Scientific Computing Program

FACULTY OF COMPUTER & INFORMATION SCIENCES
(AIN SHAMS UNIVERSITY)

(2024 – 2025)

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WELCOME AND INTRODUCTION

INTRODUCTION / WELCOME FROM PROGRAM MANAGEMENT

The Faculty of Computer and Information Sciences (FCIS) is located on Ain Shams University's main campus. When FCIS was founded in 1995, three programs were initially available. The first graduating class was in 2000. Currently, the Faculty of Computer and Information Sciences (FCIS) offers ten programs. In 2019, the National Accreditation and Quality Assurance Authority of Education (NAQAAE) accredited nine of them. FCIS recently maintained its position as a top-tier educational institution by obtaining the government's Excellence award for the years 2022 and 2023. Furthermore, the Faculty of Computer and Information Sciences has numerous agreements for educational and research cooperation on a national and international level, such as the Memorandum of between Information Engineering and Computer Science of the University of Trento, Italy, and Vidzems University Applied Sciences - Erasmus + Mobility. FCIS offers a number of consulting divisions that help many partners and stakeholders with computer and information science objectives, such as automating ASU through university payroll systems and UMS (University Management System). The FCIS has active agreements for collaboration with various entities and stakeholders in the field of information systems, such as Dell Corporation, Huawei Corporation, and ITI (information technology institute), to train students.

The faculty maintains close relationships with industrial and international partners to assure leadership and provide our students with the best opportunities for advancement.

This handbook is intended for all students taking the “Bachelor of Computer and Information Sciences" with a Scientific Computing major. You will find it a useful information guide at the start and during your study in the program. We are confident that you will enjoy studying with our scientific computing program.

Sincerely,

Prof. Dr. Nagwa Badr
(Dean of Faculty of Computer and Information Sciences - Ain Shams University)

Prof. Dr. Howaida Shaded
(Head of Scientific Computing Department, Faculty of Computer & Information Sciences - Ain Shams University)

INTRODUCTION TO THE PROGRAM

This program aims to study the processes that interact with data and that can be represented in the form of programs. Where the student studies the use of algorithms to process and store information, design software systems and computing systems themselves study the use of computer graphics in various applications, studies different programming languages, different means of interaction between humans and computers, expert systems, natural

language processing, distinguishing sounds, distinguishing and analyzing images and different patterns.

PROGRAM DURATION AND MODES OF STUDY

Students can join the scientific computing program once they have completed the 69 credit hours to become a level 3 student. The scientific computing program has no tracks or concentrations. This program's official degree title is "Bachelor of Computer and Information Sciences" with a Scientific Computing major.

PROGRAM MISSION

The Scientific Computing Program at the Faculty of Computer and Information Sciences, Ain Shams University, is committed to preparing specialized cadres in the field of scientific computing and artificial intelligence applications who have a great deal of cognitive and applied skills appropriate for the labor market and scientific research in the department's areas of specialization, in addition to establishing partnerships with educational and research bodies and institutions and cooperating with software manufacturing companies to meet the needs of the labor market in a manner consistent with the global standards of the software industry in the specialization

PROGRAM GOALS

1. Provide concepts from basic sciences necessary to apply knowledge of computing and numerical techniques appropriate to the discipline.
2. Exploit Programming paradigms and languages.
3. Design and analysis of algorithms, data structures, and databases.
4. Apply software system analysis, design, and engineering.
5. Explore computer organization, architecture, and operating systems.
6. Explain formal Languages and theory of computation.
7. Provide theoretical foundations and tools of computer graphics and animation, game programming, multimedia engineering, scientific visualization, digital signal processing and computer vision.
8. Explain the knowledge of modeling, simulation, and evaluation of different computing systems to meet desired needs.
9. Keep in touch with state-of-the-art parallelization models, architectures, and optimization strategies.
10. Solve increasingly complex computing and data-intensive problems in science and engineering on high-end parallel and distributed computing platforms.
11. Explain basic and advanced topics in machine learning, computational geometry, computational intelligence, neural networks, data security and network security.
12. Understand major computer networks components, various types of computer networks, network topologies, network protocols, routing algorithms, cloud computing and network security protocols.
13. Display professional and ethical responsibilities, and contextual understanding.
14. Conduct scientific research in the field of scientific computing that has a direct impact on society.

GRADUATE ATTRIBUTES

The Scientific Computing program is designed to allow the student to use a mix of theory, experimentation, and computer modeling. Theorists explain things using mathematical models such as partial differential equations. This will enable the graduates to integrate theory and practice and prepare them for lifelong learning that will enable them to move beyond today's technology, and meet the challenges of the present and future market needs. The scientific computing program aims to provide the student with:

1. Coverage of the fundamentals of data structures, database design, concepts of programming languages, computer organization, and architectures.
2. An exposure to a variety of programming languages and systems.
3. An ability to apply mathematical foundations, algorithmic principles, design and development principles, and computing theory in the modeling and design of computational systems of varying complexity.
4. An ability to use current techniques, skills, and tools necessary to analyze a problem, and identify the computing requirements appropriate to its solution.
5. An ability to develop a suitable numerical method to obtain quantitative estimates of important parameters in the mathematical models.
6. An ability to select and use the appropriate visualization technique for visualizing numerical data.
7. An ability to interpret results and select or assess different numerical methods.
8. An ability to manage different performance tradeoffs involved in design and utilization of high-performance computing resources whenever needed to solve large-scale problems.
9. An ability to select and use appropriate computer graphics and visualization techniques for the interpretation of numerical data.
10. An ability to select, implement and evaluate the appropriate computational intelligence, machine learning and deep Learning techniques and getting them to work for problem solving.
11. An ability to use appropriate techniques in computer vision, visualization and machine learning for perception, decision making and control in human computer interaction or human robot interaction research and applications.
12. An ability to use computer animation in game development.
13. An ability to pursue a continual learning process to maintain their skills as the field evolves rapidly.
14. An ability to make effective presentations to explain the quantitative dimensions of technical problems and their solutions.
15. An ability to use appropriate techniques and software packages for reporting and graphing results.
16. An ability to work effectively as a member of a team to accomplish a common goal.
17. An understanding of professional, ethical, legal, social issues and responsibilities.

CURRICULUM STRUCTURE & CONTENT

- Program duration: 140 hours.
- Program structure
  - Compulsory 119 credit hours (115 CH courses + 4 CH training)

- Program Levels: 4 levels.
- Level1: 33 credit hours (29 required, 4 selected)
- Level2: 34 credit hours (32 required, 2 selected)
- Level3: 33 credit hours (required)
- Level 4: 36 credit hours (21 required, 15 selected)

The following table summarizes the program structure.

	Subject Area	Number of Credit Hours	Number of Courses	Percentage of Credit Hours	Tolerance % in NARS
A	University Requirements (Humanities, ethical and Social Sciences)	12	6	8.6%	8-10%
B	Mathematics and Basic Sciences	25	8	18%	16-18%
C	Faculty Requirements (Basic Computing Sciences)	45	15	32.1%	26-28%
D G	Program Requirements (specialization) + Optional (Institution character-identifying subjects)	48	16	34.2%	28-30% + 16-4%
E	Training	4	-	2.8%	3-5%
F	Projects	6	-	4.3%	3-5%
	Total	140	45	100%	

PROGRAM CONTENTS

Program Courses

- **University Requirements**

  - **Mandatory University Courses**

Code	Course	Number of Hours / Week				Co- requirement
		Credit Hours	Lecture	Practical	Ex.	
HUM110	English language I	2	2	-	-	-
HUM113	Report Writing	2	2	-	-	-
STU130	Selected Uni. Topic (1)	2	2	-	-	-
STU140	Selected Uni. Topic (2)	2	2	-	-	-
STU150	Selected Uni. Topic (3)	2	2	-	-	-
Total		10				

  - **Mandatory University Courses not added to the GPA**

Code	Course	Number of Hours / Week				Co- requirement
		Credit Hours	Lecture	Practical	Ex.	
HUM119	Human Rights and Combating Corruption	2	2	-	-	-

  - **Selective University Courses**

Code	Course	Number of Hours / Week				Co- requirement
		Credit Hours	Lecture	Practical	Ex.	
HUM112	English language II	2	2	-	-	HUM110 English Language I

HUM118	Communication and Negotiation skills	2	2	-	-	-
HUM216	Professional Ethics and Legal Aspects	2	2	-	-	-
HUM114	Arab & Islamic Civilization	2	2	-	-	-
HUM115	Recent Egypt History	2	2	-	-	-
HUM116	Geography of Egypt	2	2	-	-	-
HUM117	Introduction to the History of Civilizations	2	2	-	-	-
HUM201	Music Appreciation	2	2	-	-	-
HUM202	Trends in Contemporary Arts	2	2	-	-	-
HUM203	Literary Appreciation	2	2	-	-	-
HUM204	Psychology	2	2	-	-	-
HUM215	First aid skills	2	2	-	-	-
HUM220	Introduction to Accounting	2	2	-	-	-
HUM222	Business Administration	2	2	-	-	-

- **Faculty Requirements**
    - **Mathematics and Basic Sciences**

Code	**Course**	**Number of Hours / Week**				**Co-requirement**
		Credit Hours	**Lecture**	**Practical**	**Ex.**	
BSC121	Physics I	3	2	1	1	-
						BSC121.

BSC126	Physics II	3	2	1	1	Physics I
BSC122	Calculus I	3	2	-	2	--
BSC124	Electronics	4	2	2	2	BSC121. Physics I
BSC125	Calculus II	3	2	-	2	BSC122. Calculus I
BSC221	Discrete Mathematics	3	2	-	2	--
BSC225	Linear Algebra	3	2	-	2	--
BSC123	Probability & Statistics	3	2	-	2	--
Total		25				

- **Basic Computing Courses**

Code	**Course**	**Number of Hours / Week**				**Co-requirement**
		Credit Hours	**Lecture**	**Practical**	**Tut.**	
CIS160	Introduction to Computer Sciences	3	2	2	-	-
CIS150	Structured Programming	3	2	2	-	CIS160. Introduction to Computer Sciences
CIS270	Data Structures	3	2	2	-	CIS150. Structured Programming
CIS230	Operations Research	3	2	2	-	-
CIS250	Object-Oriented Programming	3	2	2	-	CIS150. Structured Programming

CIS260	Logic Design	3	2	2	-	BSC121. Physics I
CIS280	Database Management Systems	3	2	2	-	CIS150. Structured Programming
CIS290	System Analysis & Design	3	2	-	2	CIS280. Database Management Systems
CIS240	Statistical Analysis	3	2	-	2	BSC123. Probability & Statistics
CIS340	Analysis & Design of Algorithms	3	2	-	2	CIS150. Structured Programming
CIS243	Artificial Intelligence	3	2	2	-	CIS150. Structured Programming
CIS220	Computer Organization & Architecture	3	2	2	-	CIS260. Logic Design
CIS353	Operating Systems	3	2	2	-	CIS220. Computer Organization & Architecture
CIS380	Software Engineering	3	2	2	-	CIS150. Structured Programming
CIS365	Computer Networks	3	2	2	-	CIS160. Introduction to Computer Sciences
Total		**45**				

- **Program Requirements**
- **Mandatory Courses**

		Number of Hours/Week	

Code	Course	Credit Hours	Lecture	Practical	Tut.	Co-Requirement
SCO 311	Computer Graphics	3	2	2	-	CIS150. Structured Programming, BSC 225 Linear Algebra
SCO 312	Modeling and Simulation	3	2	2	-	CIS150. Structured Programming
SCO 313	Numerical Computing	3	2	2	-	CIS150. Structured Programming, BSC 225 Linear Algebra
SCO 321	Digital Signal Processing	3	2	2	-	BSC 125 Calculus II
SCO 322	Machine Learning	3	2	2	-	BSC 123 Probability and Statistics
SCO 411	Neural Networks and Deep Learning	3	2	2	-	CIS 243 Artificial Intelligence
SCO 421	Computer Vision	3	2	2	-	CIS 243 Artificial Intelligence
CSY 330	High Performance Computing	3	2	2	-	CIS 353 Operating Systems
CSC 350	Concepts of Programming Languages	3	2	2	-	CIS 250 Object Oriented Programming
CSY 410	Computer and Network Security	3	2	2	-	CIS 365 Computer Networks
STS 310	Selected Topic 1	3	2	2	-	
STS 320	Selected Topic 2	3	2	2	-	

STS 330	Selected Topic 3	3	2	-	-	
STS 340	Selected Topic 4	3	2	-	-	
STS 350	Selected Topic 5	3	2	-	-	

- **Elective Courses**

Code	Course	Number of Hours /Week				Co-Requirement
		Credit Hours	Lecture	Practical	Tut.	
SCO 431	Computational Biology	3	2	2	-	CIS 340 Analysis and Design of Algorithms
SCO 432	Multimedia Engineering	3	2	2	-	SCO 311 Computer Graphics
SCO 433	Game Design & Implementation	3	2	2	-	SCO 311 Computer Graphics
SCO 434	Multidimensional Data Models	3	2	2	-	SCO 312 Modeling & Simulation
SCO 435	Computational Robotics	3	2	2	-	CIS 220 Computer Organization & Architecture
SCO 436	Computer Animation	3	2	2	-	SCO 311 Computer Graphics
SCO 437	Computational Intelligence	3	2	2	-	BSC 123 Probability & Statistics
SCO 438	Computer Forensics	3	2	2	-	CIS 243 Artificial Intelligence
SCO 439	Quantum Computing	3	2	2	-	BSC 225 Linear Algebra
SCO 440	Quantum Cryptography	3	2	2	-	SCO 438 Computer Forensics

INF 423	Cyber Security	3	2	2	-	CIS 365 Computer Networks
INF 412	Cloud Computing	3	2	2	-	CIS 365 Computer Networks
INF 311	Data Mining	3	2	2	-	CIS 280 Database Management Systems
INF 411	Data Science I	3	2	2	-	CIS 280 Database Management Systems
INF 416	Human Computer Interaction	3	2	2	-	-
CSC 420	Theory of Computation	3	2	2	-	BSC 221 Discrete Mathematics
CSC 470	Internet of Things (IoT)	3	2	2	-	CIS 365 Computer Networks
CSC 340	Natural Language Processing	3	2	2	-	CIS 150 Structured Programming

PROGRAM ACADEMIC PLAN

First semester

Course Code	Course Name	Credit Hours	Weekly Hours			Co-requisites
			Lec.	Ex.	Lab.	
CHW160	Introduction to Computer Sciences	3	2	-	2	-
BSC121	Physics I	3	2	1	1	-
BSC122	Calculus I	3	2	2	-	-
HUM110	English Language I	2	2	-	-	-
BSC123	Probability & Statistical	3	2	2	-	-
STU130	Selected Uni. Topic (1)	2	2	-	-	-
Total Hours		16				

Second semester

Course Code	Course Name	Credit Hours	Weekly Hours			Co-requisites
			Lec.	Ex.	Lab.	
CIS150	Structured Programming	3	2	-	2	CIS160. Introduction to Computer Sciences
CIS124	Electronics	4	2	2	2	BSC121. Physics I
BSC125	Calculus II	3	2	2	-	BSC121. Physics I
STU140	Selected Uni. Topic (2)	2	2	-	-	-
BSC126	Physics II	3	2	1	1	BSC121. Physics I
HUM119	Human Rights &Combating Corruption	2	2	-	-	-
Total Hours		17				

Third semester

Course Code	Course Name	Credit Hours	Weekly Hours			Co-requisites
			Lec.	Ex.	Lab.	
HUM113	Report Writing	2	2	-	-	-

CIS250	Object Oriented Programming	3	2	-	2	CIS150. Structured Programming
BSC221	Discrete Mathematics	3	2	2	-	-
CIS260	Logic Design	3	2	-	2	BSC121. Physics I
CIS280	Database Management Systems	3	2	2	-	CIS150. Structured Programming
CIS240	Statistical Analysis	3	2	2	-	BSC123. Probability & Statistics
Total Hours		17				

Fourth semester

Course Code	Course Name	Credit Hours	Weekly Hours			Co-requisites
			Lec.	Ex.	Lab.	
CIS220	Computer Organization & Architecture	3	2	-	2	CIS260. Logic Design
CIS270	Data Structure	3	2	-	2	CIS250. Structured Programming
BSC225	Linear Algebra	3	2	2	-	-
CIS230	Operations Research	3	2	2	-	-
CIS243	Artificial Intelligence	3	2	-	2	CIS150. Structured Programming
STU150	Selected Uni. Topic (3)	2	2	-	-	-
Total Hours		17				

Fifth semester

Course Code	Course Name	Credit Hours	Weekly Hours			Co-requisites
			Lec.	Ex.	Lab.	

CIS353	Operating Systems	3	2	-	2	CIS220. Computer Organization & Architecture
CIS365	Computer Networks	3	2	-	2	CIS160. Introduction to Computer Sciences
CIS290	System Analysis & Design	3	2	2	-	CIS280. Database Management Systems
SCO311	Computer Graphics	3	2	-	2	CIS150. Structured Programming, BSC225. Linear Algebra
SCO313	Numerical Computing	3	2	-	2	CIS150. Structured Programming, BSC225. Linear Algebra
Total Hours		15				

Sixth semester

Course Code	Course Name	Credit Hours	Weekly Hours			Co-requisites
			Lec.	Ex.	Lab.	
CIS380	Software Engineering	3	2	-	2	CIS150. Structured Programming
CIS340	Analysis & Design of Algorithms	3	2	-	2	CIS 150. Structured Programming
SCO322	Machine Learning	3	2	2	-	BSC123. Probability and Statistics
CSC350	Concept of Programming Languages	3	2	-	2	CIS250. Object-Oriented Programming
SCO321	Digital Signal Processing	3	2	-	2	BSC125. Calculus II
CSY330	High Performance Computing	3	2	-	2	CIS353. Operating Systems
Total Hours		18				

Seventh semester

Course Code	Course Name	Credit Hours	Weekly Hours			Co-requisites
			Lec.	Ex.	Lab.	
SCO422	Computational Geometry	3	2	2	-	SCO311. Computer Graphics
SCO411	Neural Networks & Deep Learning	3	2	2	-	BSC225. Linear Algebra
SCO421	Computer Vision	3	2	2	-	CIS243. Artificial Intelligence
STS310	Selected Topic (1)	3	2	-	2	-
STS320	Selected Topic (2)	3	2	-	2	-
PRO400	Project	3	-	1	5	-
Total Hours		18				

Eighth semester

Course Code	Course Name	Credit Hours	Weekly Hours			Co-requisites
			Lec.	Ex.	Lab.	
CSY410	Computer and Network Security	3	2	2	-	CIS365
SCO312	Modeling & Simulation	3	2	-	2	-
STS330	Selected Topic (3)	3	2	-	2	-
STS340	Selected Topic (4)	3	2	-	2	-
STS350	Selected Topic (5)	3	2	-	2	-
PRO400	Project	3	-	1	5	-
Total Hours		18				

KEY STAFF, CONTACT DETAILS AND STAFF ROLES

The Key Staff and Contact Details are correct at point of publication. You will be notified of any changes.

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PROGRAM OPERATION AND STUDENT REGISTRATION

Program admission requirement

Students are admitted to the Faculty of Computer and Information Sciences in accordance with the regulations of The Supreme Council of Egyptian Universities, and the National Coordination Centre oversees the admissions process at all Egyptian universities. All candidates to the Faculty of Computer and Information Sciences must meet the requirements for admission, which include having General Secondary Education certificate (Thanawaya Amma or equivalent), completing Mathematics 2 and Physics or equivalent. The National Coordination Centre carries out the admission requirements for various certificates as determined by the Supreme Council of Universities. The following are the general rules for admission: - The student medical examination proving that he/she is free of infectious diseases and is fit to continue the

study for which they are applying. - The student cannot be admitted to more than one faculty at the same time.

Regulations for progression and program completion

- A bachelor's degree requires 140 credit hours with a cumulative GPA not reported below 2.00 and passing the (Fail/Pass) courses.
- The students must attend at least 75% of the actual total hours (lectures, exercises, and practical) for any given course to be eligible to take the course exam.
- Summer training is one of the graduation requirements, and the student must spend two summer internships during the study period. The summer training should be at least 3 weeks inside or outside the faculty during the summer semester.
- The student completes a bachelor's project prior to graduation, and to register for the graduation project, they must have successfully completed 94 credit hours. Each group selects the project idea according to their preferences and after the approval of the academic supervisor, during the final academic level.

Assessment Methods (Evaluation Techniques):

Final Exam

Midterm

Quiz

Year Work

Practical

Evaluation of Program Intended Learning Outcomes

Evaluator	Tool	Sample
1- Senior students	Evaluation sheets	Suitable number
2- Alumni	Evaluation sheets and Interviews	Suitable number
3- Stakeholders (Employers)	Evaluation sheets and Interviews	2
4- External Evaluator (s) (External Examiner (s))	Evaluation Report	1 or 2
5- Other	---	

GRADING STANDARDS

The letter grades of A+, A, A-, B+, B, B-, C+, C, C-, D, D- indicate passing grades; a grade of F, however, is not allowed to progress to the next level course. Table 1-2 illustrates the grading system.

Table 1. The grading system

Grade	GPA	Percentage
A+	4.0	97% and up
A	4.0	93% to 97%
A-	3.7	89% to 93%
B+	3.3	84% to 89%
B	3.0	80% to 84%
B-	2.7	76% to 80%
C+	2.3	73% to 76%
C	2.0	70% to 73%
C-	1.7	67% to 70%
D+	1.3	64% to 67%
D	1.0	60% to 64%
F	0	Less than 60%

THE HIERARCHY OF THE PROGRAM AND MANAGEMENT

Prof. Howaida Shaded is a professor of Scientific Computing. The program Chair is directly responsible for monitoring the Scientific Computing program and supervising department members and teaching assistants. Figure 1 shows the faculty's organizational structure hierarchy. All program faculty members meet to discuss any program-related concerns.

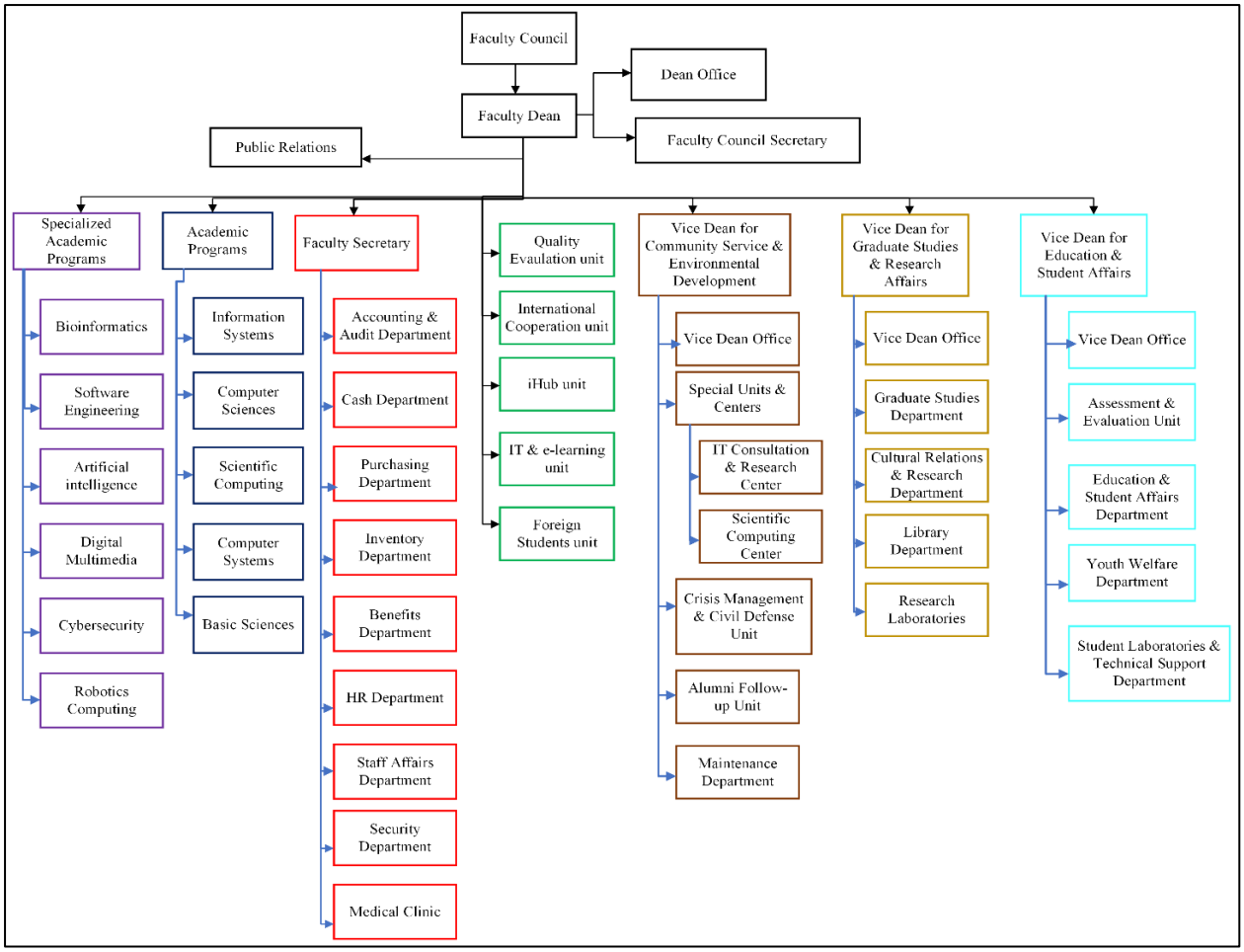

Figure 1 The faculty organizational structure hierarchy

STUDY TIMING AND REGISTRATION

The academic year is divided into two main semesters:

1. The first semester (Fall semester) starts in September and lasts for 15 weeks. Registration for courses takes place within 3 weeks before the start of the semester.
2. The second semester (Spring semester) starts in February and lasts for 15 weeks. Registration for courses takes place within a week before the start of the semester.

There may be also a summer semester which is an intensive semester. The duration of summer semester is not less than 7 weeks with a maximum of 9 credit hours per week, and the student may enroll in a maximum of three courses. The summer semester usually starts in July. Registration for courses takes place within a week before the start of the semester.

The maximum credit hours for enrollment in each semester are:

- Up to 21 credit hours for a student with a GPA greater than or equal to 3.
- Up to 18 credit hours for a student with a GPA greater than or equal to 2 and less than 3.
- Up to 14 credit hours or 5 courses for a student with a GPA of less than 2.0.
- No more than 9 credit hours per week are allowed for any student in the summer semester.

- The minimum number of credit hours for registration in the first and second semesters is 9 credit hours. The faculty council may give permission to drop below the minimum registration requirement for reasons of student graduation.
- The maximum number of credit hours for registration in the Fall and Spring semesters is 21 credit hours. The faculty Council may authorize an increase in the maximum registration limit for reasons of student graduation.

Students may substitute a course or withdraw from a course during any semester and before having been evaluated provided that the withdrawal is requested before the sixth week of the semester and the student presents an acceptable excuse for the withdrawal.

Each faculty member is assigned a group of students for whom he or she is accountable as an academic adviser at the start of each academic year, and students can refer to their advisors for any difficulties. Each semester, all students are required to identify the courses they intend to study and to meet with an Academic Advisor. Students are supposed to track their own progress; however, the Academic Advisor uses a degree flow sheet to track each student's progress at registration advising appointments.

The UMS supports registration advising. By the beginning of each semester, a list of available courses is loaded on the student profile. Students can select/unselect courses. Moreover, students can view the account information of their academic advisors. Please see details at www.ums.asu.edu.eg/

For general enquiries concerning enrolment, you must contact your local Student Support/Administrative Office or academic advisor for guidance.

EQUALITY AND DIVERSITY

- Ain Shams University (ASU) is dedicated to promoting equality and diversity on its campus. Equality is guaranteed for all students, regardless of their gender, age, color, disability, and religion.

- ASU supports a safe environment for both working and studying. The university environment must be free of bullying, harassment, and any form of discrimination. Any of the acts will not be permitted, and any complaints will be investigated thoroughly. Anyone who feels being subjected to these acts is encouraged to raise complaints.

- All students are given equal opportunities and access to facilities. Each student receives full support in developing their skills and talents. Selection for training, or other benefits shall be based on aptitude and ability.

PROGRAM MANAGEMENT

- The faculty has its own dedicated space on the University's main website which can be reached at: https://cis.asu.edu.eg/. The site provides various services for students and faculty members by presenting the internal regulations of the bachelor's degree courses.

- A welcome and induction process starts during their first week, where all students are guided to their Course studies. The purpose of induction is to introduce new students to their peers, the academic and support staff, to familiarize them with the access to and use and of facilities and to outline the relevant policies, procedures, rules and regulations.

- Students have sufficient access to technology to make it possible for them to successfully complete the academic year. This is mostly facilitated through fully fledged IT laboratories, and free Wi-Fi facilities.

- Every student is assigned an Academic Advisor who is one of the faculty members and may continue with the student for the whole study duration. The Academic Advisor should follow-up with the student, assist him in selecting courses each semester, and request to place the student under probation for one semester.

- Students will be given a student handbook at the start of their Course study or access to the LMS where a soft copy is available.

- Student support is constantly valued and acknowledged in student end-of-term evaluation questionnaires and verbal feedback.

- Students can also use their official emails to access content, assignment information, quizzes, announcements, and grades via faculty learning management software (LMS) and the University Management System (UMS).

STUDENTS INVOLVEMENT

There are different facilities that ensure students involvement:

- **Students' Affairs Administration**

  The students' affairs administration is chaired by the Vice-Dean for Education and Students' Affairs and is located in the faculty administration building. This administration has representatives who are responsible for the following tasks:
  - Archiving of the students' files.
  - Issuing the students' identity cards.
  - Electronic recording of the students' course registration, add/drop, and withdraw.
  - Processing the students' course evaluation at the end of each semester.
  - Issuing the students' records at the end of each semester.
  - Issuing the students' graduation certificates.
  - Processing the students' appeals and requests.

- **Students' Union**

  The students' union is also under the general supervision of the Vice-Dean for Education and Students' Affairs.

- **Financial Affairs Administration**

  The financial affairs administration is located at faculty administration building, is responsible for issuing the payment orders for the students' tuition fees at the beginning of the academic year.

- **Library**

The faculty has a library which serves students and researchers in various fields. It is on the Ain Shams campus in a separate building, besides the Digital Library to provide an online service for users. The faculty library contains around 4104 books in different computer science branches that serve students and faculty. The student library contains around 1189 English books in the student hall and 2915 English ones in the teaching staff hall. Also, it contains all BSc honors/graduation project documentation. The library keeps them for student reference.

The faculty library enables students and staff to access and borrow the available books. They have the right to borrow one book for a week, renewable for another week if the book is available or not in demand. Students can use the library services six days a week from 9:00 AM to 5:00 PM (Saturday to Thursday).

Students can access the Egyptian Knowledge Bank (EKB): http://www.ekb.eg/ which is an online library archive and resource that provides access to learning resources and tools for educators, researchers, students, and the Egyptians in general. Through it, they gain access to a lot of E-journals, E-books, digital libraries of many publishers such as "Wiley", "Springer", "Elsevier". Moreover, all students can access EKB remotely off-campus at anytime from anywhere on their personal devices. Moreover, all students have emails ending with @cis.asu.edu.eg which give them access to download any number of books on EKB, also any research papers from the available publishers.

ATTENDANCE AND ENGAGEMENT

Teaching Policy

- **Language**: English language should be used for lecturing and exams
- **Course Syllabus**: Each course syllabus should contain course objectives, textbook, outline, material, assessments, grading policy, and outcome. The outline should contain sections covered every week. The staff member should give the module syllabus to the students in the first class.
- **Textbook:** The staff member is free to select/recommend a textbook, but it should be international and available.
- **Attendance**: The student's attendance should not be less than 75% during the course. Otherwise, the student should not be allowed to attend the final exam.
- **Assignments\ Quizzes:** Assignments\ quizzes are given throughout the semester (spelled out in the course syllabus). Before the end of the term, assignment and quiz grades are announced.
- **Exams:** One midterm exam should be given. The midterm exam should be given during the 7th-8th week. The final exam should be a comprehensive exam covering all material.

KEY DATES

Registration for any semester occurs within two weeks of the semester's start date. The fall semester begins in early September. The spring semester begins in early February. There is also a summer semester before the academic year, which begins late June and lasts for 7 weeks. The midterm exam should be given during the 7^{th}-8^{th} week.

COURSE SPECIFICATIONS

HUM216. Professional Ethics & Legal Aspects [2 CH]

Computer crime and ethics, nature of computer crime, criminal and civil law overview, basis for protection against computer crimes, suitability and application of intellectual property to computers, application of patent to computers, copyright and its range of application ownership and third party rights, trade secrets and unfair competition, computer contracts and liability, privacy, viruses and other programmed threats, legal protection against viruses, global information networks and related legal aspects.

HUM110. English Language I [2 CH]

HUM112. English Language II [2 CH]

Co-requisite: **HUM110. English Language I**

The material reflects the stylistic variety that advanced learners have to be able to deal with ; The course gives practice in specific points of grammar to consolidate and extend learner's existing knowledge; Analysis of syntax; comprehension; Skimming and scanning exercises develop the learners skills; comprehension questions interpretation and implication; the activities and games used develop listening; speaking and writing skills through a communicative; functional approach; with suggested topics for discussion and exercises in summary writing and composition.

HUM113. Report Writing [2 CH]

This course aims to give the student the basic rudiments of report writing. The rationale for report writing, the structure of reports, and such details as physical appearance and linguistic style will be discussed. In addition to writing reports, students will also be given supplementary

HUM119. Human Rights and Combating Corruption [2 CH]

The historical background of human rights, constitutions and the protection of human rights, the crisis of rights and public freedoms in contemporary political and global systems, and the

political, social, economic and technical reasons for this crisis; evaluation of the role and activities of international organizations in the protection of human rights;
The problem of corruption in Egypt and the economic, administrative, legal and social reasons, the principles of transparency, integrity and the rule of law, the national strategy to combat corruption.

HUM222. Business Administration [2 CH]

Nature, scope, importance & characteristics of business administration - Development of the managerial thought - Business in external & internal environments - Types of institutions - The managerial process - Functions of management planning: planning concept & importance, types of plans, characteristics & contents of the plan, planning stages, budgeting for planning. Organization: organization concept & importance, characteristics of good & effective organization, types of organization structures, centralization & decentralization, span of supervision, delegation of authority, integration among the different units in the organization. Direction & supervision: motivation, communications, leadership & its different types. Control: concept & importance of control, control steps, objectives, actual performance, the deviation, reasons of the deviation, the corrective actions, types of control, internal & external control. Decision - Making: types of administrative decisions, decision - making process & steps, importance of information of decision making - Major functions in different companies: production, marketing, finance, human resources

BSC121. Physics I [3 CH]

Mechanics: physics and measurements, motion in one dimension, vectors, motion in two dimensions, laws of motion, circular motion and its applications, work and energy, potential energy and conservation of energy, linear momentum and collision, rotation of a rigid body, rolling motion, law of gravity. Waves: Oscillatory motions, wave motion, sound waves.

BSC126. Physics II [3 CH]

Co-requisite: BSC121. Physics I

Optics: Superposition of waves, interference, diffraction and polarization. Elect of magnetic field and Faraday's law, electromagnetic waves. Selected topics: Introduction to modern physics and applications, molecules and solids, superconductivity. Field, Gauss’s law, magnetic field.

BSC122. Calculus I [3 CH]

The continuity and the differentiability of a real function. Techniques of differentiation. Derivatives of the trigonometric functions. Implicit differentiation. Linear approximations and differentials. Applications of the derivative: Extrema of functions, optimization problems, velocity and acceleration. Integrals: Indefinite integrals, change of variables, definite integrals, the fundamental theorem of calculus, numerical integration. Applications of definite integrals: Areas, solids of revolution, arc length and surfaces of revolution, work, moments and centers of mass. Transcendental functions: Derivative of inverse function, natural logarithm function, exponential functions, inverse trigonometric functions, hyperbolic and inverse hyperbolic functions, indeterminate forms and rule.

BSC124. Electronics [4 CH]

Co-requisite: BSC121. Physics I

Electronic components and basic laws. Principles of circuit-analysis: Dividers, equivalent sources, methods of solutions, circuits with nonlinear resistance, maximum power-transfer,

sinusoidal excitation and impedance concept, magnitude and phase-shift of RLC circuits. Frequency response of linear circuits, passive filter types and characteristics. Diode-circuits: half and full-wave rectifiers, Zener regulators and limiters. Transistor circuits: BJT characteristics, types, basic configuration, biasing and load line, equivalent circuits, voltage gain, input and output impedance, coupling, practical circuits, FET circuits: Characteristics, types, basic configuration, switching modes. Operational amplifiers: Principles, basic circuits: adder, follower, differentiator, integrator, comparator, Schmitt-circuit, special circuits. Active filters: types, characteristics. Oscillators: Relaxation, feedback, RC, LC, and Voltage controlled oscillators. Display elements: Light-emitting-diodes, liquid-crystal displays, and cathode-ray tubes.

BSC125. Calculus II [3 CH]

Co-requisite: BSC122. Calculus I

Techniques of integration: Integration by parts, trigonometric integrals and substitutions, integrals of rational functions, quadratic expressions, tables of integrals, improper integrals. Infinite series: Sequences, convergent or divergent series, positive-term series (basic comparison test, limit comparison test, ratio and root tests), alternating series and absolute convergence, power series, power series representations of functions, Maclaurin and Taylor series, applications of Taylor polynomials. Differential equations: Definition, classifications and terminology, techniques of solution of ordinary first-order first-degree differential equations (separable, reducible to separable, homogeneous, reducible to homogeneous, linear, reducible to linear, exact differential, non-exact differential-integrating factor), applications.

BSC221. Discrete Mathematics [3 CH]

Sets, sequences, algorithms and pseudo codes. Relations and Functions. Boolean Algebra. propositional logic. Proof techniques. Proof by induction. Basic of Counting. Iteration and recursion. Graph and tree representations and properties.

BSC225. Linear Algebra [3 CH]

Bases, vector spaces, and orthogonality. Inner product spaces. Matrix representations of linear systems. Matrix inversion. Linear transformations. Solution of linear systems. Numerical solution of non-linear systems. System transformations. Eigen systems.

BSC123. Probability and Statistics [3 CH]

Discrete probability. Continuous probability. Expectation and deviation. conditional probability. Stochastic Processes. Independence and Bayes' theorem. Random variables. Distribution functions. Moments and generating function. Probability distributions.

Correlation and regression: method of least squares, multiple regression, (linear generalized and rank) correlation.

CIS160. Introduction to Computer Sciences [3 CH]

Computer definition, different computer types, digital computer, analog computer, general-purpose computer, special purpose computer, hybrid computer. Computer organization, computer hardware, input/output units, storage media, computer memory types, arithmetic and logical unit (ALU), computer software, computer programming, computers and networking, software development systems, Information management, database management systems and applications, operating systems. Introduction to programming languages, General form of Pascal program: Expressions: arithmetic expressions. Simple data types: Real, integer, Boolean, character subrange, and enumerated Data types, input and output statements.

Conditional control structures: Compound statements, Boolean expressions, IF statements, Case statements. Repetition statements: While statement, repeat statement, For statement.

CIS150. Structured Programming [3 CH]

Co-requisite: CIS160. Introduction to Computer Sciences

Structured program development: Problem solving, decision structures, repetition structures, top-down and stepwise refinement. Subprograms: Procedures, functions. Structured data types: one-dimension arrays, two-dimension arrays. Sets. Records. Files: Text files random handling files. Dynamic data structures (Pointers). Recursion: Recursive functions, towers of Hanoi.

CIS270. Data Structures [3 CH]

Co-requisite: CIS150. Structured Programming

Abstract Data Types (ADT). Stacks: Definition and operations, implementation of stacks with array and records, applications of stacks. Queues: Definitions, implementation of circular queues, applications of queues. Linked lists: Singly linked lists, linked stacks, linked queues, doubly linked lists, application of linked lists. Tree structures, binary trees: binary tree traversals, binary tree search. Searching Definitions, sequential search. Sorting: Definitions, insertion sort, and selection sort. Hashing: Hash functions, perfect Hash functions.

CIS230. Operations Research [3 CH]

Linear programming: Formulations and graphical solution. Algebraic solution: the simplex method and dual-simplex method. Sensitivity analysis. Transportation and assignment problems. Integer programming: cutting-plane algorithms, branch and bound method. Dynamic programming: Examples of the dynamic programming. Models and computations, solution of linear programs by dynamic programs. Project scheduling by PERT-CPM.

CIS250. Object Oriented Programming [3 CH]

Co-requisite: CIS150. Structured Programming

Objects: Object classes and inheritance through, a design example, deriving an object-oriented design. Functional oriented design: Data flow diagrams, structure charts, data dictionaries deriving structure charts, design examples, concurrent systems design. User interface design: User interface design objectives, interface metaphors, WIMP (Window, Icons, Menus, and Pointing) interfaces using color displays.

CIS240. Statistical Analysis [3 CH]

Co-requisite: BSC123. Probability & Statistics

Sampling distributions. Estimation: points estimates, confidence interval estimates (for means, proportions, differences, sums, variances, and variance ratios), maximum likelihood estimates. Hypothesis tests: Null hypothesis, type I and type II errors, level of significance, special tests of significance for large or for small samples, operating characteristic curves, quality control chart, fitting theoretical distributions to sample frequency distributions, goodness of fit.

CIS260. Logic Design [3 CH]

Co-requisite: BSC121. Physics I

Basic logic concepts: Logic states, number systems, Boolean algebra, basic logical operations, gates and truth tables. Combinational logic: Minimization techniques, Multiplexers and de-Multiplexers, encoders, decoders, adders and subtractors, look-ahead carry, comparators, programmable logic arrays and memories, design with MSI, logic families, tri-state devices, CMOS and TTL logic interfacing. Sequential logic: Flip-flops, monostable multi-vibrators,

latches and registers, counters, shift registers. Analog to digital conversion, digital-to-analog conversion, data acquisition, microprocessors.

CIS340. Analysis & Design of Algorithms [3 CH]

Co-requisite: CIS150. Structured Programming

Algorithm concept. Analysis and complexity. Design methods: Divide and conquer: The general method, binary search, merge sort, quick sort, selection, matrix multiplication. Greedy method: The general method, minimum spanning Trees. Dynamic programming: The general method, shortest paths, optimal search trees, and the traveling salesman problem. Backtracking: The general method, The 8-queens Problem. NP-hard and NP-complete problems: Cook's theorem, NP-hard graph problems.

CIS243. Artificial Intelligence [3 CH]

Co-requisite: CIS150. Structured Programming

Artificial and Human intelligence: Domains of AI-symbolic processing: Semantic nets, modeling, model-based reasoning, frames. Inference techniques: Implication, forward and backward chaining, inference nets, predicate logic, quantifiers, tautology, resolution, and unification. Rule based systems: Inference engine, production systems, problem solving, planning, decomposition, and basic search techniques. AI languages: Symbolic and coupled processing prolog: Objects and relations, compound goals, backtracking, search mechanism, dynamic databases, Lisp: program structure and operations, functions, unification, memory models. Fields of AI: heuristics and game playing, automated reasoning, problem solving, computational linguistics and natural language processing, computer vision, robotics. AI based computer systems: Sequential and parallel inference machines, relation between AI and artificial neural nets, fuzzy systems, neural networks.

CIS220. Computer Organization & Architecture [3 CH]

Co-requisite: CIS260. Logic Design

Basic computer organization and design: Computer instructions and their codes, timing and control, execution of instructions. Input, output and interrupt. Assembly language: Programming loops, programming arithmetic & logic operations, subroutines, I/O programming. Central processor organization: Processor bus organization. Arithmetic logic unit, stack organization. Instruction formats. Addressing modes. Data transfer and manipulation, program control. Micro-program control organization: Control memory. Address sequencing. Arithmetic processor design and algorithms: Comparison and subtraction of unsigned binary numbers, addition and subtraction algorithms, multiplication and division algorithms. Input/output organization: Peripheral devices, asynchronous data transfer, direct memory access. Memory organization: Auxiliary memory, virtual memory, cache memory, memory management hardware. Pipeline and vector processing. Multiprocessors.

CIS353. Operating Systems [3 CH]

Co-requisite: CIS220. Computer Organization & Architecture

Introduction Operating system structures: System components, operating system services, system structure, virtual machines, system design and implementation, system generation. Concurrent processes: Process concept, the producer/ consumer problem, the critical section problem, semaphores, language constructs, inter-process communication. CPU scheduling: Scheduling concepts, performance criteria, scheduling algorithm. Memory management: Multi programming with fixed partitions, multiprogramming with variable partitions, paging, segmentation. Secondary storage management: Physical characteristics, device directory, free

space management, allocation methods, disk scheduling. File systems: File concept, access methods, directory systems, file protection.

CIS280. Database Management Systems [3 CH]

Co-requisite: CIS150. Structured Programming

An overview of database management; what is a database system, operational data, data independence, relational systems and others. Architecture of a database system: The three levels of architecture, the external level, the conceptual level, the internal level, mappings, the database administrator, the database management system. The internal level: Database accesses, page sets and files, indexing. Hashing, pointer chains, comparison techniques. An overview of DB2: Relational databases, the SQL language, major system components. Relational algebra: A syntax for the relational algebra, traditional set operations, special relational operations. Relational calculus: Tuple-oriented relational calculus, relational calculus vs. relational algebra, domain-oriented relational calculus, query-by-examples. Data definition: Base tables, indexing. Data Manipulation: Simple queries, join queries, built-in functions, advanced features, update operations. The system catalog: Querying the catalog, updating the catalog. View: View definition, DML operations and view, logical data independence, advantages of views. Embedded SQL: Operations not involving cursors, operations involving cursors, a comprehensive example, dynamic SQL. Database environment: Recovery and concurrence security and integrity, database product family.

CIS290. System Analysis & Design [3 CH]

Co-requisite: CIS280. Database Management Systems

Fundamental concepts, system definition, user definition, the different types of users, communication gap, system analyst, system management, structure system analysis, system analysis tools data flow diagram (DFD), data dictionary, English structure, decision tables, decision trees. The system life cycle, problem definition and modules, feasibility studies. Source and destination of data, stores, development plan, analysis phase, IPO chart, generating alternatives. Design methods, automation boundary, alternative implementations, system flow chart, system components, cost/benefit analysis, implementation schedule, physical elements, programs, files, manual procedure and training, forms. Analysts recommendation, logic of the process, detailed design, identifying options, system control program, screens, reports and files, test plan, implementation and maintenance.

CIS380. Software Engineering [3 CH]

Co-requisite: CIS150. Structured Programming

Introduction: Well-engineered software, the software process, software evolution, and software reliability. Human factors in software engineering: Human diversity, knowledge processing, group working. Software specification and system modeling: The software requirements document, requirements evolution, system contexts, viewpoint analysis, model description, real-time system modeling, data modeling. Requirements definition and specification: Requirements specification, nonfunctional requirements definition. Requirements validation and prototyping: The prototyping process, prototyping techniques. Formal specifications, algebraic specification. Model based specification. Software design: Top-down design, systems design, design decomposition, software design quality, design description languages.

CIS365. Computer Networks [3 CH]

Co-requisite: CIS160. Introduction to Computer Sciences

Introduction: The use of computer networks, network structure, network architecture, the ISO reference model, examples of networks. Network topology: Connectivity analysis, delay analysis, backbone design, local access network design. The physical layer: The theoretical basis for data communication, the telephone system, transmission and multiplexing, terminal handling errors. The data link layer: Elementary data link protocols, sliding window protocols, analysis of protocols. The network layer: Virtual circuits and datagrams, routing algorithms, satellite packet broadcasting. Local networks: Carrier sense networks, ring networks, shared memory systems. The transport and session layers: Transport protects design issues, interconnection of packet-switching networks. The presentation layer: network security and privacy, text compression, virtual terminal protocols, file transfer protocols. The application layer: Distributed database systems, distributed computations.

PRO400. Project [6 CH]

Students are allowed to choose among a number of projects suggested by the different staff members. The general aim of the project is to allow each student to integrate all the disciplines he has studied in a unified chunk of knowledge. On the behavioral side, students are allowed to work in a team so as to practice working in a collaborative environment. This emphasizes also a proper documentation and presentation procedure.

SCO311. Computer Graphics [3 CH]

***Co-requisite*: CIS150. Structured Programming, BSC225. Linear Algebra**

Introduction to computer graphics hardware, algorithms, and software. Graphics Programming, Output primitives and their attributes. 2D/3D Geometric transformations. 2D/3D Viewing. Hidden surface removal. Light and shading. Curves and Surfaces. 3D Geometric Modeling. Animation.

SCO312. Modeling & Simulation [3 CH]

***Co-requisite:* CIS150. Structured Programming**

Basic simulation modeling. Nature of simulation. System models & simulation, discrete event simulation. Simulation of a single-server queuing system. Simulation of an inventory system. List processing in simulation. Simulation languages. Simulation of time-sharing systems. Simulation output data and stochastic processes. Building valid and credible simulation models. Principles of valid simulation modeling. Verification of simulation computer programs. An approach for developing valid & credible simulation models. Statistical procedures for computing real-world observation & simulation output data. Some practical considerations: Selecting input probability distributions. Random number generators. Generating random variables. Output data analysis for a single system.

SCO313. Numerical Computing [3 CH]

***Co-requisite:* CIS150. Structured Programming, BSC225. Linear Algebra**

This course includes elements of error analysis and the sources of error, real roots of an equation, polynomial approximation by finite difference and least square methods, interpolation, quadrature, numerical solution of ordinary differential equations, numerical integration, and numerical solutions of systems of linear equations. The student should expect to program a computer in addition to using a graphing calculator.

Much of applied mathematics requires computation. Numerical Analysis explores the theory required when entrusting computers with huge, complicated, yet vital calculations. Our questions include the following: When is computation necessary? What kinds of errors can be

introduced by computers? How quickly will give a working algorithm? How accurate will it be?

SCO321. Digital Signal Processing [3 CH]

Co-requisite: **BSC125. Calculus II**

Signal processing is the treatment of signals to enable detection, classification, transmission or enhancement. This course aims to give the student a thorough grounding in the theoretical and practical aspects of signal processing. The course is intended to cover the following topics: 1) signals and systems which include basic elements of signal processing, concepts of frequency in Analog and Digital Signals, sampling theorem, Quantization, time signals, systems, Analysis of discrete time LTI systems, Z transform, Convolution (linear and circular), Correlation; 2) Frequency transformations which include introduction to DFT, Properties of DFT, Filtering methods based on DFT – FFT Algorithms, use of FFT in Linear Filtering, DCT and wavelets; 3) IIR filter design which includes structures of IIR, Analog filter design, Discrete time IIR filter from analog filter, IIR filter design by Impulse Invariance, Bilinear transformation, Approximation of derivatives and (HPF, BPF, BRF) filter design using frequency translation; 4) FIR filter design which includes structures of FIR, Linear phase FIR filter, Filter design using windowing techniques, Frequency sampling techniques and Finite word length effects in digital Filters; 5) Applications which include brain computer interface (BCI), speech compression and biological signals as biometric traits and as a tool for diagnosis.

SCO322. Machine Learning [3 CH]

***Co-requisite*: BSC123. Probability and Statistics**

This course provides a broad introduction to machine learning and statistical pattern recognition. Topics include supervised learning (generative/discriminative learning, parametric/non-parametric learning, support vector machine); unsupervised learning (clustering, dimensionality reduction, kernel methods); learning theory (bias/variance tradeoffs; VC theory; large margins); reinforcement learning and adaptive control. The course will also discuss some of the recent applications of machine learning, such as robotic control, data mining, autonomous navigation, bioinformatics, speech recognition, and text and web data processing.

SCO411. Neural Networks & Deep Learning [3 CH]

***Co-requisite*: CIS243. Artificial intelligence**

Introduction and a historical review: Overview of neuro-computing, history of neuro-computing. Neural networks concepts: Basic definition, processing elements, Activation functions, Architecture or structure. Learning laws: Error-correction learning, Competitive learning, Hebbian learning, Stochastic learning. Linear classification, optimization, gradient descent, Multi-layer Perceptrons, back-propagation neural network. Convolutional Neural Networks (CNN): history, Convolution and pooling, Activation functions, initialization, dropout, batch normalization, CNN Architectures. Recurrent Neural Networks (RNN): Long-Short-term Memory (LSTM).

SCO421. Computer Vision [3 CH]

***Co-requisite*: CIS243. Artificial Intelligence**

Computer Vision is a branch of artificial intelligence that deals with systems that can interact intelligently with the outside world through visual perception. It deals with necessary theory and skills for automatic analysis of digital images, videos and 3D scenes. The course aims to cover topics such as image acquisition, representation, processing and properties. Image

segmentation approaches, such as thresholding, edge-based, region-based, clustering-based and graph-based algorithms, along with their defining characteristics, strengths, and weaknesses. 2d object recognition based on contour-based, region-based shape representations and machine learning methods. Feature-extraction algorithms on real data, e.g., an edge or corner detector and evaluate their performance. Motion and video analysis and their applications such as tracking, video segmentation and activity recognition. 3D models processing such as segmentation, reconstruction

SCO422. Computational Geometry [3 CH]

***Co-requisite*: SCO311. Computer Graphics**

Design and analysis of efficient geometric algorithms: Convexity, triangulation, segment intersection, partitioning, and point location. Voronoi and Delaunay diagrams. Intersection and visibility problems. Recent developments using random sampling methods. Geometric data structures of general usefulness in geometric computing, and the conceptual primitives appropriate for manipulating them. Impact of numerical issues in geometric computation. Applying different algorithmic techniques: Incremental algorithms, incremental insertion. Plane sweep algorithm. Divide and concur algorithm. In addition to some applications as motion planning, visibility preprocessing, model-based recognition, and GIS.

SCO431. Computational Biology [3 CH]

***Co-requisite*: CIS340. Analysis & Design of Algorithms**

It covers basic concepts in statistics, mathematics, and computer science needed to effectively use bioinformatics resources and understand their results. Specific topics covered include sequence data, searching and alignment, structural data, genome sequencing, genome analysis, genetic variation, gene and protein expression, biological networks and pathways, computational cell biology, computer models of population dynamics, biochemical kinetics, cell pathways, neuron behavior, and stochastic simulations.

SCO432. Multimedia Engineering [3 CH]

***Co-requisite*: SCO311. Computer Graphics**

Introduction to multimedia. Image data representation. Color in image and video. Fundamental concepts in video. Basics of digital audio. Encoding and compression. Lossless compression techniques. Lossy compression techniques. Compression standards. Multimedia Networking. Voice over IP, Video over IP. Quality of service. Types of multimedia Applications. Content distribution networks.

SCO433. Game Design &Implementation [3 CH]

***Co-requisite*: SCO311. Computer Graphics**

Introduction. The process of game design and development. Game Formal Elements. Game dramatic elements (Game world, character development), Story telling and narratives. Gameplay and level design. System dynamics and core mechanics. Game Balancing. Game Genres. Game theory in video games. AI for game development.

SCO434. Multidimensional Data Models [3 CH]

***Co-requisite*: SCO312. Modeling & Simulation**

The aim of this course to deliver intuitive, interactive, and high-performance access to large volumes of data. Firstly, the student will design and develop dimensions to browse data with hierarchy memberships. Then explore ways to assemble these dimensions in order to analyze measures in cubes. Also, the students will get details on how to enhance the cubes with business

logic; creating calculated members, named sets, scoped assignments, and key performance indicators (KPIs). You will learn how to manage and optimize multidimensional databases and compare between tabular and multidimensional models.

SCO435. Computational Robotics [3 CH]

***Co-requisite*: CIS220. Computer Organization & Architecture**

This course presents a general introduction to robotics from a computational perspective with a focus on mobile robots. It covers basic computational algorithms and techniques used in robotics including: robot Locomotion, non-visual sensors and algorithms, uncertainty modeling, data fusion, state space models, Kalman filtering, visual sensors, sampling theory, image features, depth reconstruction, multiple view geometry, Motion planning. Planning collision-free motions, active vision, reasoning, spatial decomposition, geometric representations, topological representations, Path planning, Spatial uncertainty, pose maintenance, correlation-based localization, sensorial maps, task planning and task interference, multi-robot coordination, optimization techniques, swarm algorithm, Recent robot applications.

SCO436. Computer Animation [3 CH]

***Co-requisite*: SCO311. Computer Graphics**

Introduction. Key-framing. Storyboarding. Animation software. Digital animation techniques. Interpolation and basic animation techniques. Orientation representation and interpolation using quaternions. Path following. Speed control. Cameras and their attributes. Shape deformation techniques. Hierarchical Modeling of articulated objects. Forward and inverse kinematics. physically based dynamics modeling. Motion capture. Scene composition, lighting, and sound track generation. Rendering and camera tracking techniques. Animation of natural phenomena. Flocking behavior.

SCO437. Computational Intelligence [3 CH]

***Co-requisite*: BSC123. Probability and Statistics**

The aim of this course is to present to the students; concepts, models, algorithms, and tools for development of intelligent systems. Example topics include artificial neural networks, genetic algorithms, fuzzy systems, swarm intelligence, colony optimization, artificial life, or hybridizations of the above techniques. This domain is called Computational Intelligence and is a numerical interpretation of biological intelligence. Once acquired the basic knowledge, the students are ready to go through more interesting and powerful computational intelligence approaches such as hybrid techniques: neuro-fuzzy, genetic-fuzzy systems, fuzzy inductive reasoning, fuzzy and heterogeneous neural networks or neural networks trained by means of evolutionary algorithms.

SCO438. Computer Forensics [3 CH]

***Co-requisite*: CIS243. Artificial Intelligence**

Computer forensics involves the investigation of computer-related crimes with the goal of obtaining evidence to be presented in a court of law. It specifically covers topics of digital forensic processes, hardware forensics, digital forensic tools, forensic readiness, networks forensics, live forensics, professionalism and ethics. In addition, it will further gain in-depth knowledge of privacy, cyber forensics, cyber law and cyber warfare and/or terrorism, among other aspects relevant to digital forensics.

SCO439. Quantum Computing [3 CH]

***Co-requisite*: BSC225. Linear Algebra**

It will provide an introduction to the theory of quantum computing and information. The topics that will be covered are include 1) the fundamental elements of quantum information processing (qubits, unitary transformations, density matrices, measurements); 2) entanglement, protocols for teleportation, the Bell inequality, 3) basic quantum algorithms such as Shors factoring and Grovers search, and 4) basic quantum data compression and error correction.

SCO440. Quantum Cryptography [3 CH]

***Co-requisite*: SCO438. Computer Forensics**

It focuses on the ways in which quantum mechanics can be used to create secure lines of communication. Topics include: From essential tools to the first quantum protocol, the power of entanglement, Quantifying information, from imperfect information to (near) perfect security, distributing keys, Quantum key distribution protocols, Quantum cryptography using untrusted devices, Quantum cryptography beyond key-distribution, and Perfect security from physical assumptions.