978-0534435387. Philippe G. Ciarlet "Introduction to numerical linear algebra and optimization", Cambridge University Press New York, NY, USA ©1989, ISBN: 0521339847. 								
References	• Kendall E edition, 19	. Atkins 993. (I	son." Eleme SBN: 0-471	ntary Nun -60010-5)	nerical Analy).	sis." V	Viley, New Y	ork, second	

Course Name	Object Ori	iented Progra	amming 2	البرمجة كائنية التوجه 2			
Course Information	Course Code	CourseCourseCodeNo.		Credit Hour	Prerequisite(s)		
	CS310	0921310	5 th	4(3-3-3)	0921210(Object Oriented Programming 1)		
Course Track	University	Requirement	College Red	quirement 🔀 Sp	pecialized Core Electives		

The main objective of this course is to present advanced object-oriented programming techniques such as: event-driven programming concepts, graphical user interface (GUI) API basics and design tools, 2D Graphics, Java Networking focusing on GUI based client–server application, Multi-threading concepts and applications, Accessing database using JDBC APIs, Java 2 EE concepts, Web services with focus on Java Spring Framework, Unit testing applications.

Course Outcomes

- 1. Use appropriate APIs to develop GUI applications through event handling [1]
- 2. Apply JDBC concepts for developing a data-driven applications [2]
- 3. Explain Java 2 EE components and web service architecture [3]
- 4. **Recognize** responsibilities in a team project and contribute effectively in building software solutions [4]
- 5. Design, implement, and evaluate distributed applications using Java APIs [2,6]

Assessment Policy	Assignment	10%	Quiz	10%	Lab	15%	Project	15%		
	Midterm	20%	Final	30%	Others	-	TTOJECT			
Textbook	Paul Deitel, Harvey Deitel "Java How to Program Early Objects", 11 th Edition, Publisher: Prentice Hall, 2018, ISBN: 0-13-474335-0									
References	 K Rajkum Herbert So McGraw-J C. Thoma with Java Kathy Wa 2nd edition 	ar, " Ja childt, " Hill. IS s Wu ((", 5 th E lrath, " , 2004,	va Progra JAVA: T BN-13: 97 Dtani), "An dition, 201 The JFC S Addison-V	mming" he Comp 8-125953 1 Introd 0, McG1 Swing Tu Wesley. 1	, 2013, Pearso olete Reference 89331 uction to Obj raw-Hill. ISBN utorial: A Gu ISBN-13: 978	n. ISBN ce", 10 th ect-Orie N-13: 97 ide to C -020191	-13: 97881 edition, 20 ented Prog 8–0073523 onstructin 4672	31799093 017, gramming 3309 ng GUIs",		

Course Name	Design ar	ıd Analysis o	f Algorithms	تصميم وتحليل الخوار زميات					
Course	Course Code	Course No.	Course Level	Credit Hour	Prerequisite(s)				
Information	CS 311	0921311	5 th	3 (3-0-6)	0921211(Data Structure and Algorithms)				
Course Track	University Requirement College Requirement Specialized Core Electives								

This course discusses various approaches for algorithm design and analysis in solving real-life problems. It also demonstrates use of various techniques in proving correctness of algorithms. Related mathematical concepts including asymptotic analysis, solving homogenous and nonhomogeneous recurrence relations, master theorem are reviewed. Analysis of iterative and recursive algorithms are covered. Finding lower bounds for sorting and searching algorithms are discussed. Time and space tradeoffs in algorithm design are emphasized. Various algorithm design techniques including brute-force approach, divide and conquer, transform and conquer, dynamic programming, greedy algorithms and linear programming are elaborated. Various complexity classes such as P, NP and NP-complete problems are introduced.

Course Outcomes

- 1. Develop mathematical models for algorithmic problem solving [2]
- 2. Design algorithms for problems using fundamental approaches [2]
- 3. Argue the correctness of algorithms using proving techniques [2]
- 4. **Determine** and **compare** efficiency of algorithms using asymptotic complexity notations [2]
- 5. **Differentiate** between tractable and intractable problems and identify the basic complexity classes [1]

Assessment	Assignment	10%	Quiz	10%	Lab	-	Drojaat	15%		
Policy	Midterm	25%	Final	40%	Others	-	TTOJECI	1370		
Textbook	Anany Levitin, "Introduction to the Design and Analysis of Algorithms", 3 rd Edition, 2012, Addison-Wesley. ISBN-13: 978-0132316811									
References	Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein, "Introduction to Algorithms", 3 rd Edition, 2012, Addison-Wesley. ISBN-13: 978- 0262033848.									

Course Name	Те	chnical Repo	orts	كتابة التقارير التقنية				
Course Information	CourseCourseCodeNo.		Course Level	Credit Hour	Prerequisite(s)			
	IS312	0922312	5 th	3 (3-0-6)	1722111 (Academic English)			
Course Track	University	Requirement	College Reg	uirement Spe	cialized Core Electives			

This course is designed to prepare students to develop their technical writing and presentation skills as needed to successfully conduct course projects as well as Co-op report and the graduation project. Unlike the Academic English course, this course focuses on the aspects of writing full-length papers and reports as well as making oral presentations in professional settings. The skills covered include: methods of planning, researching, organizing, designing and editing technical documents and presentations. The rhetorical strategy and the deductive organization found in computing discipline are particularly emphasized. This course will review in detail the function, the organization and the design of each part of technical documents of various types. This course introduces the basic techniques and methods for writing technical documents collaboratively with other students in the form of writing assignments including a major report on IT related topics like a graduation project. This course requires intensive writing, reading and participation in editing and peer-review as assignments, projects and exams.

Course Outcomes

- 1. **Apply** technical information and knowledge in practical report and presentation for a variety of audiences (including technical, managerial and public). [3]
- 2. **Collect, analyze, document**, and **report** technical information clearly, concisely, logically, and ethically using authentic source with proper citation, reference and acknowledgment. [1, 2, 3, 4]
- 3. **Recognize**, **explain**, and **use** the rhetorical strategies and the formal elements of these specific genres of technical communication: technical abstracts, data and system based research reports, instructional manuals, technical descriptions, web pages, wikis and blogs. [2, 3]
- 4. **Practice** the unique qualities of professional writing style, including sentence conciseness, readability, clarity, accuracy, honesty, avoiding wordiness or ambiguity and plagiarism, unbiased analysis, summarizing and coherence. [3, 4]
- 5. **Participate** actively in writing activities (individually and in collaboration) that model effective scientific and technical communication in the IT workplace. [3, 5]

Assessment	Assignment	25%	Quiz	-	Lab	-	Proiect	20%	
Policy	Midterm	15%	Final	35%	Others	5%	•J•••		
Textbook	K. Woolever, "Writing for the Technical Professions", 4 th Edition, 2007, Longman. ISBN- 13: 978-0-321-47747-7.								
References	• Gerald A Martin's P	lred, "I ress. IS	Handbook BN-13: 978	of Tec -12500	hnical Writin 04413	g ", 10	th Edition,	, 2011, St.	

Course Name	Computer O	rganization c	and Architecture	تنظيم ومعمارية الحاسب			
Course	Course Code	Course No.	Course Level	Credit Hour	Prerequisite(s)		
Information	CE313	0923313	5 th	4(3-3-3)	0923223 (Digital Logic and Design)		
Course Track	University	Requirement	🔀 College Requirer	nent 🗌 Spe	cialized Core 🗌 Electives		

The main objective of this course is to familiarize students about the basic structure and various functional modules of the computer system. It introduces the modern computer organization and architecture concepts and deals with instruction sets, CPU structure, memory system organization, system I/O and multiprocessors. The emphasis is on analyzing issues in architecture design and their impact on performance.

Course Outcomes

- 1. **Describe** the simple computer by explaining its basic organization. [3]
- 2. **Explain** the different instruction set architectures and addressing modes. [3]
- 3. Elucidate memory hierarchy by defining different types of memory. [3]
- 4. **Discuss** different Input / Output storage systems. [3]
- 5. **Differentiate** and **analyze** different parallel and multiprocessor architectures. [1, 2]

Assessment Policy	Assignment	-	Quiz	10%	Lab	20%	D	1.00/			
	Midterm	20%	Final	40%	Others	-	Project	10%			
Textbook	L. Null and J. Lobur, "Essentials of Computer Organization and Architecture", 4 th Edition, 2015, Jones & Bartlett Learning. ISBN-13: 978-1284074482										
References	 D. A. Pat Edition, 20 Morris M Koufman, William S performa 02737691 	terson, . 009, Mc ano, "C ISBN-1 tallings, nce ", 9 94.	J. L. Henr organ Kauf omputer 3: 978-01 "Comput Oth Editio	nessy, "Com mann, ISBN System Arc 23747501. ter Organiza on, 2012,	puter Org [-13: 978-0] chitecture", ation and A Pearson E	anizat 123744 , 3 rd Ed Archite Educatio	ion and D 937 dition, 199 ecture: Des on, ISBN	Design ", 4 th 2, Morgan signing for (-13: 978-			

Course Name	Fundamen	tals of Web	Programming	أساسيات برمجة الويب			
Course Information	Course Code	Course No.	Course Level	Credit Hour	Prerequisite(s)		
	CS314	0921314	5 th	4 (3-3-3)	0921210(Object Oriented Programing1),0922222(Databa se Concepts& Design)		
Course Track	University	Requireme	nt 🗌 College Red	quirement 🖂	Specialized Core Electives		

This course provides an overview of the web-based development lifecycle with focus on differentiating and developing static and dynamic web applications. The theoretical and practical aspects of front-end development and back-end development are covered thoroughly. Front-end development topics include markup languages and their application to describe the structure of content on a web page, style sheets to define and control the visual structure and layout of web interfaces, and scripting languages to develop interactive event-driven web applications. As the course progresses, topics covering the knowledge and skills necessary to convert simple static websites into dynamic, database-driven web applications are covered. Students are trained on standard markup, client-side and server-side scripting languages to develop their own robust web-based systems. Advanced topics such as web security, search engine optimization and application deployment are introduced.

Course Outcomes

- 1. **Describe** the web application development process and technologies used.[1,3]
- 2. Create user-interfaces for web pages using HTML and style sheets. [2,6]
- 3. Use client-side scripting language to create event-driven interactive web pages [2,6]
- 4. Use server-side scripting language to create dynamic database-driven web applications [2,6]
- 5. Explain and apply methods to provide security within a web application [2,3]
- 6. **Demonstrate** teamwork as member of a development team to deliver a complete web-based application [3,6]

Assessment Policy	Assignment	5%	Quiz	10%	Lab	25%	Ducient	-		
	Midterm	20%	Final	40%	Others	-	Project			
Textbook	Robin Nixon "Learning PHP, MySQL, JavaScript, and CSS", 2nd Edition, O'Reilly Media 012, ISBN: 1449319262.									
References	 Nicholas C. 047022780X Jon Duckett ISBN: 1118 Jon Duckett John Wiley 	Zakas " Pro K , " HTML a 008189 , " JavaScri j and Sons, IS	fessional nd CSS: I pt & JQu SBN: 1118	JavaSci Design a ery: Int 531647	ript for We and Build V ceractive Fi	b Develope Websites", . cont-End V	e rs ", (2009), John Wiley a Veb Develop	ISBN: and Sons, oment",		

Course Name	Са	mputer Secu	rity	حماية الحاسوب				
Course	CourseCourseCodeNo.		Course Level	Credit Hour	Prerequisite(s)			
Information	CS320	0921320	6 th	3 (3-0-6)	-6) 0924214 (Fundamentals of Computer Networks)			
Course Track	University	Requirement	🔀 College Req	uirement 🗌 Spe	cialized Core Electives			

The course introduces the basic concepts of computer security and focuses on the need of computer security for keeping the systems and networks secure. The course begins with the introduction of objectives of computer security, and identifying threats and vulnerabilities. The course demonstrates implementation of system access control via authentication mechanism including password, token-based, and biometric approaches. Furthermore, data access control techniques will be demonstrated that includes discretionary, mandatory, and role based access control; The types and counter measures of malicious code will be demonstrated. Concepts of cryptography including notion of public key, private key, classic cryptographic algorithms, digital signatures, key management, and cryptographic protocols will be taught. The network security fundamentals and basic concepts of firewalls, intrusion detection, and intrusion prevention systems, DoS attacks will be introduced. Finally, the students will learn the skills of security management including risk management and analysis, security plans, security policies, security audit, and legal aspects of security.

Course Outcomes

- 1. Describe security management & policy rules for organizations. [3]
- 2. Explain system and data access control mechanism. [3]
- 3. Analyze the tradeoffs of balancing key security properties (Confidentiality, Integrity, Availability). [1, 4]
- 4. **Identify** and **classify** various types of vulnerabilities and threats that exist for computers and networks. [1]
- 5. **Practice** encryption & decryption using variety of simple cryptographic algorithms. [2]

Assessment Policy	Assignment	15%	Quiz	10%	Lab	-	Project	15%		
	Midterm	20%	Final	40%	Others	-	TTOJECI	1370		
Textbook	W. Stallings & L. Brown, "Computer Security, Principles and Practice", 3 rd Edition, 2015, Prentice Hall. ISBN-13: 978-0133773927.									
References	 Rick Leh Basics", 2 Charles I Computing 	tinen, nd Editi P. Pfle ng", 5 th	Deborah R on, 2006, C eger, Shar Edition, 20	ussel, O D'Reilly I ri Lawr 015, Pren	G.T. Gangemi, Media. ISBN-13 ence, Jonathar tice Hall. ISBN	Sr., " 3: 978- 1 Mar -13: 9	Compute -0-596-006 glies, " S 78-013408	r Security 69-3. ecurity in 5043.		

Course Name	Operating Systems			نظم التشغيل			
Carrie	Course Code	Course No.	Course Level	Credit Hour	Prerequisite(s)		
Course Information	CS321	0921321	6 th	4 (3-3-3)	0923313 (Computer Organization and Architecture)		
Course Track	University Requirement College Requirement Specialized Core Electives						

This course aims to provide a strong foundation for students to understand the Operating System. It covers the main objectives, functions, evolution, characteristics and architectures of modern operating systems. In addition, process description and control including process definition, states, description and process synchronization will be illustrated. The needs for threads and relationship between processes and threads are demonstrated. Introduction to the Concurrency, mutual exclusion and deadlock concepts will be covered. Moreover, this course covers the main memory and virtual memory concepts, requirements, policies and techniques. Uni-processor scheduling and I/O scheduling concepts, algorithms and criteria will be explained. Finally, this course discusses the file and storage managements, security and protection. Lab sessions and projects in this course provide an in-depth experience with operating system internals through kernel programming to develop and test several data structures and algorithms.

Course Outcomes

- 1. **Explain** the main concepts, objectives and functions of the typical and modern operating systems. [3]
- 2. **Describe** the design of the process description and control and uni-processor and I/O scheduling algorithms. [3]
- 3. Compare the structuring methods of the operating systems. [1]
- 4. **Differentiate** the processes and threads concepts and their uses. [1]
- 5. **Discuss** and **analyze** main memory and virtual memory concepts, policies techniques and uni-processor and I/O scheduling. [1]
- 6. Use Unix commands and kernel programming to develop and test several data structures and algorithms. [1, 2]

Assessment	Assignment	-	Quiz	10%	Lab	20%	Project	10%
Policy	Midterm	20%	Final	40%	Others	-	Troject	1070
Textbook	Avi Silberschatz, Peter Baer Galvin, Greg Gagne, " Operating System Concepts ", 10th Edition, 2018, John Wiley & Sons, Inc. ISBN- 978-1-118-06333-0							
References	 William S Edition, 2 Robert Lo Profession 	Stalling 017, Pr ve, " Li nal. ISB	s, "Operati entice Hall nux Kerne N-13: 978-	ng Syste Internat I Develo 067232	ems: Internals ional. ISBN-1 pment", 3 rd E 9463.	s and De 13: 978-0 Edition, 2	esign Princ 0134670959 010, Addis	ciples", 9th 9. son-Wesley

Course Name	Professional Responsibility			المسؤولية المهنية			
Countra	Course Code	Course No.	Course Level	Credit Hour	Prerequisite(s)		
Course Information	IS322	0922322	6 th	3 (3-0-6)	0816152 (Biology) and 0922312 (Technical Reports)		
Course Track	University	Requirement	🛛 College Reau	irement Spe	cialized Core Electives		

This course introduces the students to the legal, social and ethical aspects of Information Technology and makes them understand selected codes of ethics and professional conducts to apply in real situations. In addition, it aims to foster students' ability to communicate, both in written and oral form, for the analysis and reporting of real situations indicating potential ethical problems in professional context. Topics included are: information rights, intellectual property rights, liability, accountability, privacy, security, cybercrime, ethical principles, codes of ethics, role of government, role of law enforcement, role of business and industry, professional conduct, and social responsibility. Students are required to read, write, discuss, and present reports on topics such as fraud and abuses, security, privacy protection, copyright and patent statute, communication decency, IT law as well as software engineering code of ethics.

Course Outcomes

- 1. **Describe** the social and ethical impacts of Information Technology. [3, 4]
- 2. **Describe** the concept of rights and laws related to intellectual property, privacy and computer crimes. [3, 4]
- 3. Make ethical decisions based on ethical principles, professional code of ethics and laws. [4]
- 4. Analyze and report realistic ethical cases involving Information Technology in the professional context. [1, 4]
- 5. Prepare ethical guidelines for Information Technology professionals. [3, 4]

Assessment	Assignment	10%	Quiz	10%	Lab	-	Ducient	150/
Policy	Midterm	25%	Final	35%	Others	5%	Project	13%
Textbook	Sara Baase, Timothy Henry, "A Gift of Fire: Social, Legal, and Ethical Issues for Computing and the Internet", 5 th Edition, 2017, Pearson. ISBN-13: 978-0134615271							
References	 John P. G Technolo ISBN-13: Michael J. ISBN-13: Saudi An http://www 04_%20E 	rillo, E gy: An 978-01 . Quinn 978-01 ti-Cybo w.citc.g %20A	rnest A. Ka Introduct 34615271. ,"Ethics fo 34296548. er-Crime I gov.sa/Engl: .nti-Cyber%	allman, "I ion with r the Info aw: ish/Rules: 620Crime	Ethical Decisio Cases", 2 nd E ormation Age' andSystems/Cl %20Law.pdf	on Ma dition, ', 7 th E TCSy:	king & Ir 1995, Mc dition, 201 ste/Docum	formation Graw Hill. 6, Pearson. ents/LA_0

Course Name	Digital	Digital Image Processing			معالجة الصور الرقمية
Commo	Course Code	se Course Course e No. Level		Credit Hour	Prerequisite(s)
Course Information CS323	0921323	6 th	4 (3-3-3)	0921224(Mathematics for CS), 0921310(Object Oriented Programming 2)	
Course Track	University	Requirement	nt 🗌 College	Requirement	Specialized Core

This course aims to introduce the field of digital image processing that encompasses areas from image acquisition to processing of these digital images in order to enhance them for better perception or understanding. The course covers the topics: Image acquisition with different sensors and the associated noise and distortions due to sampling and quantization; knowledge of image enhancements both at the point level, like histogram processing, and the neighborhood level like median filters; spatial domain and frequency domain filtering techniques including DFT, DCT and DWT; types of noise and noise filtering techniques; Image coding and compression techniques with and without loss, like Huffman coding and run length coding; the concept of edges and edge enhancement techniques; geometric image processing techniques including scaling, rotation, warping and morphing; morphological operations like hit and miss transformation, dilation and erosion, opening and closing, thinning and skeletonization; image segmentation based on boundary, region or texture; shape measures and descriptors; color image representation and coding techniques, pseudo coding and color image processing; and design solutions to digital image processing problems such as object detection and image recognition using tools like Python, Matlab and OpenCV.

Course Outcomes

- 1. **Describe** digital image acquisition with respect to sampling, quantization, and associated noise. [3]
- 2. Apply the techniques of image enhancement at the point and neighborhood level. [6]
- 3. **Describe** Image transformation using geometric and frequency domain and use enhancement in the frequency domain. [3]
- 4. **Apply** image coding and compression techniques.[6]
- 5. **Apply** feature extraction on images with the objective of object recognition and classification. [6]
- 6. **Design** practical solutions to a range of common image processing problems and to critically assess the results of their solutions, including shortcomings. [2,6]

Assessment	Assignment	5%	Quiz	5%	Lab	20%	Project	10%
Policy	Midterm	20%	Final	40%	Others	-	iiojeet	1070
Textbook	Rafael C. Gonzalez, Richard E. Woods, " Digital Image Processing ", Pearson, 4th Edition, 2017, ISBN-10: 0133356728, ISBN-13: 978-0133356724							
References	W. K. Pratt, "I	Digital 1	Image Pro	cessing	', J. Wiley, 20	07, ISB	N 012379'	7772

Course Name		Artific	ial Intellig	ence			لمناعي	فكاء الإصد	40 //
Course	Course (Code	Cours	e No.	Course Level	Credit	Hour	Prere	quisite(s)
Information	CS32	CS324		324	6 th	4 (3-3	4 (3-3-3)		11(Desig nalysis of prithms)
Course Track University Requirement College Requirement Specialized Core Electives									
Course Description									
develops a basic understanding of the building blocks of AI as presented in two main parts theoretical and practical. The theoretical part has three core sections: problem-solving through search, logic and knowledge representation, and inference through uncertainty. The practical part of the course includes topics connecting the models explored in the first part with application in natural language processing, computer vision, machine learning, and robotics. Finally, the course includes several programming tasks into applications like puzzle solving, Sudoku solver, game playing, a ghost avoiding agent for Pac-Man, conversational Chatbots, among others.									
Course Outcomes									
After the com	After the completion of this course, the student will be able to:								
 Identi Select Emploinform 	fy the fundame and implemen by and evalua ation. [2]	ntals of t an AI te work	knowledg search alg king know	ge repres corithm l vledge o	entation.[based solu of reasoni	1] tion to a j ng in th	probler e pres	n. [2] ence of	uncertain
4. Apply	knowledge re	epresent	ation, rea	soning,	and mac	nine lear	ning to	ools to r	eal-world
5. Recog	nize profession	al respo	onsibilities	and ma	ke inform	ed judgm	ents in	AI pract	tice based
on star 6. Devel o	idards legal and p programs to	i ethical	e AI based	s. [4] l solutio	ns [6].				
Assessment	Assignment	5%	Quiz	10%	Lab	15%	6	Ducient	100/
Policy	Midterm	20%	Final	40%	Other	's -		l lojeci	1070
Textbook	Stuart Russell Edition, Prent	and Pet ice Hall	ter Norvig , 2009. IS	," Artifi BN: 013	cial Intell 6042597	igence: A	Mode	ern Appr	roach" 3 rd
References	ReferencesBen Coppin, "Artificial Intelligence Illuminated," Jones and Bartlett Publishers, 1 st Edition, 2004, ISBN 0-7637-3230-3								

Course Name	Practi	Practical (Co-op) Training			التدريب (التعاوني) العملي		
Course Information	Course Code	Course No.	Course Level	Credit Hour	Prerequisite(s)		
	CS330	0921330	After 6	3	95 Credit Completed		
Course Track	University	University Requirement College Re			cialized Core Electives		

The Cooperative (Co-op) training program is a joint venture between King Faisal University and employers to better prepare students for employment upon graduation. The training must constitute a link between theoretical and scientific academic background with the work environment to provide a better understanding and a clear view of the real-world experiences. It also provides students with complementary knowledge and training such as confronting real world issues and working as part of a team. Co-op training is a 3-credit-hours course and is taken by those students who have completed at least 95 credit hours. Student must be oriented in one of the companies for a period of 12 weeks in the summer session, and well supervised by a faculty supervisor and a site supervisor, to accomplish the training objectives correctly. Courses to be completed before training for Computer Science students are:

- IS-322: Professional Responsibility
- CS-220: Fundamentals of Software Engineering
- CS 311: Design and Analysis of Algorithms
- CS 314: Fundamentals of Web Programming

Course Outcomes

- 1. **Develop** practical skills through real-world applications. [1, 2, 4]
- 2. Apply acquired knowledge to different domains. [1, 2, 6]
- 3. Relate the courses studied in the university with real world application. [1, 2, 4, 5]
- 4. Relate the attitude and the manner of the work environment. [4, 5]
- 5. Write a comprehensive report according to predetermined guidelines summarizing the training. [3, 4]
- 6. **Perform** oral presentation to convey in a limited time, the range of experience obtained and the skills learned. [4]

Assessment	Faculty Supervisor Evaluation	50%	Report	20%			
Policy	Site Supervisor Evaluation	20%	Presentation	10%			
Textbook	No specific textbook for the course.						
References	No specific reference book for the course.						

Course Name	Project Proposal			مقترح مشروع		
	Course Code	Course No.	Course Level	Credit Hour	Prerequisite(s)	
Course Information	CS410	0921410	7 th	2 (0-6-6)	0922322 (Professional responsibility), 0921220(Fundamentals of Software Engineering), 0921311(Design & Analysis of Algorithms, 0921314(Fundamentals of Web Programming)	
Course Track	Universi	ty Requirement	nt 🗌 Colleg	ge Requirement	Specialized Core Electives	

In this course, students form a group of two to four members and choose an applied or theoretical project topic under the supervision of a faculty member. The course enables the students to apply the skills learned in other courses to define and analyze a computing problem, define its solution requirements, review related work, identify and compare candidate solutions and select/justify the chosen solution. A logical design is developed using the selected approach. The writing skills of students are developed and assessed from their project report, and oral communication skills are assessed through presentations. The students learn how to work in a group. Awareness of their ethical, professional and legal responsibilities in the society is also inculcated in the students through this course. The progress of students is monitored and evaluated by the supervisor and committee members at three milestones. Constant feedback is provided by the supervisor and two committee members to improve the quality of students' work.

Course Outcomes

- 1. Analyze a theoretical or applied computing problem and develop its solution requirements. [1, 2]
- 2. **Design** a computer based system or solution based on a set of requirements or goals. [2]
- 3. Analyze and evaluate other people's work related to their problem. [1, 2]
- 4. Work in a team to accomplish a common goal under time and design constraints. [5]
- 5. Use written and oral communications skills to communicate with diverse audiences. [3]
- 6. **Practice** professional, ethical, legal and social issues related with Computer Science discipline. [4]

		Milestone-1	10%	a i				
Assessment Policy	Committee Evaluation	Milestone-2	20%	Supervisor Evaluation	40%			
		Milestone-3	30%					
Textbook	There is no single textbook for this course. The students are encouraged to select and read various related texts under the recommendation of their supervisor.							
References	 Graduation Provide the second s	roject Handboo ner and Lynn E Greenwood. ISE son, " Projects de", 3 rd Edition,	 k, CCSIT, Kin Miner, "Pro 3N-13: 978-144 in Computin 2015, Pearson 	g Faisal University, 20 posal Planning & W 40829697. g and Information S . ISBN-13: 978-129207	13 riting", 5 th ystems: A /3460.			

Course Name	Advanced	Advanced Software Engineering			هندسة بر مجيات متقدمة		
	Course Code	Course No.	Course Level	Credit Hour	Prerequisite(s)		
Course Information	CS411	0921411	3	3(3-0-3)	0921220(fundamentals of Software Eng.), 0921310(Object Oriented Programming)		
Course Track	University	Paquiraman	t College Reg	Superior Core Electives			

The objective of this course is to provide more detailed software engineering techniques and skills that are not presented in previous courses. Students will review existing software engineering techniques and standards and are exposed to more advanced topics in Software Engineering that are gaining increasing attention with in the industrial and research communities. Students will apply the software engineering knowledge and skills together with recent trends and techniques learned in this course to assignments and class projects. Emphasis will be given on individual and group-oriented tasks assigned throughout the course. Class participation is an essential component of the course. Students will have opportunities to gain knowledge about model driven engineering, quality engineering, software configuration management, software metrics and cost estimations, risk management, emerging technologies such as service-oriented and aspect-oriented software development, secure software engineering, internet of things (IoT) and cloud.

Course Outcomes

After studying this course, the students will be able to

- 1. Identify new and emerging trends in software engineering [1]
- 2. **Develop** advanced skills in software engineering by understanding the differences between different techniques and standards. [2]
- 3. **Demonstrate** team work by applying software engineering skills in projects using cutting edge techniques and technologies. [3,5]
- 4. **Appraise** new software engineering trends and technologies and impact on future software applications.[3,6]

Assessment	Assignment	10%	Quiz	10%	Lab	-	Project	15%
Policy	Midterm	25%	Final	40%	Others	-	TTOJECI	1370
Textbook	Ian Sommerville, " Software Engineering ", 10 th Edition, 2015, Pearson Education Limited, ISBN-13: 978-0133943030							
References	 Research P Roger Prese Edition, 20 Jeffry L. We and Design 007247417 Stephen R. 7th Edition Soren L., "2002. 	apers (0 ssman, 09, Mc /hitten, n Meth 3. Schacl , Irwin, Softwa	Dnline D "Softwa Graw-Hi Lonnie I ods", Mo ods", Mo h, "Obje 2006. re Requ	igital Libra re Engine Il Higher E D. Bentleg cGraw-Hill ect-Oriente iirements:	ries – IEEE, ering: A P ducation. IS abd Kevin C Companies ed and Clas Styles and T	ACM, Sj ractition BN-13: 9 C. Dittman Inc., 6th sical Soft	pringer) er's Appr 78-0-073-3 a, "System edition, 20 tware Eng es", Addiso	oach", 7th 37597-7. Is Analysis 004, ISBN: gineering", on-Wesley,

Course Name	I	Data Science	2	علم البيانات				
Carrie	Course Code	Course No.	Course Level	Credit Hour	Prerequisite(s)			
Course Information	CS412 0921412		7 th	4 (3-3-3)	0921224(Mathematics for CS), 0922222(Database Concepts & Design)			
Course Track	University Requirement College Requirement Specialized Core							
	Electives							

This course aims to introduce the multidisciplinary concepts of data inference, algorithm development, and technology in order to solve analytically complex problems. The topics covered are: demands and expectations of data science; the process of data science; required basic coding and mathematics skills; hands on experience with R and Python; both structured and unstructured data importing, cleaning and preparation for analysis; data visualization and exploratory data analysis; statistical inference; regression models; basics of machine learning; big data & architecture and cloud computing.

Course Outcomes

- 1. Use statistics, machine learning and software engineering in data science [1]
- 2. Describe the structure of a data science project and develop data science team [2]
- 3. **Describe** data models, graphical perception and techniques for visual encoding and interaction of data. [1,2]
- 4. Apply statistical techniques on the data for both descriptive and inferential analysis. [6]
- 5. **Develop** programs to visualize & analyze data and make inference using regression models. [6]

Assessment	Assignment	5%	Quiz	10 %	Lab	20%	[%] Project 1 ⁴	
Policy	Midterm	20%	Final	30%	Others	-	Troject	1570
Textbook	 Field Cady, "The Data Science Handbook", Wiley, 1st Edition, 2017, ISBN- 13: 978-1119092940, ISBN-10: 1119092949 William McKinney, Python for Data Analysis, O'Reilly Media, 2nd Edition, 2018, ISBN-13: 9781491957660 Hadley Wickham, "R for Data Science", O'Reilly Media; 1st Edition, 2017, ISBN-10: 1491910399, ISBN-13: 978-1491910399 							
References	 Alberto Ca graphics a 032183473 Edward R. Edition, 20 	uiro, " T a nd vis 37 Tufte, 001, IS	The Functio ualization "The Visua BN-13: 978-	nal Art: , New Ri al Displa -0961392	An introduct ders; 1st Edition y of Quantita 2147	ion to in on, 2012 tive Infe	formation , ISBN-13 prmation"	n : 978- , 2nd

Course Name	Proj	ect Implemente	ation	تنفيذ مشروع		
Course Information	Course Code	Course No.	Course Level	Credit Hour	Prerequisite(s)	
	CS420	0921420	8	3 (0-9-6)	0921410 (Project Proposal)	
Course Track	University	Pequirement		nuirement 🛛 Spa	ciplized Core Electives	

This course is the continuation of Project Proposal course completed in the previous semester. Students focus on the implementation of the Project Proposal they defended earlier by using the selected technology, methodology and approach. The implemented solution is generally tested and results are validated. These results are compared against the objectives and solution requirements identified during Project Proposal phase. The writing skills of students are developed and assessed through project report and oral communication skills are improved through presentations. The students learn how to work in a group. They also gain awareness of their ethical, professional and legal responsibilities in the society. The progress of students is monitored and evaluated by the supervisor as well as two committee members over two milestones during the semester. Necessary feedback is provided by the supervisor and committee members at each milestone to improve the quality of students' work.

Course Outcomes

- 1. Develop and evaluate a computer-based system to meet a set of solution requirements. [2,6]
- 2. Work in a team to accomplish a common goal under time and design constraints. [5]
- 3. Use written and oral communications skills to communicate with diverse audience. [3]
- 4. Practice professional, ethical, legal and social issues related with Computer science discipline. [4]

Assessment	Committee	Milestone-3	20%	Supervisor	40%			
Policy	Evaluation	Milestone-4	40%	Evaluation	4070			
Textbook	There is no single textbook for this course. The students are encouraged to select and read various related texts under the recommendation of their supervisor.							
References	 Jeremy T. Miner a 2013, Greenwood. Graduation Proje Christian Dawson, Guide", 3rd Edition 	and Lynn E. Miner, ISBN-13: 978-1440 ect Handbook, CCS , " Projects in Comp n, 2015, Pearson. ISI	" Proposal Plan 829697. IT, King Faisal U outing and Infor 3N-13: 978-12920	ning & Writing", niversity, 2013. mation Systems: A 073460.	5 th Edition, A Student's			

Course Name	Selected T	opics in Compi	iter Science	موضو عات مختارة في علوم الحاسب		
Course	Course Code	Course No.	Course Level	Credit Hour	Prerequisite(s)	
Course Information	CS421	0921421	8 th	3 (3-0-3)	0921320(Computer Security),0921321(Operating Systems)	
Course Track	University	y Requirement	College Re	quirement 🖂	Specialized Core Electives	

This course aims to introduce the basic concepts of new trends in computer science. It helps the students to research new trends and become familiar with their applications in modern times. Topics are selected from different areas in Computer Science that are not covered in the traditional courses and may include new and emerging trends. This course will cover topics of recent issues and trends in computer science according to the choice of the instructor. The topics may include any four emerging computer science trends not limited to the following. New trends in the Web technology, trends in distributed and mobile computing, new trends in Artificial intelligence, Neural computing, trends in software engineering, cloud computing, big data, etc... Students are introduced to case studies of applications in these areas and assigned individual/team projects in these specific fields.

Course Outcomes

- 1. Recognize the new trends and technologies in computer science.[1]
- 2. Develop skills in collecting information about global issues in computing.[1]
- 3. Demonstrate skills in oral presentation and report writing.[3]
- 4. **Demonstrate** team work and organizational skills.[3,5]
- 5. Appraise impact of new technology and analyze its potential for future applications.[6]

Assessment Policy	Assignme nt	10%	Quiz	10%	Lab	-	Project	20%
	Midterm	25%	Final	35%	Others	-	1.01000	
Textbook	Lecture Slides; No textbooks, but papers will be selected for each topic.							
References	ElecLec	etronic N ture note	Aaterials, es distribu	Web Site ited by sp	es, KFU Library D beakers.	atabases,	etc	

Course Name	Advance	ed Web Prog	ramming	لغة برمجة متقدمة		
Course	Course Code	Course No.	Course Level	Credit Hour	Prerequisite(s)	
Information	CS 413	0921413	$7^{th}/8^{th}$	3 (3-0-6)	0921314(Fundamentals of Web Programming)	
Course Track	University	Requirement [College Requ	irement 🗌 Sp	ecialized Core 🛛 Electives	

This course aims to provide .Net framework and other advance programming techniques include: C# core concepts, Building a web application using ASP.NET, Working with ASP.NET server controls, Creating consistent-looking websites, ASP.NET Master pages, Navigation, User controls, Validating user Input, Programming ASP.NET web pages, AJAX , jQuery, Connecting to a database, Data Readers, Stored Procedures, Displaying and Updating Data, LINQ and the ADO.NET Entity Framework, Working with Data—Advanced Topics, Security in ASP.NET Website, Web services SOAP, WSDL, SOA, Web Service Enhancement WSE , Developing ASP.NET web services, Deploying Web Services using IIS, Web Service Clients, Web Service Proxies, ASP.NET Web Service Programming Model and XML Serialization.

Course Outcomes

- 1. Use advance programming concepts in .NET Framework. [2]
- 2. Create and use components in Windows Forms using C# APIs [2]
- 3. Develop Web Services using C# and ASP.NET [6]
- 4. Develop database driven ASP.NET web applications [6]

Assessment	Assignment	5%	Quiz	10%	Lab	-	Project	15%
Policy	Midterm	30%	Final	40%	Others	-	Troject	
Textbook	 Imar Spaanjaars, "Beginning ASP.NET 4.5 in C# and VB", 2013, By John Wiley & Sons, Inc, ISBN-13: 978-0470502211. Alex Ferara and Mathew Macdonald, "Programming .NET Web service" OREILLY publishers. ISBN-13: 9780596002503 							
References	 Vincent Va Visual Stud Microsoft c Basic .NET 	arallo," dio 2008 corporati f and M	ASP.NET 3", Wrox I on" Devel licrosoft V	3.5 En Press, IS oping W isual C#	terprise App BN: 0470396 /eb Applicati # .NET", Mic	olicatio 865 ions wit crosoft P	n Develop h Microso Press.	ment with oft Visual

Course Name	Ubiq	uitous Comp	uting	الحوسبة واسعة الإنتشار				
	Course Code	Course No.	Course Level	Credit Hour	Prerequisite(s)			
Course Information	CS 414	0921414	7 th /8 th	3 (3-0-6)	0921321(Operating Systems), 0924214(Fundamentals of Computer Networks)			
Course Track	Universit	University Requirement College Requirement Specialized Core						
Course mack	Electives	y Requireme.		Requirement				

This course will first give general introductions of ubiquitous computing, essential devices, important networks and representative services, and then check various ubiquitous devices including RFID, e-tag, sensors, handhelds, robots, etc. as well as their typical applications. The context as a special kind of information in ubiquitous computing will be described in details and related context-aware computing technologies, systems and application will be presented. Various key issues in ubiquitous computing smartness, intelligence, security, safety, trust and related social issues will be discussed.

Course Outcomes

- 1. **Describe** fundamentals of sensor technology and sensor networks [3]
- 2. **Design** and **implement** simple context aware applications, using standard sensor technology [2]
- 3. Explain interfaces suitable for ubiquitous computing [3]
- 4. **Compare** the usability of alternative design of interactions for specific ubiquitous computing systems [1]
- 5. Explain security issues in Ubiquitous Computing [3]

Assessment	Assignment	10%	Quiz	10%	Lab	-	Project	15%
Policy	Midterm	25%	Final	40%	Others	-	Troject	
Textbook	Stefan Poslad, " Ubiquitous Computing: Smart Devices, Environments and Interactions ", Wiley, ISBN: 978-0-470-03560-3, 2009.							
References	 Y. Zhang, I Protocols, Press, ISBN Q. Li and T Hall/CRC, 	L.T. Ya Archite N-10: 1- C.K. Shi ISBN: 1	ng, J. Ma, " ectures, Sec 4200-5537 h, "Ubiqui 978-1-4200	Unlice curity, -2, 2009 tous M -9338-4	nsed Mobile Standards an). ultimedia Co I, 2010	Access 7 nd Appli omputing	Cechnolog cations", (g", Chapma	y: CRC an &

Course Name	Mining	g of Massive I	Datasets	تنقيب البيانات الكثيفة		
Course	Course Code	urse Course Course ode No. Level		Credit Hour	Prerequisite(s)	
Information	IS414	0922414	7^{th} / 8^{th}	3 (3-0-6)	0922222 (Database Concepts and Design)	
Course Track	University	Requirement	College Requ	irement 🗌 Spe	cialized Core 🛛 Electives	

This course will discuss method and algorithms for mining large amount of data to extract valuable knowledge. The emphasis will be given on MapReduce as a tool for parallel processing of big datasets. The main focus of the course is to discuss data preprocessing techniques, understand how different data mining algorithms work including: frequent pattern analysis, association rule mining, clustering, and other large scale supervised machine learning algorithms such as decision tree, support vector machine and neural network; introduce MapReduce and distributed file systems as a tool for creating parallel algorithms; introduce emerging topics such as text and graph mining, recommendation systems and social network analysis. Students will gain practical experience through working on large scale realistic dataset using popular data mining algorithms and big data processing technologies.

Course Outcomes

- 1. **Describe** basic concepts in data mining and explain how it can be employed to solve scientific and business problems. [1, 3]
- 2. Recognize big data processing and related technologies to analyze massive datasets. [1]
- 3. Explain how different data mining and machine learning algorithms work. [1]
- 4. **Identify** and **select** the most appropriate data mining and big data solutions to solve specific business and scientific problems. [1, 6]
- 5. Use data mining and big data processing tools to analyze massive datasets. [1, 2]
- 6. **Collaborate** with team members in a group projects to tackle with real-world big data problems. [1, 2, 5]
- 7. Write a comprehensive report on results obtained from the data analysis process on a realistic dataset. [3, 6]

Assessment	Assignment	15%	Quiz	10%	Lab	-	Project	15%	
Policy	Midterm	20%	Final	40%	Others	-	TTOJECI		
Textbook	Jure Leskovec, Anand Rajaraman, Jeffery David Ullman. "Mining of Massive Datasets", 2 nd Edition, 2014, Cambridge University Press. ISBN-13: 978-1107077232								
References	 J. Han, M Edition, 2 Margaret Edition, 2 	 J. Han, M. Kanber and J. Pei, "Data Mining: Concepts and Techniques", 3rd Edition, 2011, Morgan Kauffman Publishers. ISBN-13: 978-0123814791 Margaret H. Dunham, "Data Mining: Introductory and Advanced Topics", 1st Edition, 2002, Prentice Hall, ISBN-13: 978-0130888921 							

Course Name	Ma	achine Learning	g	تعلم الآلة					
Course	Course Code	Course Code Course No.		Credit Hour	Prerequisite(s)				
Information	CS415	0921415	$7^{th}/8^{th}$	3 (3-0-3)	0921324(Artificial Intelligence)				
Course Track	□University Requirement □College Requirement □ Specialized Core ⊠ Electives								

This course provides an introduction to machine learning techniques. It gives an overview of the concept of learning, learning models, Inductive Learning (Regression, Bayes Learning, Maximum Likelihood, Decision Trees,), Supervised learning (generative/discriminative learning, parametric/non-parametric learning, neural networks, support vector machines); unsupervised learning (KNN, K-Means clustering,); learning theory (bias/variance tradeoffs); reinforcement learning and adaptive control. Various architectures for neural networks are discussed with learning rules like Hebb, perceptron and delta rule. Supervised and un-supervised training algorithms for Neural Networks like, Association Maps, Backpropagation, Hopfield Networks, LVQs and SONN are explained along with their applications to simple problems. The course will also discuss recent applications of machine learning, such as to robotic vision and path planning, data mining, and text and web data processing. Students will develop the applications using Matlab or Python with machine learning tools and libraries.

Course Outcomes

- 1. **Describe** machine learning concepts and techniques in order to formulate, structure and solve practical problems that involve large or complex data. [1,3]
- 2. **Formulate** and solve machine learning problems corresponding to different applications such as prediction, clustering, classification and decision making. [2,6].
- 3. **Recognize** the fundamental issues and challenges of machine learning: data, model selection, model complexity, etc. [1]
- 4. Describe various neural network architectures, learning rules and training paradigms. [1,3]
- 5. **Apply** various classification and clustering techniques to the problems using Matlab or Python with machine learning libraries [5, 6]

Assessment	Assignment	10%	Quiz	10%	Lab	-			
Policy	Midterm	25%	Final	40%	Others	-	Project	15%	
Textbook	Ethem Alpaydin, "Introduction to Machine Learning", MIT Press, 3 rd ed. 2014, ISBN-13: 978-0-262-02818-9.								
References	 Sebastian Ra Learning wi Publishing, I James, G., W Learning wi 7138-7 	aschka, " i th Pytho SBN: 17 Vitten, D i th Appli	Python Ma on, scikit-le 87125933 ., Hastie, T cations in	achine L earn, and ., Tibshir R ", Sprin	earning: Ma TensorFlov ani, R., "An ger-Verlag N	w", 2nd 1 Introdu IY, 2013	Learning a Edition, 20 action to 9 , ISBN 97	and Deep)17, Packt Statistical 8-1-4614-	

Course Name	Web Applie	cation Penetro	ation Testing	اختبار الاختراق لتطبيقات الويب		
Course	Course Code	Course No.	Course Level	Credit Hour	Prerequisite(s)	
Information	IS416	0922416	7^{th} / 8^{th}	3 (3-0-6)	0921320 (Computer Security)	
Course Track	University	Requirement	College Requ	irement Spe	cialized Core 🛛 Electives	

The course initially provides an overview of technologies, languages and structures used in the implementation of web applications such as HTTP, HTTPS and AJAX within the context of security. Students will be introduced to different web application testing frameworks including the Open Web Application Security Project (OWASP) Testing Guide which will be the focus in this course. Overview of different stages of penetration testing according to the Penetration Testing Execution Standard (PTES) including pre-engagement planning, intelligence gathering, threat modeling, vulnerability scanning, exploitation, post-exploitation and reporting will be covered. Brief introduction to different vulnerabilities and flaws that exist in web applications and the techniques to exploit them will be provided. The primary focus of this course is to identify and exploit injection-based, scripting-based and session management vulnerabilities in web applications using automated tools. The course will also provide students with the essential know-how to setup their own penetration testing environment and use tools such web application proxies, vulnerability scanners and application fuzzers.

Course Outcomes

- 1. Describe fundamental concepts and phases of penetration testing. [3]
- 2. Identify known vulnerabilities and flaws associated with web applications. [1]
- 3. Explain the impact of exploitation of web application vulnerabilities. [1, 2]
- 4. **Analyze** communication between the client and the server application to find security issues. [1, 2]
- 5. Use tools and techniques to identify and exploit vulnerabilities in web applications. [1, 2]
- 6. **Present** the results of the penetration test in the form of a report. [2, 3]

Assessment	Assignment	10%	Quiz	10%	Lab	-	Project	20%	
Policy	Midterm	20%	Final	40%	Others	-	J		
Textbook	Juned Ahmed Ansari, "Web Penetration Testing with Kali Linux", 2 nd Edition, 2015, Packt Publishing Ltd. ISBN-13: 978-1783988525								
References	 Andres An 2006, Wrd Dafydd S Handbool ISBN-13: 	ndreu, " ox. ISB Stuttard k: Find 978-81	Profession: N-13: 978-0 and Mar ling and Ex 26533404	al Pen Te 94717896 cus Pint ploiting S	esting for Wel 66 70, "The Wo Security Flaw	b Appl eb Aj s", 2 nd	l ications" , p plication Edition, W	1 st Edition, Hacker's /iley, 2011.	

Course Name	Mobile A	pplication D	Development	بر مجة تطبيقات الأجهزة المتنقلة			
Course	Course Code	Course No.	Course Level	Credit Hour	Prerequisite(s)		
Information	CS 422	0921422	$7^{th}/8^{th}$	3 (3-0-6)	0921210(Object Oriented Programming 1)		
Course Track	University	Requirement	College Requir	ement Sp	ecialized Core 🛛 Electives		

This course aims to provide mobile app development using most common Android OS platform which include topics: Introduction to Android, Android Activity, Activity Life Cycle, Fragment, User Interfaces, Gradle build DDMS, Android Building Blocks, Android Views, Widgets, Layouts, Intents, Fragment Life Cycle, Broadcast Receivers, Android Notification, GUI Menu design, Process and Threads, Async Task, Data Persistence, Data Storage, SQLite, JSON, App and Web Integration, Location, GPC, Multimedia and Gestures, Services, App publishing and business Module.

Course Outcomes

- 1. Identify the basic differences among popular mobile application platforms. [2]
- 2. Develop applications for mobile phones, tablets and smart devices using popular application development frameworks. [6]
- 3. Create multimedia and database driven mobile applications. [2, 6]
- 4. Develop context-aware application using advanced APIs. [6]

Assessment	Assignment	5%	Quiz	10%	Lab	-	Ducioat	15%	
Policy	Midterm	30%	Final	40%	Others	-	rroject	1370	
Textbook	 Erik Hellman, "Android Programming Pushing the Limits", Willy, 2014. ISBN 978-1118717370 Reto Meier, "Professional Android 4 Application Development", John Wiley & Sons, 2012, ISBN: 9781118102275 								
References	 Brain Hardy, Bill Phillips, "Android Programming: The Big Nerd Ranch Guide, Addison-Wesley Professional, 2013, ISBN: 9780132869102. Paul J. Deitel, Harvey M. Deitel, Abbey Deitel, Michael Morgano, "Android for Programmers: An App-Driven Approach"; Prentice Hall, 2012. ISBN-13: 9780132121361 								

Course Name	Softwar	e Project Ma	nagement	إدارة مشاريع البرمجيات			
Course	Course Code	Course No.	Course Level	Credit Hour	Prerequisite(s)		
Information	CS423	0921423	7^{th} / 8^{th}	3 (3-0-3)	0921411(Advanced Software Engineering)		
Course Track	University	Requirement	College Requ	irement 🗌 Spe	cialized Core 🛛 Electives		

This course provide students with overview of software project management theory and practice. It includes topics: an introduction to software project management (what is a project, software projects versus other types of projects, software projects categorizing, project management, problems with software projects, stakeholders), an overview of project planning (project selection, identifying scopes and objectives, identifying project infrastructure, analyzing project characteristics), project evaluation (strategic assessment, technical assessment, risk evaluation), selection of an appropriate project approach (choosing technologies, choosing process models, software prototyping), software effort estimation (problems with over and under estimation, the basis with software estimating, software effort estimating techniques), monitoring and control (creating the framework, collecting data, visualizing progress, cost monitoring, earned value), managing people and organizing teams (understanding behavior, working in groups, becoming a team, decision making, leadership).

Course Outcomes

- 1. Describe the main concepts and principles of software project management. [1]
- 2. Develop a comprehensive project plan using basic steps in project planning. [2]
- 3. Select and evaluate software projects. [6]
- 4. Apply a range of estimating methods and techniques. [6]
- 5. Illustrate, visualize and assess the progress of a project. [1]
- 6. **Select** the most appropriate people for a project, increase staff motivation and improve group working. [4]

Assessment	Assignment	10%	Quiz	10%	Lab	0%	Project	15%	
Policy	Midterm	25%	Final	40%	Others	0%	TTOJECI		
Textbook	Hughes, Robert and Cotterell, M. "Software Project Management"5 th Edition, 2009, McGraw-Hill, ISBN-13: 9780077122799								
ReferencesRose, K.H., "A Guide to the Project Management Body of Knowledge" (PMBOK® Guide), Sixth Edition, 2017. ISBN-13 :9781935589679									

Course Name	Formal Metho	ods in Softwa	are Engineering	الطرق الرسمية في هندسة البر مجيات		
Course	Course Code	Course No.	Course Level	Credit Hour	Prerequisite(s)	
Information	CS424	0921424	$7^{th}/8^{th}$	3(3-0-3)	0921411(Fundamentals of Software Engineering)	
Course Track	University R	lequirement [College Requirer	ment 🗌 Spe	cialized Core 🛛 Electives	

60

Course Description

This course provide students with a review of Mathematical Fundamentals, Relations, Functions, Logical Expressions, Propositional and Predicate Logic, Undirected and Directed Graphs, Modeling with Objects, Objects and its Types, Sets and Set Types, Modeling with Sequences, Sequence and its Type, Tuples and Cartesian Product Types, Generic and Axiomatic Definitions, Bindings and Schema Types, Modeling with Relations and Functions, Structures Operators, Domain/Range Restrictions and Subtractions, Notations and Properties of Relations and Functions, Free Types, Schemas, Properties, Type, Declaration, Predicate, Operators, Modeling with Mappings, Requirement Analysis, Systems Specification, Model-Based Approaches, Event-based Approaches, Algebraic Specification, Properties of Systems, Structural Properties, Behavioral Properties, Creation of Systems, Invariant-Based Verification of Systems, Structural and Dynamic Analysis of Systems, Specification Analysis, Program Verification, Consistency and Completeness, Visualization, Systematic Testing, Validation, Verification, Tools and Techniques.

Course Outcomes

- 1. **Define** software systems using model oriented approaches [1]
- 2. **Apply** formal tools, for example, VDM and Z/Eves for description and analysis of the systems [6]
- 3. **Identify** relationships among various formal specification techniques and **choose** an appropriate one based on the requirements of a system to be developed [1]
- 4. **Practice** the model validation and verification approaches enhancing quality of the software systems [2]

Assessment	Assignment	10%	Quiz	10%	Lab	I	D • (1.50/		
Policy	Midterm	25%	Final	40%	Others	-	Project	15%		
Textbook	J. M. Spivey, "Understanding Z: A Specification Language and its Formal Semantics", 1st Edition 2008, Cambridge University Press; ISBN: 0521334292									
References	 Paul Boca of the Art ISBN: 18² John Fitzg Verhoef, ' Verlag, IS 	, Jonatha t and Ne 4882735 gerald, Po 'Validat BN: 185	an P. Bowe w Directi 0 eter Gorm ed Design 52338814	en and Jaw on", 1st Ec Larsen, Pa Is for Obje	ved Siddiqi, lition, 2010 aul Mukherj ect-oriented	"Form , Spring jee, Nic l Syste	al Methoc ger Publica o Plat and ms ", 2005,	ls: State ttions. Marcel Springer		

Course Name	Рс	arallel Compu	ting	الحوسبة المتوازية			
Course	Course Code	Course No.	Course Level	Credit Hour	Prerequisite(s)		
Information	CS425	0911425	$7^{th}/8^{th}$	3 (3-0-3)	0921321 (Operating Systems)		
Course Track	Universit	y Requirement	College Req	uirement 🗌 Spe	cialized Core 🛛 Electives		

This course introduces students an overview on Parallel Computing. This course deals with emerging trends in the use of large scale computing platforms ranging from desktop multicore processors, tightly coupled SMPs, message passing platforms, and state-of-the-art virtualized cloud computing environments. The course consists of four major parts: The first part for parallel programming includes: Programming models and language support, Message passing using MPI, thread-based programming using POSIX threads, directive-based programming using OpenMP, and GPU programming in CUDA. The second part parallel and distributed platforms includes outlines parallel computing hardware. Topics covered include processor and memory architectures, multicore, SMP, and message passing hardware, interconnection networks, and evaluation metrics for architectures. Cost models for communication are also developed. The third part parallel and distributed algorithms includes designing principles for parallel algorithms, developing parallel algorithms for a variety of problems. Various metrics for evaluating these algorithms are also discussed. The forth part applications include a variety of parallel applications from diverse domains such as data analysis, graphics and visualization, particle dynamics, and discrete event and direct numerical simulations.

Course Outcomes

- 1. Explain the main concepts and fundamental of the parallel computing. [1]
- 2. Understand various parallel programming models. [1, 2]
- 3. Describe different parallel and distributed platforms [2, 6]
- 4. Discuss and analyze various parallel algorithms for various problems [2, 3,6]

Assessment Policy	Assignment	10%	Quiz	10%	Lab	-	Ducioat	20%	
	Midterm	25%	Final	35%	Others	-	rroject		
Textbook	Peter Pacheco, " An Introduction to Parallel Programming ", 2 nd edition, 2019, Morgan Kaufmann. ISBN-13 : 978-0123742605								
References	 Ananth Gra "Introduct ISBN-13: 1 Thomas Ra Cluster Sy Darryl Gov and Oracle 032171137 	ama, Ar ion to l 978-020 auber, G stems", re, "Mu e Solari 3	nshul Gupta Parallel Co D1648652 Fudula Reur 2013, Spr Iticore App is", 2011, A	, Georg mputin nger, "P inger. 1 blication Addison	e Karypis and V g", 2 nd Edition, arallel Program SBN-13: 978-3 n Programmin -Wesley Profes	Vipin F 2003, mming -642-3 g: for sional.	Kumar, Addison V g For Mult 7801-0 Windows ISBN-13:	Wesley. ticore and , Linux, 978-	

Course Name	Со	mputer Visi	on	رؤية الكمبيوتر				
Course Information	Course Code	CourseCourseCourseCodeNo.		Credit Hour	Prerequisite(s)			
	CS426	0921426	$7^{th}/8^{th}$	3 (3-0-6)	0921323(Digital Image Processing)			
Course Track	University Requirement College Requirement Specialized Core Electives							

This course provides an introduction to algorithms and techniques for computer vision applications. It explains the image formation fundamentals like camera model and homography, along with the human perception characteristics, such as stereo vision, as the necessary components of a machine perception model. Creation of 3-dimensional (3D) models from images using the concepts of fundamental matrix and structure from motion will be discussed. Image feature extraction and selection will be analyzed, along with various types of classification systems. Several application challenges will be studied, such as motion recognition, target recognition and tracking, image stitching and rendering from 2D to 3D image.

Course Outcomes

- 1. **Explain** the concepts of image formation and understanding of human perception for image modeling [3]
- 2. Apply stereo vision techniques to create panoramic images [6]
- 3. **Apply** computer vision techniques for object detection, segmentation, classification and recognition in images. [6]
- 4. **Develop** computer vision applications using Open source libraries. [2, 6]

Assessment Policy	Assignment	5%	Quiz	10%	Lab	-	D • (15%		
	Midterm	30%	Final	40%	Others	-	Project			
Textbook	Richard Szeliski, "Computer Vision: Algorithms and Applications", Springer 2011, ISBN-13: 978-1848829343.									
References	 Richard Ha Computer 052154051 W. B. Thor Computer 0275-8. Rafael C. C. 4th Edition 	rtley and Vision" 3 npson, F Graphi Gonzalez 2017, J	d Andrew Z ,Cambridg Fleming R, cs Perspec , Richard H SBN-13: 9	Zisserma e Univer , Regehr etive, CR E. Woods 78-0133	n, " Multipl e sity Press, 2 Stefanucci, C Press, T& s, " Digital I 356724	e View (nd ed., 2 "Visual F, 2011, mage Pr	Geometry in 2004, ISBN- Perception , ISBN13 97 rocessing",	n -13: 978- from a 78-1-4665- Pearson,		

Course Name	Ce	omputer Graphic	الرسومات بالحاسب الآلي						
Course Information	Course Code	le Course No. Course Level		Credit Hour	Prerequisite(s)				
	CE426	0911426	$7^{th}/8^{th}$	3 (3-0-3)	0817122 (Discrete Maths)				
Course Track	□University Requirement □College Requirement □Specialized Core □ Electives								

63

Course Description

This course aims to provide fundamental concepts of 2D and 3D computer graphics. Topics include basic image synthesis techniques, geometric transformations, projections, Bézier and B-Spline functions for geometric modeling, animation, and rendering through ray tracing, shading and lighting. Students will use a standard computer graphics API in OpenGL to reinforce the concepts of computer graphics algorithms through projects.

Course Outcomes

- 1. Evaluate line, circle, and ellipse drawing algorithms [1, 2, 6].
- 2. Define and describe 2D and 3D points by applying affine transformations [1].
- 3. Analyze curves and surfaces using both implicit and parametric forms [1, 2, 6].
- 4. Develop algorithms using OpenGL API for 2D and 3D graphics applications [1, 2, 6].
- 5. **Compare** and **contrast** the different rendering techniques like ray tracing, shading and lighting [1, 2, 6].
- 6. Interpret the transformations and clipping operations on 2D images [1, 2, 6].
- 7. **Demonstrate** the concepts and applications of geometric modeling, animation and texture mapping [1, 2, 6].

Assessment Policy	Assignments	10%	Quiz	10%	Lab.	-	Project	20%		
	Mid-term	20%	Final	40%	Others	-	- 9			
Textbook	Edward Angel, "Interactive Computer Graphics", 7 th Edition, Pearson, 2012, ISBN: 9780321535863.									
References	 Peter Shirle Edition, CR Dave Shreir Wesley, 201 	 Peter Shirley and Steve Marschner, "Fundamentals of Computer Graphics", 3rd Edition, CRC Press, 2009. (ISBN 978-1-56881-469-8) Dave Shreiner et al, "OpenGL Programming Guide", 8th Edition by. (Addison-Wesley, 2013). 								

Course Name	Se	oftware Sect	urity	أمن البرامج				
Course Information	Course Code	Course No.	Course Level	Credit Hour	Prerequisite(s)			
	CS 427	0921427	$7^{th}/8^{th}$	3 (3-0-3)	0921320 (Computer Security)			
Course Track	University Requirement College Requirement Specialized Core Electives							

In this course, the students will be introduced to the approaches, mechanisms and tools that can be used to make software systems more secure. The course will cover important software vulnerabilities and attacks that exploit them such as buffer overflows, SQL injection, and session hijacking and will consider defenses that prevent or mitigate these attacks. Techniques for software protection, such as code obfuscation, tamper-proofing, and water- marking will be introduced. This course will provide an introduction of operating system security features and vulnerabilities in Windows and UNIX/Linux operating systems. Various techniques will be introduced to mitigate operating system vulnerabilities.

Course Outcomes

- 1. Describe how security can be incorporated into the software development process [3]
- 2. List types of coding errors and their root causes [2]
- 3. Explain how good software development practices impact application security[2]
- 4. Describe security features and vulnerabilities in operating systems.[1]
- 5. Apply techniques to mitigate operating system vulnerabilities.[6]

Assessment Policy	Assignment	10%	Quiz	15%	Lab	-	Project	10%	
	Midterm	25%	Final	40%	Others	-	TTOJECI	1070	
Textbook	Ransome, Anmol Misra, "Core Software Security: Security at the Source", 1 st Edition, Auerbach Publications, 2014. ISBN: 978-1466560956								
References	Jason Grembi, "Secure Software Development: A Security Programmer's Guide", 2008, Cengage Learning, ISBN-13: 978-1418065478								