



**Higher Institute for Computers & Information Technology  
Department of Computer Science**

**Computer Science  
Undergraduate Program**

**Credit Hours Program Specification**

**Version 1**

**2023-2024**

**Approvals**

**Coordinator:**

**Name : A.Prof.Dr. Abd El-Latif Hussein**

**Signature :**

**Head of Department:**

**Name : A.Prof. Dr. Ahmed El Abbassay**

**Signature :**

## Revision History

Date	Version	Description	Author
	V 1.0	Initial version	Dr. Ahmed Elabbassy
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		-	

\* NAQAAE: National Authority for Quality Assurance and Accreditation of Education

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## A. BASIC INFORMATION

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1. Program Title	Bachelor of Computer Science
2. Program Type	Credit Hours
3. Department	Computer Science
4. Coordinator	Dr. Ahmed Elabbasy
5. External Evaluator	
6. Last Date of Approval	

## B. PROFESSIONAL INFORMATION

### 1. Department aims

#### Program Vision

We look forward to being among the distinguished programs at the national and regional level in the field of computer science, with a continuous commitment to supporting scientific research and community development.

#### Program Mission

Preparing a knowledgeable, skilled and professional graduate to meet the needs of the labor market locally and regionally in the field of computer science, developing the educational and administrative environment to keep abreast of scientific and technological developments, and the continuous development of scientific research and community and environmental services in a way that supports the institute's competitive position and achieves a high level of satisfaction for all societal parties.

#### Department Aims

Department aims are A brief statement setting out the intention in providing the degree program in terms of the scope of the subject, and the overall learning outcomes sought.

The overall aims of the computer science program are:

1. Preparing specialized graduates to meet the needs of the labor market and able to compete locally and internationally.
2. Create a supportive educational and research environment.
3. Continuous development of the skills of teaching staff and the supporting staff.
4. Build effective collaboration with the community.

The Computer Science Program aims are articulated through statements of graduate attributes in compliance with NARS:

- Attributes of Computing and Information Programs Graduates; and
- Attributes of Computer Science Graduate.

From graduate attributes perspectives, aims of our BSc Degree program in Computer Science are:

- |   |
|---|
| 1. To develop, in a flexible and progressive structure, students' knowledge and understanding of fundamental areas of computer science such as: algorithms, design and analysis, computational theory, computer architecture and software-based systems, with the ability to use this knowledge to devise, specify, design, implement, test, document and critically evaluate computer-based systems. |
| 2. To provide students with a sound understanding and how to apply mathematics, science to real world problems; as well as to analyze and interpret data.   |
| 3. To provide students with the analytic skills necessary to effectively evaluate the relative merits of software and computer systems, and algorithmic approaches.   |
| 4. To provide students with a sound understanding and how to apply a wide range of principles and tools of software engineering, such as design methodologies, choice of algorithm, language, software libraries and user interface technique.  |
| 5. To equip students with state-of-the-art knowledge and understanding of algorithms and data structures, computer organization and architecture, programming language concepts, networks, artificial intelligence, graphics, natural language processing, data mining, human computer interfaces, and databases, and identify and define the computing requirements for its solution.                |
| 6. To give students the opportunity to deepen their technical expertise in designing, implementing, and evaluating a computer-based systems, process, component or program.   |
| 7. To develop the students' ability to use knowledge and understanding in the modeling and design of computer-based systems in a way that demonstrates comprehension of the tradeoff involved in design choices.  |
| 8. To prepare students for working effectively in teams in designing and implementing software systems and to equip them with management skills to be able to carry out a work plan with minimal supervision  |
| 9. To develop the students understanding of the key ethical, moral, legal issues affecting computer science and their responsibilities as computer science professionals.   |
| 10. To develop the students' ability to communicate, present and document ideas and concepts clearly and in an organized manner.  |
| 11. To equip the students with independent learning skills and encourage an appreciation of the importance to computer science professionals of continuing professional development and lifelong learning.  |

## **B. PROFESSIONAL INFORMATION**

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### **2. Intended learning outcomes (ILOs)**

The program provides students with opportunities to develop and demonstrate knowledge and understanding, intellectual, professional and practical and transferable skills as listed below. These outcomes have been developed with reference to the National Academic Reference Standards (NARS) for COMPUTER SCIENCE, 1st Edition, October 2010 benchmark statement.

Learning outcomes are statements on what successful students should achieve as the result of learning. They threshold statements of achievement and are linked to the knowledge, understanding and skills that a student will have gained on successfully completing a program

## 2. Intended learning outcomes (ILOs)

### A- Knowledge and understanding

On successful completion of this program, graduates should be able to:

A1	Understand the essential mathematics and physics relevant to computer science.
A2	Understand the concepts of the different high-level programming languages.
A3	Show a critical understanding of Requirements, practical constraints and computer-based systems.
A4	Demonstrate basic knowledge and understanding of a core of analysis, algebra, applied mathematics and statistics.
A5	Recognize the basis of data qualitatively and/or quantitatively.
A6	Know and understand the principles and techniques of a number of application areas informed by the research directions of computer science.
A7	Show a critical understanding of the principles of artificial intelligence, image Processing, Machine Learning, Neural Networks, and Virtual Reality.
A8	Understanding fundamental topics of computer systems especially hardware architectures and operating System .
A9	Understanding of fundamental topics in computer science, including software architectures, software engineering principles and methodologies, and software tools.
A10	Select advanced topics to provide a deeper understanding of some aspects of the hardware systems design, computer security, Cloud Computing, and compiler theory.
A11	Select advanced topics to provide a deeper understanding of some aspects of object-oriented analysis and design, and software engineering.
A12	Select advanced topics to provide a deeper understanding of some aspects of the Game Design & Development, Geographic Information Systems, and computer graphics & animation.
A13	Demonstrate strong knowledge of fundamentals of programming and the construction of computer-based systems.
A14	Demonstrate strong knowledge of fundamentals of Data Warehousing, data structures and algorithms.
A15	Select advanced topics to provide a deeper understanding of some aspects of the operating systems, Parallel Processing, Real Time Systems.
A16	Provide a deeper understanding of legal, professional, ethical issues and moral aspects of the exploitation of computing.
A17	Determine the tools, practices and methodologies used in the specification.
A18	Identify the methods used in defining and assessing criteria for measuring the extent to which a computer system is appropriate for its current deployment and future evolution.
A19	Recognize the current and underlying technologies that support computer processing and inter-computer communication.
A20	Describe the principals of generating tests which investigate the functionality of computer programs and computer systems and evaluating their results.
A21	Identify Modeling and design of computer-based systems bearing in mind the trade-offs
A22	Define criteria and specifications appropriate to specific problems, and plan strategies for their solution.
A23	Understand of abroad context within computing including issues such as quality, reliability... (NARS General K7).

## 2. Intended learning outcomes (ILOs)

### B- Intellectual skills

On successful completion of this program, graduates should be able to:

<b>B1</b>	Define traditional and non-traditional problems, set goals towards solving them, and observe results.
<b>B2</b>	Perform comparisons between (algorithms, methods, techniques, etc.).
<b>B3</b>	Perform classifications of (data, results, methods, techniques, algorithms, etc.).
<b>B4</b>	Identify attributes, components, relationships, patterns, main ideas, and errors.
<b>B5</b>	Summarize the proposed solutions and their results.
<b>B6</b>	Restrict solution methodologies upon their results.
<b>B7</b>	Establish criteria, and verify solutions.
<b>B8</b>	Identify a range of solutions and critically evaluate and justify proposed design solutions.
<b>B9</b>	Solve computer science problems with pressing commercial or industrial constraints.
<b>B10</b>	Generate an innovative design to solve a problem containing a range of commercial and industrial constraints.
<b>B11</b>	Use investigative skills to research new and novel aspects of their work.
<b>B12</b>	Create and/or justify designs to satisfy given requirements (synthesis, evaluation, application).
<b>B13</b>	Analyze and evaluate a range of options in producing a solution to an identified problem.
<b>B14</b>	Perform problem analysis from written descriptions; derive requirements specifications from an understanding of problems (analysis, synthesis).
<b>B15</b>	Apply the concepts, principles, theories and practices underpinning computing as an academic discipline.
<b>B16</b>	Define and assess criteria to measure the appropriateness of a computer system for its current deployment and future evolution, and to interpret the results thereof.
<b>B17</b>	Synthesize ideas, proposals and designs effectively using rational and reasoned arguments for presentation to a range of audiences.
<b>B18</b>	Evaluate the results of tests to investigate the functionality of computer systems.
<b>B19</b>	Address and apply professional, moral and ethical issues within the discipline.
<b>B20</b>	Interpreting and analyzing the basis of data qualitatively and/or quantitatively.



## 2. Intended learning outcomes (ILOs)

### C- Professional and practical skills

On successful completion of this program, graduates should be able to:

<b>C1</b>	Use appropriate programming languages and design methodologies.
<b>C2</b>	Use appropriate web-based systems, tools and design methodologies.
<b>C3</b>	Use appropriate database systems.
<b>C4</b>	Perform independent information acquisition and management, using the scientific literature and Web sources.
<b>C5</b>	Specify, design, and implement and manage computer-based systems.
<b>C6</b>	Evaluate systems in terms of general quality attributes and possible trade-offs presented within the given problem.
<b>C7</b>	Apply the principles of effective information management, information organization, and information-retrieval skills to information of various kinds, including text, images, sound, and video.
<b>C8</b>	Apply the principles of human-computer interaction to the evaluation and construction of a wide range of materials including user interfaces, web pages, and multimedia systems.
<b>C9</b>	Identify any risks or safety aspects that may be involved in the operation of computing equipment within a given context.
<b>C10</b>	Deploy effectively the tools used for the construction and documentation of software, with particular emphasis on understanding the whole process involved in using computers to solve practical problems.
<b>C11</b>	Make effective use of general computing facilities, plan and manage a project to complete within budget and schedule.
<b>C12</b>	Appreciate and manage the need for continuing professional development in recognition of the need for lifelong learning.
<b>C13</b>	Communicate effectively by oral, written and visual means. (NARS P S2)
<b>C14</b>	Operate computing equipment efficiently, taking into account its logical and physical properties.
<b>C15</b>	Prepare technical reports, and a dissertation, to a professional standard; use IT skills and display mature computer literacy. (NARS P S6)
<b>C16</b>	Apply tools and techniques for the design and development of applications.
<b>C17</b>	Develop a range of fundamental research skills, through the use of online resources, technical repositories and library-based material. (NARS P G5)
<b>C18</b>	Handle a mass of diverse data, assess risk and draw conclusions.
<b>C19</b>	Prepare and present seminars to a professional standard. (NARS P S4)

## 2. Intended learning outcomes (ILOs)

### D- General and transferable skills

On successful completion of this program, graduates should be able to:

<b>D1</b>	Communicate effectively by oral, written and visual means.
<b>D2</b>	Work effectively as an individual and as a member of a team.
<b>D3</b>	Collaborate effectively within multidisciplinary team.
<b>D4</b>	Work in stressful environment and within constraints.
<b>D5</b>	Demonstrate efficient IT capabilities.
<b>D6</b>	Lead and motivate individuals.
<b>D7</b>	Manage tasks and resources.
<b>D8</b>	Search for information and adopt life-long self-learning.
<b>D9</b>	Manage one's own learning and development.
<b>D10</b>	Communicate effectively with team members, managers and costumers.
<b>D11</b>	Exhibit appropriate numeracy skills in understanding and presenting cases involving a quantitative dimension.
<b>D12</b>	Use an appropriate mix of tools and aids in preparing and presenting reports for a range of audiences, including management, technical, users, industry or the academic community.

e- Appendix A1.1 illustrates the Map of Program objectives against Program ILOs

## B. PROFESSIONAL INFORMATION

### 3. Academic Standards

- 3.a External references for standards (Benchmarks) a.1 المعايير القومية القياسية الأكاديمية لقطاع الحاسبات والمعلومات  
National Academic Reference Standards (NARS) for  
COMPUTER SCIENCE, 1st Edition , October 2010  
<https://admin.naqaae.eg/api/v1/archive/download/4787>

The Academic standards were approved by the department council on: 2/5/2014 and by the institute board of directors- minutes No. (7) dated 21/5/2014 .

## **B. PROFESSIONAL INFORMATION**

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### **3. Academic Standards**

**3.b Comparison of provision to external references**

**3.b-1 Compliance to NARS Degree Programs & Career Requirements**

- **The curriculum of computer science program follows the NARS recommendations**
- **Appendix (3) illustrates NARS recommendations.**

## B. PROFESSIONAL INFORMATION

4. Curriculum Structure and Contents	
4.a Program duration	Four Levels - 8 Semesters- Summer Course
4.b Program structure	
4.b.1 No. of hours:	<b>Compulsory : 114 Elective : 21</b>
4.b.2 No. of hours of Math. & basic sciences courses	No. 57      % 44
4.b.3 No. of hours of courses of social sciences	No. 12      % 8
4.b.4 No. of hours of specialized courses	No. 66      % 48
4.b.5 Practical/Field Training: Programming & application skills	No. 30

### 4.b.7 Compliance with NARS

Curricula content by subject area

Total Number of Hours: 135

	Subject Area	NARS Requirements Tolerance %	CS Program	
			Hours	%
<b>A</b>	<b>Humanities, ethical and social sciences (Univ. Req.)</b>	<b>8-10</b>	<b>12</b>	<b>8</b>
<b>B</b>	<b>Mathematics and basic sciences</b>	<b>16-18</b>	<b>21</b>	<b>16</b>
<b>C</b>	<b>Basic computing sciences (Institution req.)</b>	<b>26-28</b>	<b>36</b>	<b>28</b>
<b>D</b>	<b>Applied computing Sciences (specialization)</b>	<b>28-30</b>	<b>39</b>	<b>28</b>
<b>E</b>	<b>Projects and Practical Training</b>	<b>6-10</b>	<b>6</b>	<b>6</b>
<b>G</b>	<b>Specialized Topics (Determined by the program's nature)</b>	<b>4-16</b>	<b>21</b>	<b>14</b>
	<b>Total</b>	<b>100</b>	<b>135</b>	<b>100%</b>

- Field Training: Upon completing a minimum of 30 approved credit hours, each student is mandated to participate in two summer internships, either on-campus or off-campus, as determined by the Institute's Board of Directors. These internships are conducted in subjects specified by the Board and are each of a duration of at least 120 hours, distributed over a minimum period of 4 weeks.
- An examination committee is responsible for evaluating the student's performance, rendering a determination of "pass" or "fail." Should a student not attain a passing grade, they will be required to undertake a compensatory project within their specialized field, equivalent in scope to the internship. The "pass" designation will only be granted upon the successful completion of this project.

## B. PROFESSIONAL INFORMATION

### 5. Programme Courses

#### 5.1 General Requirements: Humanities and Social Sciences: (12) Mandatory Approved Credit Hours distributed as follows:

Code No.	Course title	Credits	Teaching Hours			Prerequisite	
			L**	E**	P**	Code	Course
H 101	English Language	2	2	-	-		
H 102	Creative Thinking and Communication Skills	2	2	-	-		
H 103	Technical Report Writing	2	2	-	-	H 101	English Language
H 201	Work Ethics	2	2	-	-		
H 202	Business Administration	2	2	-	-		
H 204	Human Rights	2	2	-	-		

\*\* L: Lecture, P: Practical, E: Exercise

## B. PROFESSIONAL INFORMATION

### 5. Programme Courses

#### 5.2 Institute Requirements (57 Approved Credit Hours)

##### 5.2.1 Mathematics and Basic Sciences

(21) Mandatory Approved Credit Hours distributed as follows:

Code No.	Course title	Credits	Teaching Hours			Prerequisite	
			L**	E**	P**	Code	Course
BS 101	Calculus	3	2	2	-	-	-
BS 102	Linear Algebra	3	2	2	-	BS 101	Calculus
BS 103	Discrete Mathematics	3	2	2	-	BS 101	Calculus
BS 121	Physics	3	2	-	2	-	-
BS 131	Electronics	3	2	2	-	-	-
BS 205	Operations Research	3	2	2	-	BS 101	Calculus
BS 210	Statistics and Probabilities	3	2	2	-	BS 101	Calculus

\*\* L: Lecture, P: Practical, E: Exercise

#### 5.2 Institute Requirements (57 Approved Credit Hours)

##### 5.2.2 Fundamental Computer Science (36) Approved Credit Hours

(36) Mandatory Approved Credit Hours distributed as follows:

Code No.	Course title	Credits	Teaching Hours			Prerequisite	
			L**	E**	P**	Code	Course
CS 101	Intro to computer Science	3	2	-	2	-	-
CS 102	Computer Programming	3	2	-	2	CS 101	Intro to computer Science
CS 103	Intro to Information Systems	3	2	-	2	-	-
CS 121	Logic Design	3	2	-	2	BS 131	Electronics
CS 201	Data Structure	3	2	-	2	CS 102	Computer Programming
CS 203	Object-Oriented Programming	3	2	-	2	CS 102	Computer Programming
CS 206	Web Programming	3	2	-	2	CS 102	Computer Programming
CS 210	Systems Analysis and Design	3	2	-	2	CS 103	Intro to Information Systems
CS 211	File Processing	3	2	-	2	CS 102	Computer Programming
CS 220	Computer Organization & Assembly Language	3	2	-	2	CS 121	Logic Design
CS 250	Computer Networks	3	2	-	2	CS 220	Computer Organization
CS 323	Intro to Databases	3	2	-	2	CS 103	Intro to Information Systems

\*\* L: Lecture, P: Practical, E: Exercise

## B. PROFESSIONAL INFORMATION

### 5. Programme Courses

#### 5.3 Major Requirements (66 Approved Credit Hours)

##### 5.3.1 Mandatory Applied Computer Science (39) Approved Credit Hours (39) Mandatory Approved Credit Hours distributed as follows:

Code No.	Course title	Credits	Teaching Hours			Prerequisite	
			L**	E**	P**	Code	Course
CS 307	Logic Programming	3	2	-	2	CS 102	Computer Programming
CS 309	Mobile App Development	3	2	-	2	CS 206	Web Programming
CS 312	Analysis of Algorithms	3	2	-	2	CS 201	Data Structure
CS 315	Software Engineering	3	2	-	2	CS 210	Systems Analysis and Design
CS 321	Compiler Design & Theory	3	2	-	2	CS 220	Computer Organization
CS 331	Theory of Operating Systems	3	2	-	2	CS 220	Computer Organization
CS 340	Computer Graphics	3	2	-	2	CS 220	Computer Organization
CS 353	Fundamentals of Multimedia	3	2	-	2	CS 102	Computer Programming
CS 360	Artificial Intelligence	3	2	-	2	CS 312	Analysis of Algorithms
CS 413	Computer Security	3	2	-	2	CS 312	Analysis of Algorithms
CS 443	Digital Image Processing	3	2	-	2	CS 340	Computer Graphics
CS 455	Internet of things	3	2	-	2	CS 250	Computer Networks
CS 462	Machine Learning	3	2	-	2	BS 210	Statistics & Probabilities

\*\* L: Lecture, P: Practical, E: Exercise



## 5. Programme Courses

### 5.3 Major Requirements (66 Approved Credit Hours)

#### 5.3.2 Elective Specialized Topics, determined based on the student's preferences:

(21) Approved Credit Hours to be chosen by the student from the following elective courses:

Code No.	Course title	Credits	Teaching Hours			Prerequisite	
			L**	E**	P**	Code	Course
CS 300	Selected Topics – Level 3**	3	2	-	2	TBD	TBD
CS 313	Game Design & Development	3	2	-	2	CS 312	Analysis of Algorithms
CS 314	Human Computer Interaction	3	2	-	2	CS 102	Computer Programming
CS 332	Real Time Systems	3	2	-	2	CS 331	Theory of Operating Systems
CS 351	Simulation and Modeling	3	2	-	2	CS 312	Analysis of Algorithms
CS 361	Neural Networks	3	2	-	2	CS 307	Logic Programming
CS 400	Selected Topics-Level 4**	3	2	-	2	TBD	TBD
CS 405	Geographic Information System	3	2	-	2	CS 323	Intro to databases
CS 418	Parallel Processing	3	2	-	2	CS 250	Computer Networks
CS 432	Distributed Systems	3	2	-	2	CS 331	Theory of Operating Systems
CS 433	Cloud Computing	3	2	-	2	CS 250	Computer Networks
CS 444	Virtual Reality	3	2	-	2	CS 312	Analysis of Algorithms
CS 445	Computer Vision Systems	3	2	-	2	CS 443	Digital image processing
CS 463	Introduction to embedded systems	3	2	-	2	CS 220	Computer Organization
CS 470	Data warehousing	3	2	-	2	CS 323	Intro to databases

\*\* L: Lecture, P: Practical, E: Exercise

\*\* Course: Selected Topics

The scientific content and prerequisites for this course are determined by the Department Council and the Institute's Board of Directors.

## B. PROFESSIONAL INFORMATION

### 5. Programme Courses

#### 5.3 Graduation Project (6) Approved Credit Hours

##### 5.3.3 (6) Mandatory Approved Credit Hours distributed as follows:

Code No.	Course title	Credits	Teaching Hours			Prerequisite	
			L**	E**	P**	Code	Course
CS 498	Senior Project 1	3	1	2	2	The student must pass at least 70% of the hours required for graduation	
CS 499	Senior Project 2	3	1	2	2	CS 498	CS 498

\*\* L: Lecture, P: Practical, E: Exercise

**Mandatory Training** as per Article (22) of the Regulations.

**Appendix A1.3 illustrates Program ILOs and Program Courses cross references.**

#### 5.9 Contents of Program Courses

**Appendix (2) outlines the contents of Program Courses**

## B. PROFESSIONAL INFORMATION

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### 6. Academic Regulations and Conditions

#### **\*\*Article (1) Admission Requirements:\*\***

The program accepts students who have graduated from the General Secondary Education program with a science-oriented track (Science - Mathematics) in accordance with the established rules set forth by the relevant authorities. As for students who have graduated from the General Secondary Education program with a Science track, they are required to pass the "Mathematics 2" course within the timeframe specified by the competent authorities.

#### **\*\*Article (2) Transfer Conditions from Parallel Institutes and Colleges:\*\***

The Institute may admit transfers to the program from students of parallel institutes and colleges, as well as from students previously enrolled on an old list of the same institute, following a scientific comparison of the courses completed by the transferring student. Transfers are subject to the condition that they are not in their final year and have obtained a cumulative GPA of 75% or more of the required credit hours for graduation, in accordance with the conditions stipulated by the Ministry of Higher Education.

#### **\*\*Article (3) Transfer Conditions from Another Study Program:\*\***

Students are allowed to transfer from one study program to another, subject to a scientific comparison of the courses completed by the transferring student. This can be done a maximum of two times during the student's tenure at the institute, without violating the general transfer rules.

#### **\*\*Article (4) Academic Degrees:\*\***

A program graduate is conferred a Bachelor's degree in Computer Science. Specializations approved by the institute fall under this degree.

#### **\*\*Article (5) Language of Instruction:\*\***

The language of instruction in the program is either English or Arabic, depending on the nature of the course. Examinations are conducted in the same language as the instruction.

#### **\*\*Article (6) Academic Guidance:\*\***

The institute assigns an academic advisor from the faculty members to each student, who guides and assists the student in their academic choices, particularly in the courses they take. However, the student remains ultimately responsible for their choices. It is preferred that the advisor stays with the student until graduation.

#### **\*\*Article (7) Distance Learning:\*\***

Certain courses may be taught through electronic means, such as the internet, video conferences, or any other form of remote or hybrid education, subject to the approval of the Institute's Board of Directors and the Ministry of Higher Education. Regardless, the final exam is conducted within the institute premises, following the regulations set by the Ministry regarding interaction with lecturers, submitting reports and studies, in accordance with the nature of the courses.

#### **\*\*Article (8) Study System:\*\***

At least one week before the start of any academic semester, the institute announces the list

of courses that will be taught during that semester and opens the registration process for students. The Institute's Board of Directors determines the minimum and maximum number of students for each course based on the institute's capacities. Students enroll in the selected courses in coordination with their academic advisor, as long as the courses are available.

**\*\*Article (9) Course Drop and Add:\*\***

After completing the registration process, students are allowed to drop or add one or more courses within two weeks of the start of the semester, in accordance with the specified limits, without incurring any academic or financial obligations.

**\*\*Article (10) Enrollment Suspension:\*\***

The Institute's Board of Directors is permitted to suspend a student's enrollment for one or more semesters (up to a maximum of 4 academic semesters) if the student presents an acceptable reason preventing them from attending classes.

**\*\*Article (11) Academic Warning:\*\***

A student who fails to register within the first two weeks of the start of the academic semester, and who does not request an enrollment suspension, nor provides an excuse accepted by the Institute's Board of Directors, is prohibited from registering for that semester. An "Academic Warning" is issued to them.

**\*\*Article (12) Grading System:\*\***

The student is awarded a numerical and letter grade for each course based on the grade obtained in the course, in accordance with the following table:

Grade (Attributed to the Maximum Endpoint)	Numerical Grade	Letter Grade
96% and above	4	A+
92% - less than 96%	3.7	A
88% - less than 92%	3.4	A-
84% - less than 88%	3.2	B+
80% - less than 84%	3	B
76% - less than 80%	2.8	B-
72% - less than 76%	2.6	C+
68% - less than 72%	2.4	C
64% - less than 68%	2.2	C-
60% - less than 64%	2	D+
55% - less than 60%	1.5	D
50% - less than 55%	1	D-
less than 50%	0	F

Using this table, the calculation of a student's course points, semester GPA, and cumulative GPA is done as follows:

A. The student's course points are obtained by multiplying the number of approved credit hours of the course by the numerical grade the student achieved.

B. The semester GPA is calculated by dividing the total course points the student earned during the semester by the total number of approved credit hours for those courses.

C. The cumulative GPA is calculated by dividing the total course points the student has earned up to that date by the total number of approved credit hours for those courses.

Please note that the grading system and calculations may vary depending on the specific educational institution and its policies.

**\*\*Article (13) Minimum Approved Credit Hours per Semester:\*\***

The minimum approved credit hours that a student must register for in each academic semester is nine (9) hours. Exceeding this limit is allowed in exceptional cases, such as when a student is about to graduate, with the approval of the Institute's Board of Directors.

**\*\*Article (14) Maximum Approved Credit Hours per Semester:\*\***

The maximum approved credit hours that a student can register for in each academic semester, excluding the first semester for new students, is linked to their cumulative GPA as follows:

Cumulative GPA	Maximum
3 and above	21 credit hours
2 - less than 3	18 credit hours
1 - less than 2	15 credit hours
less than 1	12 credit hours

For a new student's first semester in the program, where they don't have a cumulative GPA yet, they are allowed to register for up to 21 credit hours.

Regarding the summer semester, if a student chooses to enroll, the maximum credit hours allowed are as follows:

Cumulative GPA	Maximum
3 and above	9 credit hours
less than 3	6 credit hours

**\*\*Article (15) Course Withdrawal:\*\***

A student is allowed to withdraw from one or more courses up until the end of the seventh week from the start of the semester, provided that the number of registered credit hours does not fall below the minimum registration limit (Article 13). In this case, the student's status will be recorded as "Withdrawn (W)" without affecting their cumulative GPA.

**\*\*Article (16) Types of Courses:\*\***

The program's courses are divided into two types: compulsory or mandatory courses and elective courses. A course, whether compulsory or elective, may have a prerequisite that must be successfully completed in order to register for the course. The prerequisite must be a compulsory course within the same program and its course code must be lower than that of the course.

**\*\*Article (17) Prerequisite Passing Condition:\*\***

The Institute's Board of Directors, based on the approval of the Department Council and the Program Director, may waive the prerequisite passing condition for registration in a certain course. This would allow the student to enroll in both the course and its prerequisite in the same semester, only in exceptional circumstances, such as graduation-related reasons. A failing student is also allowed to take the course and its prerequisite in the same semester.

**\*\*Article (18) Absence from the Final Exam:\*\***

If a student is absent from the final exam, they are considered to have failed the course. However, if they provide a compelling excuse within two days (excluding the exam day) after the exam, which is accepted by the Institute's Board of Directors, their status for that course will be recorded as "Incomplete (I)" in the records, without affecting their cumulative GPA.

**\*\*Article (19) Exam Disqualification:\*\***

A student who has attended less than 75% of the lectures and exercises for a course is disqualified from taking the final exam. In this case, the student is considered to have failed the course unless they present an acceptable excuse, approved by the Institute's Board of Directors. Their status will then be recorded as "Incomplete (I)" in the records, without affecting their cumulative GPA.

**\*\*Article (20) Course Retake:\*\***

A student is allowed to retake the same course multiple times, whether due to failing or to improve their cumulative GPA. The grade obtained in the retake is as follows:

- If the retake is due to failure, the student is awarded the grade they achieved, not exceeding the maximum limit of a B+ grade in the first retake, a C+ grade in the second retake, and a D+ grade in any subsequent retake.
- If the retake is for improvement, the student is awarded the grade they obtained in the latest retake. If this grade falls within the "Fail (F)" category and they retake the course again, the previous criteria apply (Section "A").

**\*\*Article (21) Academic Warning:\*\***

An academic warning is issued to a student if their cumulative GPA drops below 2.0. A student will be dismissed from the Institute if they receive four consecutive or six scattered academic warnings. In case a student is dismissed for any of these reasons and has completed at least 80% of the required credit hours, they are given another chance for two essential academic semesters (excluding summer semester). If the student fails to meet the graduation requirements during this period, they are permanently dismissed from the Institute.

**\*\*Article (22) Summer Training:\*\***

Each student, after completing at least 30 approved credit hours, must undergo a summer training (internally or externally) in subjects determined by the Institute's Board of Directors. Students must complete this training twice during their study period, with each session lasting at least 120 hours distributed over a minimum of four weeks. An examination committee will determine whether the student has "Passed" or "Failed" the training. If a student fails, they are assigned a compensatory project in their specialization equivalent to the training. The "Passed" status will not be given until the project is completed.

**\*\*Article (23) Graduation Project:\*\***

At the end of their Institute study, and after completing at least 70% of the required credit hours, each student must submit a graduation project in subjects determined by the relevant scientific department. Students must dedicate a period of at least four weeks after the final exams to work on their graduation project. The project is registered as two consecutive courses, each lasting 3 approved credit hours.

**\*\*Article (24) Bachelor's Degree Attainment:\*\***

A student is awarded a bachelor's degree upon fulfilling a minimum of 135 approved credit hours, provided their cumulative GPA does not fall below 2.0 and they comply with Article (14) throughout their study period. If either or both conditions are not met, the student will not be awarded the degree until they satisfy them.

**\*\*Article (25) Credit Hours for Non-Humanities Courses:\*\***

All non-humanities courses are worth 3 approved credit hours, consisting of 2 hours of lectures and 2 hours of practical exercises (counted as one approved credit hour).

**\*\*Article (26) Credit Hours for Humanities Courses:\*\***

All humanities courses are worth 2 approved credit hours, consisting of 2 hours of lectures.

**\*\*Article (27) Exam Duration:\*\***

The exam duration for all courses is 2 hours.

**\*\*Article (28) Maximum Grade:\*\***

The maximum grade for all courses is 100, divided into 60 for the final exam and 40 for coursework.

**\*\*Article (29) Implementation Date:\*\***

This regulation comes into effect from the date of issuance of the ministerial decision, and applies to students who join the program after its issuance or who transfer to it from other regulations through equivalence procedures.

## B. PROFESSIONAL INFORMATION

### 7- Evaluation of program intended learning outcomes

<b>Evaluator</b>	<b>Tool</b>	<b>Sample</b>
1- Senior students	Questionnaire	Refer to Quality Unit Manual/Reports
2- Alumni	Questionnaire	
3- Stakeholders (Employers)	Questionnaire	
4-External Evaluator(s)	Review Report	Attached
5- Other	-	



## B. PROFESSIONAL INFORMATION

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### 8- Teaching, learning and Assessment

#### 8-1 Teaching & learning methods

- Various teaching methods are used.
- To support the teaching process, the instructors are using the academy portal and the IT-based media like PowerPoint presentations.
- Students are encouraged to participate in group work and open discussions.
- Students will be provided with opportunities to sample the learning content of the Computer Science program. An online induction will ensure that they are prepared for study and are familiar with the learning environment and sources of support during their student journey.
- All students will have access to the Virtual learning environment, learning content, tools and activities related to their chosen program of study. Students will be able to select from two modes of study: web supported learning (online) or institution supported learning (Face To Face).
- The learning content will be designed to provide students with opportunities to engage, and encourage reflective and deep learning, with accessibility a key feature to enable all students to study across a range of mobile and media channels using the academy portal.
- All students will have access to the VLE (Virtual Learning Environment), with learning support and tools enabling them to monitor their progress, assessing fulfillment of learning outcomes and development of skills-based outcomes throughout the curriculum. The learning environment will provide a framework for the level of support selected by students, which involves local and online tuition services.
- To support the teaching process due to covid-19 pandemic the instructors are using the academy portal to upload lectures videos, labs videos and exchange assignments through academic mails
- To support the teaching process the instructors are using new teaching techniques in sessions to encourage students like problem solving and inductive learning
- The design, development and delivery of this program will be supported with training for:
  - Academic teams involved in the development of the materials and assessment;
  - Module Leaders;

**Teaching and learning methods**

<b>Teaching and learning Strategies</b>	<b>Teaching and learning methods</b>
Active Learning	Lectures
	Tutorial Exercises
	Practical Lab
	Discussions
Self – Learning strategy	Reading material
	Websites search
	Research and reporting
	Self-studies
Experimental strategy	Group work
	Presentation
Problem solving strategy	Problem solving/problem solving learning based
	Case study
Synchronous E-Learning	Virtual lab
	Virtual class
	Chat Room
	Video lectures
Asynchronous E-Learning	E-Learning
Blended Learning	Combination between methods of Synchronous E-Learning and Asynchronous E-Learning

**In addition to the following:**

- Supervision of Course practical project
- Feedback and guidance

**Appendix A1.4 Teaching and Learning methods vs. Program Courses**

## 8-2 Assessment

### Assessment

In line with our current General Regulations, the Academy may offer students alternative assessments where necessary. This includes holding online timed assessments in place of written quizzes, which are usually held at the academy portal.

- The system is in compliance with the NARS General Principles and guidelines for Effective Assessment
- Assessment of students is based, in the first place, upon examinations.
- A variety of assessment methods are adopted based around traditional academic techniques such as practical and essay-based coursework and exams. Assessment shall include opportunity for self-reflection and contain an element of performance monitoring to ensure student's perform to their abilities and will make full use of the Academy virtual learning environment.
- The semester work is assessed based on assignments, mid-term exam. Quizzes, lab. Work, seminar presentations, discussions and project reports.
- The coursework submission constitutes multiple, staged deliverables including, but not limited to: a project proposal, a preliminary report, weekly progress logs, a final report and a presentation.
- The coursework element(s) may consist of multiple items, online quizzes, one or more writing assignments and/or one or more programming assignments. The written examination is unseen and is two hours in length.
- The course catalogue defines explicitly the methods of assessment for each course.
- All courses carry the same weight (100 marks) except the graduation project courses which carry 200 marks (i.e. the graduation project is equivalent to two courses).

#### - Student assessment methods

Methods	Assessment
Pop Quiz (Formative assessment)	Give the students a quiz at the beginning, middle, or end of a lesson that involves just 5 to 10 questions, to assess the knowledge and understanding achieved by the student during lecture
Think-Pair-Share(Formative assessment)	Students spend one minute individually writing down key points from what they learned. They then pair up with a partner and compare notes, to assess the knowledge ,understanding and general skills achieved by student during lecture.
Participation	To assess the knowledge and understanding achieved by the student during the previous weeks.
Electronic Midterm Exam	To assess the knowledge and understanding achieved by the student during the previous weeks. (online on e-learning hub )
Pencil-to-Paper Final Exam	To evaluate what the student gain at the end of the course, and to assess: the knowledge and understanding, general skills, and intellectual skills.
Course Project	To allow students work in team, and to evaluate knowledge, understanding, intellectual, and transferable skills. (online on e-learning hub , FTF)
Electronic Course Work & Quizzes	To keep the student always in the course, and to evaluate knowledge, understanding, intellectual, and transferable skills.(online on e-learning hub)
Home works	To test and help student training on exams, to evaluate knowledge understanding, and intellectual skills.
Practical Exam	To measure the ability of students to design and implement a software program(FTF).

Project	The project assessment and the feedback received by the student, is designed to encourage consistent, well-structured activity and progress throughout the project.
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- Course Work & Quizzes:
  - o Short Exams, Assignments, Researches, Reports, Presentations on e-learning hub
  - o Class/Project discussion in virtual classroom
  - o Pop quiz
  - o think-pair share

**- Weighting of assessments**

According to regulations and requirements of the ministry of higher education, Courses fall into three categories:

**Category # 1: Courses with lab. Components**

**Weighting of assessments**

Mid-term exam &	15	%
Final-term written exam	60	%
Practical exam and project	15	%
Course Work & Quizzes	10	%
Total	100	%

**Category # 2: Courses with no lab. Components**

**Weighting of assessments**

Mid-term examination &	20	%
Course Work & Quizzes	20	%
Final term written exam	60	%
Total	100	%

**Category # 3: Graduation Project**

**Weighting of assessments**

Mid-term examination &	40	%
Final presentation, documentation &	60	%
Oral exam		
Total	100	%

## **B. PROFESSIONAL INFORMATION**

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### **10- Characteristics of computer science graduates**

Appendix (4) illustrates the characteristics of computer science graduates

## B. PROFESSIONAL INFORMATION

### 11- Computer Science Jobs

The work of the graduates from the computer science program falls into four categories in compliance with ACM/IEE Computing Curricula :

Designing and implementing software; devising new ways to use computers; developing effective ways to solve computing problems; and planning and managing organizational technology infrastructure.

1. **Software Developer/Engineer:** This role involves designing, coding, testing, and maintaining software applications and systems. Software developers/engineers work with programming languages, frameworks, and tools to create innovative software solutions.
2. **Data Scientist:** Data scientists analyze and interpret complex data to derive meaningful insights. They use techniques such as data mining, machine learning, and statistical analysis to solve business problems and make data-driven decisions.
3. **Web Developer:** Web developers specialize in creating and maintaining websites and web applications. They work with programming languages such as HTML, CSS, JavaScript, and frameworks like Angular, React, or Django.
4. **Systems Analyst:** Systems analysts bridge the gap between business requirements and technology solutions. They analyze organizational processes, gather requirements, and design information systems to meet business needs.
5. **Cybersecurity Analyst:** With the growing concern for data security, cybersecurity analysts play a crucial role in protecting computer systems and networks. They identify vulnerabilities, implement security measures, and respond to security incidents.
6. **Network Administrator/Engineer:** Network administrators/engineers manage and maintain computer networks within organizations. They are responsible for network infrastructure, connectivity, security, and performance optimization.
7. **Database Administrator:** Database administrators handle the design, implementation, and management of databases. They ensure data integrity, security, and availability while optimizing database performance.
8. **IT Project Manager:** IT project managers oversee the planning, execution, and delivery of IT projects. They coordinate resources, manage timelines, and ensure project success within budget and scope.
9. **Artificial Intelligence/Machine Learning Engineer:** AI/ML engineers develop and deploy machine learning models and algorithms. They work on tasks such as natural language processing, computer vision, and predictive analytics.
10. **Software Quality Assurance Engineer:** Quality assurance engineers ensure the quality and reliability of software applications. They develop and execute test plans, identify and report bugs, and work closely with development teams to improve software quality.
11. **Technical Consultant:** Technical consultants provide expertise and guidance to clients on technology solutions. They assess business requirements, recommend suitable technologies, and help implement and integrate systems.
12. **IT Entrepreneur/Startup Founder:** Some computer science graduates venture into entrepreneurship, starting their own technology-based companies or startups to develop innovative products or provide specialized services.

Appendix (5) illustrates the categories of jobs for computer science graduates

## C. APPENDICES

### Appendix (1): Program Matrices

#### A1.1 Map of Program aims against Program ILOs

Program aims	Intended learning outcomes (ILOs)			
	Knowledge and understanding	Intellectual skills	Professional and practical skills	General and transferable skills
1. Developing, in a flexible and progressive structure, students' knowledge and understanding of fundamental areas of computer science such as: algorithms, design and analysis, computational theory, computer architecture and software-based systems, with the ability to use this knowledge to devise, specify, design, implement, test, document and critically evaluate computer-based systems	A8, A9, A10, A11, A13, A14	B8, B9, B12, B15, B16, B18	C6, C9, C14, C18	D5, D11, D12
2. Providing students with a sound understanding and how to apply mathematics, science to real world problems; as well as to analyze and interpret data	A1, A4, A5	B1, B2, B3, B4	C9, C18	D11
3. Providing students with the analytic skills necessary to effectively evaluate the relative merits of software and computer systems, and algorithmic approaches.	A18, A20	B7, B8, B12, B16, B18	C6, C9, C18	D11
4. Providing students with a sound understanding and how to apply a wide range of principles and tools of software engineering, such as design methodologies, choice of algorithm, language, software libraries and user interface technique.	A2, A9, A17	B2, B3, B6	C1, C2, C3, C8, C10	D5, D12

Program aims	Intended learning outcomes (ILOs)			
	Knowledge and understanding	Intellectual skills	Professional and practical skills	General and transferable skills
5. Providing students with state-of-the-art knowledge and understanding of algorithms and data structures, computer organization and architecture, programming language concepts, networks, artificial intelligence, graphics, natural language processing, data mining, human computer interfaces, and databases, and identify and define the computing requirements for its solution.	A3, A6, A7, A8, A9, A12, A19, A21, A22	B1, B4	C11, C14	D5, D11
6. Giving students the opportunity to deepen their technical expertise in Designing, implementing, and evaluating a computer-based systems, process, component or program.		B8, B10, b13, B14, B17	C1, C2, C3, C5, C8, C10, C16,	D5
7. Developing the students' ability to use knowledge and understanding in the modeling and design of computer-based systems in a way that demonstrates comprehension of the tradeoff involved in design choices.		B8, B10, B13, B14, B17	C1, C2, C3, C5, C8	D5
8. Preparing students for working effectively in teams in designing and implementing software systems and to equip them with management skills to be able to carry out a work plan with minimal supervision	A15	B19	C5, C11	D2, D3, D4, D5, D6, D7, D11
9. Developing the students understanding of the key ethical, moral, legal issues affecting computer science and their responsibilities as computer science professionals.	A15, A16	B19	C11	D2, D3, D6,
10. Developing the students' ability to communicate, present and document ideas and concepts clearly and in an organized manner.		B5	C13, C15, C19	D1, D10, D11, D12



Program aims	Intended learning outcomes (ILOs)			
	Knowledge and understanding	Intellectual skills	Professional and practical skills	General and transferable skills
11. Equipping the students with independent learning skills and encourage an appreciation of the importance to computer science professionals of continuing professional development and lifelong learning		B11	C4, C7, C12, C17	D5, D8, D9

## C. APPENDICES

### Appendix (1): Program Matrices

#### Appendix A1.2: Matching the academic reference standards to the program's ILOs

##### A1.2.1 Knowledge and Understanding

National Academic Reference Standards	program ILOs
General ILOs (For Computing and Information programs):	
Knowledge and Understanding of:	
1. (K1) Essential facts, concepts, principles and theories relating to computing and information and computer applications as appropriate to the program of study	A7, A8, A9, A13, A14
2. (K2) Modelling and design of computer-based systems bearing in mind the trade-offs	A21
3. (K3) Tools, practices and methodologies used in the specification, design, implementation and evaluation of computer software systems	A17
4. (K4) Criteria and specifications appropriate to specific problems, and plan strategies for their solution	A22
5. (K5) The extent to which a computer-based system meets the criteria defined for its current use and future development	A18
6. (K6) The current and underlying technologies that support computer processing and inter-computer communication	A19
7. (K7) Principles of generating tests which investigate the functionality of computer programs and computer systems and evaluating their results	A20
8. (K8) Management and economics principles relevant to computing and information disciplines	A15
9. (K9) Professional, moral and ethical issues involved in the exploitation of computer technology and be guided by the appropriate professional, ethical and legal practices relevant to the computing and information industry	A16
10. (K10) Current developments in computing and information research	A6
11. (K11) Requirements, practical constraints and computer-based systems	A3
Specific ILOs (For Computer Science programs)	
1. (A1) Understand the essential mathematics relevant to computer science.	A1
2. (A2) Use high-level programming languages	A2
3. (A3) Demonstrate basic knowledge and understanding of a core of analysis, algebra, applied mathematics and statistics	A4
4. (A4) Interpret and analyzing data qualitatively and/or quantitatively	A5

National Academic Reference Standards	program ILOs
5. (A5) Know and understand the principles and techniques of a number of application areas informed by the research directions of the subject, such as artificial intelligence, natural language processing, data mining, databases and computer graphics.	A6
6.(A6) Show a critical understanding of the principles of artificial intelligence, image, and pattern recognition	A7
7. (A7)Understand the fundamental topics in Computer Science, including hardware and software architectures, software engineering principles and methodologies, operating systems, compilers, parallel and distributed computing, systems and software tools.	A8, A9
8. (A8)Select advanced topics to provide a deeper understanding of some aspects of the subject, such as hardware systems design, object-oriented analysis and design, and artificial intelligence, and parallel and concurrent computing	A10, A11, A12

### A1.2.2 Intellectual Skills

National Academic Reference Standards	Program ILOs
<b>General ILOs (For Computing and Information programs):</b>	
1. (I1) Analyze computing problems and provide solutions related to the design and construction of computing systems	B14
2. (I2) Realize the concepts, principles, theories and practices behind computing and information as an academic discipline	B15
3. (I3) Identify criteria to measure and interpret the appropriateness of a computer system for its current deployment and future evolution	B16
4.(I4) Analyze, propose and evaluate alternative computer systems and processes taking into account limitations, and quality constraints	B13
5. (I5) Make ideas, proposals and designs using rational and reasoned arguments for presentation of computing systems	B17
6. (I6) Evaluate the results of tests to investigate the functionality of computer systems	B18
7. (I7) Achieve judgments considering balanced costs, benefits, safety, quality, reliability, and environmental impact	B12
8. (I8) Familiar with the professional, legal, moral and ethical issues relevant to the computing industry	B19
9. (I9) Evaluate research papers in a range of knowledge areas	B11
<b>Specific ILOs (For Computer Science programs)</b>	
1. (B1) Define traditional and non-traditional problems, set goals towards solving them, and. observe results	B1
2. (B2) Perform comparisons between (algorithms, methods, techniques...etc)	B2
3. (B3) Perform classifications of (data, results, methods, techniques, algorithms..etc.)	B3
4. (B4) Identify attributes, components, relationships, patterns, main ideas, and errors	B4
5. (B5) Summarize the proposed solutions and their results	B5
6. (B6) Restrict solution methodologies upon their results	B6
7. (B7) Establish criteria, and verify solutions	B7
8. (B8) Identify a range of solutions and critically evaluate and justify proposed design solutions	B8
9. (B9) Solve computer science problems with pressing commercial or industrial constraints	B9
10. (B10) Generate an innovative design to solve a problem containing a range of commercial and industrial constraints	B10

### A1.2.3 Professional and Practical Skills

National Academic Reference Standards	The program ILOs
General ILOs (For Computing and Information programs):	
1.(P1) Operate computing equipment, recognizing its logical and physical properties, capabilities, and limitations	C11, C14
2. (P2) Implement comprehensive computing knowledge and skills in projects and in deployment of computers to solve position practical problems	C5, C16
3. (P3) Deploy the equipment and tools used for the construction, maintenance and documentation of computer applications	C10
4. (P4) Apply computing information retrieval skills in computing community environment and industry	C7
5. (P5) Develop a range of fundamental research skills, through the use of online resources, technical repositories and library-based material	C17
6. (P6) Design, implement, maintain, and manage software systems.	C5
7. (P7) Assess the implications, risks or safety aspects involved in the operation of computing equipment within a specific context	C9
8. (P8) Handle a mass of diverse data, assess risk and draw conclusions	C18
Specific ILOs (For Computer Science programs)	
1. (C1) Use appropriate programming languages, web-based systems and tools, design methodologies, and knowledge and database systems	C1, C2, C3
2. (C2) Communicate effectively by oral, written and visual means	C13
3. (C3) Perform independent information acquisition and management, using the scientific literature and Web sources	C4, C12
4. (C4) Prepare and present seminars to a professional standard	C19
5.(C5) Perform independent information acquisition and management, using the scientific literature and Web sources (redundant with 3)	C4, C12
6. (C6) Prepare technical reports, and a dissertation, to a professional standard; use IT skills and display mature computer literacy	C15
7. (C7) Specify, design, and implement computer-based systems	C5
8. (C8) Evaluate systems in terms of general quality attributes and possible trade-offs presented within the given problem	C6
9. (C9) Apply the principles of effective information management, information organization, and information-retrieval skills to information of various kinds, including text, images, sound, and video	C7
10. (C10) Apply the principles of human-computer interaction to the evaluation and construction of a wide range of materials including user interfaces, web pages, and multimedia systems	C8
11.(C11) Identify any risks or safety aspects that may be involved in the operation of computing equipment within a given context	C9
12. (C12) Deploy effectively the tools used for the construction and documentation of software, with particular emphasis on understanding the whole process involved in using computers to solve practical problems	C10
13.(C13) Prepare technical reports, and a dissertation, to a professional standard (redundant with 6)	C19

#### A1.2.4 General and transferable skills

National Academic Reference Standards	The program ILOs
General ILOs (For Computing and Information programs):	
1. (T1) Demonstrate the ability to make use of a range of learning resources and to manage one's own learning	D9
2. (T2) Demonstrate skills in group working, team management, time management and organizational skills	D7, D2, D3, D4, D6
3. (T3) Show the use of information-retrieval	D5, D8
4. (T4) Use an appropriate mix of tools and aids in preparing and presenting reports for a range of audiences, including management, technical, users, industry or the academic community	D12
5. (T5) Exhibit appropriate numeracy skills in understanding and presenting cases involving a quantitative dimension	D11
6. (T6) Reveal communication skills, public speaking and presentation skills, and delegation, writing skills, oral delivery, and effectively using various media for a variety of audiences	D1, D10
7. (T7) Show the use of general computing facilities	D5
8. (T8) Demonstrate an appreciation of the need to continue professional development in recognition of the requirement for life-long learning	D8, D9

Knowledge and Understanding

Program ILOS – NARS	1. Concepts relating to computing and information	2. Modeling and design of computer-based systems	3. Tools, practices and methodologies	4. Criteria and specifications appropriate to specific problems	5. criteria defined for its current use and future development	6. technologies that support computer processing	7. generating tests	8. Management and economics principles	9. moral and ethical issues	10. Current developments	11. Requirements, practical constraints and computer-based systems	1. essential mathematics relevant to computer science	2. Use high-level programming languages	3. core of analysis, algebra, applied mathematics and statistics	4. analyzing data qualitatively	5. a number of application areas i	6. principles of artificial intelligence, image, and pattern recognition	7. fundamental topics in Computer Science	8. advanced topics
A1. Understand the essential mathematics and physics relevant to computer science.												√							
A2. Understand the concepts of the different high-level programming languages..													√						
A3. Show a critical understanding of Requirements, practical constraints and computer-based systems.										√									
A4. Demonstrate basic knowledge and understanding of a core of analysis, algebra, applied mathematics and statistics.													√						
A5. Recognize the basis of data qualitatively and/or quantitatively.														√					
A6. Know and understand the principles and techniques of a number of application areas informed by the research directions of computer science.										√					√				
A7. Show a critical understanding of the principles of artificial intelligence, image Processing, Machine Learning, Neural Networks, and Virtual Reality.	√																√		
A8. Understanding fundamental topics of computer systems especially hardware architectures and	√																	√	

Program ILOS – NARS	1. Concepts relating to computing and information	2. Modeling and design of computer-based systems	3. Tools, practices and methodologies	4. Criteria and specifications appropriate to specific problems	5. criteria defined for its current use and future development	6. technologies that support computer processing	7. generating tests	8. Management and economics principles	9. moral and ethical issues	10. Current developments	11. Requirements, practical constraints and computer-based systems	1. essential mathematics relevant to computer science	2. Use high-level programming languages	3. core of analysis, algebra, applied mathematics and statistics	4. analyzing data qualitatively	5. a number of application areas i	6. principles of artificial intelligence, image, and pattern recognition	7. fundamental topics in Computer Science	8. advanced topics
operating System.																			
A9. Understanding of fundamental topics in computer science, including software architectures, software engineering principles and methodologies, and software tools.	√																	√	
A10. Select advanced topics to provide a deeper understanding of some aspects of the hardware systems design, computer security, Cloud Computing, and compiler theory..																			√
A11. Select advanced topics to provide a deeper understanding of some aspects of object-oriented analysis and design, and software engineering.																			√
A12. Select advanced topics to provide a deeper understanding of some aspects of the Game Design & Development, Geographic Information Systems, and computer graphics & animation.																			√
A13. Demonstrate strong knowledge of fundamentals of programming and the construction of computer-based systems.	√																		
A14. Demonstrate strong knowledge of fundamentals of Data Warehousing, data structures and algorithms.	√																		
A15. Select advanced topics to provide a deeper understanding of some aspects of the operating systems, Parallel Processing, Real Time Systems.							√												



Program ILOS – NARS	1. Concepts relating to computing and information	2. Modeling and design of computer-based systems	3. Tools, practices and methodologies	4. Criteria and specifications appropriate to specific problems	5. criteria defined for its current use and future development	6. technologies that support computer processing	7. generating tests	8. Management and economics principles	9. moral and ethical issues	10. Current developments	11. Requirements, practical constraints and computer-based systems	1. essential mathematics relevant to computer science	2. Use high-level programming languages	3. core of analysis, algebra, applied mathematics and statistics	4. analyzing data qualitatively	5. a number of application areas i	6. principles of artificial intelligence, image, and pattern recognition	7. fundamental topics in Computer Science	8. advanced topics
A16. Provide a deeper understanding of legal, professional, ethical issues and moral aspects of the exploitation of computing.									√										
A17. Determine the tools, practices and methodologies used in the specification.			√																
A18. Identify the methods used in defining and assessing criteria for measuring the extent to which a computer system is appropriate for its current deployment and future evolution.					√														
A19. Recognize the current and underlying technologies that support computer processing and inter-computer communication.						√													
A20. Describe the principals of generating tests which investigate the functionality of computer programs and computer systems and evaluating their results.							√												
A21. Identify Modeling and design of computer-based systems bearing in mind the trade-offs		√																	
A22. Define criteria and specifications appropriate to specific problems, and plan strategies for their solution.				√															
A23. Understand of abroad context within computing including issues such as quality, reliability... (NARS General K7)..																			

Intellectual

Program ILOS – NARS

	1. Analyze computing problems and provide solutions	2. concepts, theories behind computing and information	3. criteria to measure and interpret the appropriateness	4. evaluate alternative computer systems	5. ideas, proposals and designs	6. Evaluate the results of tests	7. judgments considering costs, benefits, safety, quality, reliability	8. Familiar with the professional, legal, moral and ethical issues	9. Evaluate research papers		1 Define traditional and non-traditional problems	2 Perform comparisons	3. Perform classifications	4 Identify attributes, components, relationships, patterns	5. Summarize the proposed solutions	6. Restrict solution methodologies	7 Establish criteria, and verify solutions	8 critically evaluate and justify proposed design	9. Solve computer science problems	10. Generate an innovative design	
B1. Define traditional and non-traditional problems, set goals towards solving them, and observe results.											√										
B2. Perform comparisons between (algorithms, methods, techniques, etc.).												√									
B3. Perform classifications of (data, results, methods, techniques, algorithms, etc.).													√								
B4. Identify attributes, components, relationships, patterns, main ideas, and errors.														√							
B5. Summarize the proposed solutions and their results.															√						
B6. Restrict solution methodologies upon their results.																√					
B7. Establish criteria, and verify solutions.																	√				
B8. Identify a range of solutions and critically evaluate and justify proposed design solutions.																		√			
B9. Solve computer science problems with pressing commercial or industrial constraints.																			√		
B10. Generate an innovative design to solve a problem containing a range of commercial and industrial constraints.																					√
B11. Use investigative skills to research new and novel aspects of their work.									√												

Program ILOS – NARS

	1. Analyze computing problems and provide solutions	2. concepts, theories behind computing and information	3. criteria to measure and interpret the appropriateness	4. evaluate alternative computer systems	5. ideas, proposals and designs	6. Evaluate the results of tests	7. judgments considering costs, benefits, safety, quality, reliability	8. Familiar with the professional, legal, moral and ethical issues	9. Evaluate research papers	10. Define traditional and non-traditional problems	11. Perform comparisons	12. Perform classifications	13. Identify attributes, components, relationships, patterns	14. Summarize the proposed solutions	15. Restrict solution methodologies	16. Establish criteria, and verify solutions	17. critically evaluate and justify proposed design	18. Solve computer science problems	19. Generate an innovative design
B12. Create and/or justify designs to satisfy given requirements (synthesis, evaluation, application).							√												
B13. Analyze and evaluate a range of options in producing a solution to an identified problem.				√															
B14. Perform problem analysis from written descriptions; derive requirements specifications from an understanding of problems (analysis, synthesis).	√																		
B15. Apply the concepts, principles, theories and practices underpinning computing as an academic discipline.		√																	
B16. Define and assess criteria to measure the appropriateness of a computer system for its current deployment and future evolution, and to interpret the results thereof.			√																
B17. Synthesize ideas, proposals and designs effectively using rational and reasoned arguments for presentation to a range of audiences.					√														
B18. Evaluate the results of tests to investigate the functionality of computer systems.						√													
B19. Address and apply professional, moral and ethical issues within the discipline.								√											
B20. Interpreting and analyzing the basis of data qualitatively and/or quantitatively.																			



Program ILOS – NARS	1. Operate computing equipment	2. Implement computing knowledge and skills in projects	3. Deploy the equipment and tools used for the construction	4. Apply computing information retrieval skills	5. Develop a range of fundamental research skills	6. Design, implement, maintain, and manage software systems	7 Assess the implications, risks	8. Handle a mass of diverse data		1 Use appropriate programming	2 Communicate effectively	3. Perform independent information	4 Prepare and present seminars	5 Perform independent information	6. Prepare technical reports	7 Specify, design, and implement	8 Evaluate systems in terms of general quality	9. effective information management	10 human-computer interaction	11. risks involved in the operation of computing equipment	12.. tools for building & docs	13. technical reports	
C1. Use appropriate programming languages and design methodologies. [NARS CS C1]									√														
C2. Use appropriate web-based systems, tools and design methodologies. [NARS CS C1]									√														
C3. Use appropriate database systems. [NARS CS C1]									√														
C4. Perform independent information acquisition and management, using the scientific literature and Web sources. [NARS CS C3]											√		√										
C5. Specify, design, and implement and manage computer-based systems. [NARS CS C7]		√				√									√								
C6. Evaluate systems in terms of general quality attributes and possible trade-offs presented within the given problem. [NARS CS C8]																√							
C7. Apply the principles of effective information management, information organization, and information-retrieval				√													√						

Program ILOS – NARS	1. Operate computing equipment	2. Implement computing knowledge and skills in projects	3. Deploy the equipment and tools used for the construction	4. Apply computing information retrieval skills	5. Develop a range of fundamental research skills	6. Design, implement, maintain, and manage software systems	7. Assess the implications, risks	8. Handle a mass of diverse data		1. Use appropriate programming	2. Communicate effectively	3. Perform independent information	4. Prepare and present seminars	5. Perform independent information	6. Prepare technical reports	7. Specify, design, and implement	8. Evaluate systems in terms of general quality	9. effective information management	10. human-computer interaction	11. risks involved in the operation of computing equipment	12.. tools for building & docs	13. technical reports
skills to information of various kinds, including text, images, sound, and video. [NARS CS C9]																						
C8. Apply the principles of human-computer interaction to the evaluation and construction of a wide range of materials including user interfaces, web pages, and multimedia systems. [NARS CS C10]																			√			
C9. Identify any risks or safety aspects that may be involved in the operation of computing equipment within a given context. [NARS CS C11]							√													√		
C10. Deploy effectively the tools used for the construction and documentation of software, with particular emphasis on understanding the whole process involved in using computers to solve practical problems. [NARS CS C12]			√																		√	
C11. Make effective use of general computing facilities, plan and manage a project to complete within budget and schedule. [NARS GENERAL P1]	√																					
C12. Appreciate and manage the need for continuing professional development											√		√									

Program ILOS – NARS	1. Operate computing equipment	2. Implement computing knowledge and skills in projects	3. Deploy the equipment and tools used for the construction	4. Apply computing information retrieval skills	5. Develop a range of fundamental research skills	6. Design, implement, maintain, and manage software systems	7 Assess the implications, risks	8. Handle a mass of diverse data		1 Use appropriate programming	2 Communicate effectively	3. Perform independent information	4 Prepare and present seminars	5 Perform independent information	6. Prepare technical reports	7 Specify, design, and implement	8 Evaluate systems in terms of general quality	9. effective information management	10 human-computer interaction	11. risks involved in the operation of computing equipment	12.. tools for building & docs	13. technical reports
in recognition of the need for lifelong learning. [NARS CS C3]																						
C13. Communicate effectively by oral, written and visual means [NARS CS C2]										√												
C14. Operate computing equipment efficiently, taking into account its logical and physical properties. [NARS GENERAL P1]	√																					
C15. Prepare technical reports, and a dissertation, to a professional standard; use IT skills and display mature computer literacy [NARS CS C6]														√								√
C16. Apply tools and techniques for the design and development of applications. [NARS GENERAL P2]		√																				
C17. Develop a range of fundamental research skills, through the use of online resources, technical repositories and library-based material [NARS GENERAL P5]					√																	
C18. Handle a mass of diverse data, assess risk and draw conclusions [NARS GENERAL P8]								√														
C19. Prepare and present seminars to a professional standard [NARS CS C4]												√										

General

Program ILOS - NARS	1. learning resources and to manage one's own learning	2. group working, team management, time	3. use of information-retrieval	4. mix of tools and aids in preparing and presenting reports	5. numeracy skills	6. communication skills	7. use of general computing facilities	8. life-long learning
D1. Communicate effectively by oral, written and visual means. [NARS GENERAL T6]						√		
D2. Work effectively as an individual and as a member of a team. [NARS GENERAL T2]		√						
D3. Collaborate effectively within multidisciplinary team. [NARS GENERAL T2]		√						
D4. Work in stressful environment and within constraints. [NARS GENERAL T2]		√						
D5. Demonstrate efficient IT capabilities. [NARS GENERAL T7]			√				√	
D6. Lead and motivate individuals. [NARS GENERAL T2]		√						
D7. Manage tasks and resources. [NARS GENERAL T2]		√						
D8. Search for information and adopt life-long self-learning. [NARS GENERAL T3]			√					√
D9. Manage one's own learning and development. [NARS GENERAL T1]	√							√
D10. Communicate effectively with team members, managers and costumers. [NARS GENERAL T6]						√		
D11. Exhibit appropriate numeracy skills in understanding and presenting cases involving a quantitative dimension. [NARS GENERAL T5]					√			
D12. Use an appropriate mix of tools and aids in preparing and presenting reports for a range of audiences, including management, technical, users, industry or the academic community [NARS GENERAL T4]				√				

**Note:** The entire NARS-Program ILOs Matrix is also provided in an attached separate Excel file



## A1.2.6 Program ILOs VS Graduate attributes

### Graduate Attributes

General Attributes
GA1: Apply the fundamental theories and principles of computing and information applications
GA2: Integrate and evaluate the computing tools and facilities
GA3: Apply knowledge of mathematics and science
GA4: Design a computing system, component and process to meet the required needs within realistic constraints.
GA5: Exploit the techniques, skills and up-to-date computing tools, necessary for computing and information practice
GA6: Display professional responsibilities and ethical, societal and cultural concerns
GA7: Use, compare and evaluate a range of formal and informal techniques, theories and methods to develop computing and information applications
GA8: Consider and deal with the individual, social, environmental, organizational and economic implications of the application of computing and information
GA9: Carry out a work plan with minimal supervision
GA10: Communicate effectively
GA11: Hold knowledge and skills required by the computing and information industry
GA12: Engage in self and life-long learning and research in computing and information
GA13: Fulfill requirements of potential employers
GA14: Demonstrate knowledge and competence in fundamental areas of computer science such as: algorithms, design and analysis, computational theory, computer architecture and software based systems
GA15: Apply mathematical foundations, algorithmic principles, and computer science theory in the modelling and design, implementation, evaluation and evolution of computer-based systems
GA16: Apply knowledge of mathematics and science to real world problems; as well as to analyze and interpret data
GA17: Demonstrate the analytic skills necessary to effectively evaluate the relative merits of software and computer systems, and algorithmic approaches
GA18: Understand and apply a wide range of principles and tools of software engineering, such as design methodologies, choice of algorithm, language, software libraries and user interface technique.
GA19: Understand and apply a wide range of principles and tools of natural language processing and data mining
GA20: Have a solid understanding of the used concepts in computer science to be able to pursue further learning, whether as graduate students or on their own
GA21: Demonstrate an understanding of algorithms and data structures, computer organization and architecture, programming language concepts, compilers, networks, artificial intelligence, graphics, human computer interfaces, and databases, and identify and define the computing requirements for its solution
GA22: Design, implement, and evaluate a computer-based systems, process, component or program
GA23: Use knowledge and understanding in the modelling and design of computer-based systems in a way that demonstrates comprehension of the trade-off involved in design choices

Knowledge and Understanding

Program ILOs – NARS Graduate Attributes	General Graduate Attributes										Computer Science Graduate Attributes												
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
A1. Understand the essential mathematics and physics relevant to computer science.															√	√							
A2. Understand the concepts of the different high-level programming languages..	√		√																				
A3. Show a critical understanding of Requirements, practical constraints and computer-based systems.			√																				
A4. Demonstrate basic knowledge and understanding of a core of analysis, algebra, applied mathematics and statistics.	√		√												√	√							
A5. Recognize the basis of data qualitatively and/or quantitatively.	√	√	√																				
A6. Know and understand the principles and techniques of a number of application areas informed by the research directions of computer science.		√	√		√		√				√		√										
A7. Show a critical understanding of the principles of artificial intelligence, image Processing, Machine Learning, Neural Networks, and Virtual Reality.																		√	√			√	
A8. Understanding fundamental topics of computer systems especially hardware architectures and operating System.														√								√	
A9. Understanding of fundamental topics in computer science, including software architectures, software engineering principles and methodologies, and software tools.														√								√	
A10. Select advanced topics to provide a deeper understanding of some aspects of the hardware systems design, computer security, Cloud Computing, and compiler theory..																			√	√		√	
A11. Select advanced topics to provide a deeper understanding of some aspects of object-oriented analysis and design, and software engineering.																			√	√		√	
A12. Select advanced topics to provide a deeper understanding of some aspects of the Game Design & Development, Geographic Information Systems, and computer graphics & animation.																			√	√		√	
A13. Demonstrate strong knowledge of fundamentals of programming and the construction of computer-based systems.	√			√										√						√			

Program ILOs – NARS Graduate Attributes	General Graduate Attributes										Computer Science Graduate Attributes												
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
A14. Demonstrate strong knowledge of fundamentals of Data Warehousing, data structures and algorithms.																			√	√	√		
A15. Select advanced topics to provide a deeper understanding of some aspects of the operating systems, Parallel Processing, Real Time Systems.					√			√			√												
A16. Provide a deeper understanding of legal, professional, ethical issues and moral aspects of the exploitation of computing.			√										√										
A17. Determine the tools, practices and methodologies used in the specification.							√		√		√		√										
A18. Identify the methods used in defining and assessing criteria for measuring the extent to which a computer system is appropriate for its current deployment and future evolution.											√		√										
A19. Recognize the current and underlying technologies that support computer processing and inter-computer communication.		√				√		√	√		√		√										
A20. Describe the principals of generating tests which investigate the functionality of computer programs and computer systems and evaluating their results.					√	√					√	√	√										
A21. Identify Modeling and design of computer-based systems bearing in mind the trade-offs		√		√	√		√						√										√
A22. Define criteria and specifications appropriate to specific problems, and plan strategies for their solution.			√		√		√				√	√	√										
A23. Understand of abroad context within computing including issues such as quality, reliability... (NARS General K7)..																							

Intellectual

Program ILOs – NARS Graduate Attributes	General Graduate Attributes										Computer Science Graduate Attributes												
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
B1. Define traditional and non-traditional problems, set goals towards solving them, and observe results.							√																
B2. Perform comparisons between (algorithms, methods, techniques, etc.).						√		√															
B3. Perform classifications of (data, results, methods, techniques, algorithms, etc.).				√							√		√										
B4. Identify attributes, components, relationships, patterns, main ideas, and errors.							√			√													
B5. Summarize the proposed solutions and their results.				√													√						
B6. Restrict solution methodologies upon their results.							√																
B7. Establish criteria, and verify solutions.								√			√												
B8. Identify a range of solutions and critically evaluate and justify proposed design solutions.	√			√	√		√	√				√					√						
B9. Solve computer science problems with pressing commercial or industrial constraints.							√								√								√
B10. Generate an innovative design to solve a problem containing a range of commercial and industrial constraints.																		√					
B11. Use investigative skills to research new and novel aspects of their work.				√			√	√			√		√										
B12. Create and/or justify designs to satisfy given requirements (synthesis, evaluation, application).				√		√		√															
B13. Analyze and evaluate a range of options in producing a solution to an identified problem.				√	√																		
B14. Perform problem analysis from written descriptions; derive requirements specifications from an understanding of problems (analysis, synthesis).	√	√		√	√						√				√								
B15. Apply the concepts, principles, theories and practices underpinning computing as an academic discipline.											√		√										
B16. Define and assess criteria to measure the appropriateness of a computer system for its current deployment and future evolution, and to interpret the results thereof.				√																			

Program ILOs – NARS Graduate Attributes	General Graduate Attributes										Computer Science Graduate Attributes												
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
B17. Synthesize ideas, proposals and designs effectively using rational and reasoned arguments for presentation to a range of audiences.		√																					
B18. Evaluate the results of tests to investigate the functionality of computer systems.				√	√	√	√	√			√												
B19. Address and apply professional, moral and ethical issues within the discipline.		√			√		√					√											
B20. Interpreting and analyzing the basis of data qualitatively and/or quantitatively.																							

Professional

Program ILOs – NARS Graduate Attributes	General Graduate Attributes										Computer Science Graduate Attributes													
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	
C1. Use appropriate programming languages and design methodologies. [NARS CS C1]		√		√	√		√						√											
C2. Use appropriate web-based systems, tools and design methodologies. [NARS CS C1]		√		√	√		√						√											
C3. Use appropriate database systems. [NARS CS C1]		√		√	√		√						√											
C4. Perform independent information acquisition and management, using the scientific literature and Web sources. [NARS CS C3]	√				√		√				√	√	√											
C5. Specify, design, and implement and manage computer-based systems. [NARS CS C7]				√	√					√														
C6. Evaluate systems in terms of general quality attributes and possible trade-offs presented within the given problem. [NARS CS C8]											√		√							√				
C7. Apply the principles of effective information management, information organization, and information-retrieval skills to information of various kinds, including text, images, sound, and video. [NARS CS C9]		√		√		√					√		√						√					
C8. Apply the principles of human-computer interaction to the evaluation and construction of a wide range of materials including user interfaces, web pages, and multimedia systems. [NARS CS C10]																	√	√						
C9. Identify any risks or safety aspects that may be involved in the operation of computing equipment within a given context. [NARS CS C11]										√														
C10. Deploy effectively the tools used for the construction and documentation of software, with particular emphasis on understanding the whole process involved in using computers to solve practical problems. [NARS CS C12]					√													√					√	
C11. Make effective use of general computing facilities, plan and manage a project to complete within budget and schedule. [NARS GENERAL P1]					√						√		√											
C12. Appreciate and manage the need for continuing professional	√				√		√				√	√	√											

Program ILOs – NARS Graduate Attributes	General Graduate Attributes										Computer Science Graduate Attributes												
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
development in recognition of the need for lifelong learning. [NARS CS C3]																							
C13. Communicate effectively by oral, written and visual means [NARS CS C2]		√																					
C14. Operate computing equipment efficiently, taking into account its logical and physical properties. [NARS GENERAL P1]					√						√		√										
C15. Prepare technical reports, and a dissertation, to a professional standard; use IT skills and display mature computer literacy [NARS CS C6]	√	√		√	√		√	√			√		√										
C16. Apply tools and techniques for the design and development of applications. [NARS GENERAL P2]		√			√		√				√		√										
C17. Develop a range of fundamental research skills, through the use of online resources, technical repositories and library-based material [NARS GENERAL P5]				√																			
C18. Handle a mass of diverse data, assess risk and draw conclusions [NARS GENERAL P8]											√												
C19. Prepare and present seminars to a professional standard [NARS CS C4]	√																						

General

Program ILOs – NARS Graduate Attributes	General Graduate Attributes										Computer Science Graduate Attributes												
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
D1. Communicate effectively by oral, written and visual means. [NARS GENERAL T6]									√			√											
D2. Work effectively as an individual and as a member of a team. [NARS GENERAL T2]								√	√	√			√										
D3. Collaborate effectively within multidisciplinary team. [NARS GENERAL T2]								√	√	√			√										
D4. Work in stressful environment and within constraints. [NARS GENERAL T2]								√	√	√			√										
D5. Demonstrate efficient IT capabilities. [NARS GENERAL T7]		√																					
D6. Lead and motivate individuals. [NARS GENERAL T2]								√	√	√			√										
D7. Manage tasks and resources. [NARS GENERAL T2]								√	√	√			√										
D8. Search for information and adopt life-long self-learning. [NARS GENERAL T3]		√										√											
D9. Manage one's own learning and development. [NARS GENERAL T1]												√										√	
D10. Communicate effectively with team members, managers and costumers. [NARS GENERAL T6]										√			√										
D11. Exhibit appropriate numeracy skills in understanding and presenting cases involving a quantitative dimension. [NARS GENERAL T5]										√													
D12. Use an appropriate mix of tools and aids in preparing and presenting reports for a range of audiences, including management, technical, users, industry or the academic community [NARS GENERAL T4]										√													



## C. APPENDICES

### Appendix (1): Program Matrices

#### Appendix A1.3: program ILOs & Program Courses cross references

A1.3.1 Courses and their ILOs

A1.3.2 Program ILOs versus Courses

A1.3.1.1 First level

Code No.	Course title	Program ILO covered			
		Knowledge and understanding	Intellectual Skills	Professional and practical skills	General and Transferable skills
H 101	English Language	A3, A8, A9	B4, B14	C4,C9	D1,D5
H 102	Creative Thinking and Communication Skills	A1,A8,A10	B1,B10,B15	C7,C8,C12,C17	D1, D2, D3, D7, D10,D12
BS 101	Calculus	A1, A4	B1, B7, B8	C16	D1,D2,D3
CS 101	Intro to computer Science	A8,A9,A13,A14	B4,B15	C4,C7	D5,D8
CS 103	Intro to Information Systems	A2,A3,A6,A9	B1,B2	C1	D1
BS 131	Electronics	A1,A5,A17,A22	B1,B2,B5, B8,B9,B13	C2,C7,C11	D2,D7,D11
H 103	Technical Report Writing	A9,A13	B13,B19	C17,C18	D1,D8,D9
BS 121	Physics	A1,A4	B1,B5,B7,B12	C13,C15	D5,D12
CS 102	Computer Programming	A2,A13	B6,B9,B10,B13	C1,C5	D2,D5,D9
BS 102	Linear Algebra	A1,A4	B1,B7,B8	C16	D1,D2,D3
BS 103	Discrete Mathematics	A1,A4	B1,B7,B8	C16	D11
CS 121	Logic Design	A1,A4,A8,A10	B1,B5,B7,B8	C5,C6,C16	D1,D2,D7,D9

### A1.3.1.2 Second Level

Code No.	Course title	Program ILO Covered			
		Knowledge and understanding	Intellectual Skills	Professional and practical skills	General and Transferable skills
H 201	Work Ethics				
CS 203	Object-Oriented Programming	A2,A11,A13,A20	B3,B4	C1,C5,C10,C16	D5
BS 205	Operations Research	A4,A21	B1,B2,B4,B7,B8,B13	C6,C16	D11
BS 210	Statistics and Probabilities	A1,A4	B1,B5,B8,B13,B14	C16	D1,D2,D3,D8
CS 211	File Processing	A2,A8,A13,A14	B2,B13	C1,C7	D1,D2
CS 220	Computer Organization & Assembly Language	A8,A10,A15,A18	B7,B8,B12,B16	C1,C6,C9,C14	D1,D3,D4,D10
H 202	Business Administration				
CS 201	Data Structure	A2,A13,A14	B2,B3	C1	D2,D5
H 204	Human Rights	A16	B13,B19	C17,C18	D1,D8,D9
CS 210	Systems Analysis and Design	A3,A9,A11,A13, A17,A21,A22,A23	B1,B2,B4,B5,B6, B7,B8,B12,B14,B17	C5,C6,C9, C12,C14,C19	D1,D2,D5, D9,D10,D12
CS 250	Computer Networks	A18,A19,A21	B1,B2,B4,B5, B13,B16	C6,C9, C10,C14	D5
CS 206	Web Programming	A2, A13, A20, A21	B3, B4	C1, C5, C8, C10, C16	D5

### A1.3.1.3 Third Level

Code No.	Course title	Program ILO Covered			
		Knowledge and understanding	Intellectual Skills	Professional and practical skills	General and Transferable skills
CS 307	Logic Programming	A2,A7,A9	B1,B2,B4,B17	C1,C10	D1,D3
CS 309	Mobile App Development	A15	B1,B2	C5,C16	D2
CS 315	Software Engineering	A3, A9, A11, A16, A17, A18, A20,A21, A22,A23	B1, B2, B4, B5, B6, B7, B8, B9, B11, B12, B14, B15, B18, B19	C2, C3, C4, C5, C6, C9, C10, C11, C13, C15, C17, C18, C19	D1, D2, D3, D4,D6, D7, D8, D9, D10, D12
CS 331	Theory of Operating Systems	A8, A10, A13,A15,A18, A19,	B1, B3, B4,B7, B14	C5,C6	D5,D7
CS 323	Intro to Databases	A5, A9, A20, A21, A22	B3, B4, B7, B8, B10, B12, B20	C1, C3, C5, C7, C10, C18, C19	D5, D12
<b>CS 314</b>	<b>Human Computer Interaction</b>	A2, A13, A20, A21	B3, B4	C1, C5, C8, C10, C16	D5
CS 312	Analysis of Algorithms	A3,A4, A5, A9, A14, A21	B1, B2, B3, B4	C5, C6, C10	D1, D2, D8, D9
CS 321	Compiler Design & Theory	A10	B1,B2,B4,B15	C10	D12
CS 340	Computer Graphics	A1,A3,A5,A7,A9, A12	B1,B3,B9,B10	C1,C5,C7	D1,D2,D8,D9
CS 353	Fundamentals of Multimedia	A3,A6,A13,A19,A21	B1, B3, B4, B8	C7, C8, C10	D11, D12
CS 360	Artificial Intelligence	A7, A12, A21	B1, B2, B3, B4, B5, B10	C1, C5, C6, C10	D5
<b>CS 313</b>	<b>Game Design &amp; Development</b>	A2, A11, A13, A20	B3, B4	C1, C5, C10, C16	D5
<b>CS 332</b>	<b>Real Time Systems</b>	A15	B9, B10	C1, C5	D2
<b>CS 351</b>	<b>Simulation and Modeling</b>	A14, A21	B1, B2, B4, B7, B8, B13, B15	C6, C16	D11
<b>CS 361</b>	<b>Neural Network</b>	A1, A6, A7	B1, B6, B11, B15, B17	C7, C16	D8, D9

**A1.3.1.4 Fourth Level**

Code No.	Course title	Program ILO Covered			
		Knowledge and understanding	Intellectual Skills	Professional and practical skills	General and Transferable skills
CS 413	Computer Security	A1,A4,A6,A10	B2,B3,B12	C9, C10	D1, D8
CS 443	Digital Image Processing	A3, A6, A12, A13	B1, B10, B13	C1, C5, C7	D5,D10,D12
CS 455	Internet of things	A9, A10, A17, A19	B9 , B11 , B14, B20	C3 , C4	D3 , D12
CS 462	Machine Learning	A1, A4,A7	B1, B3,B5	C1,C16	D1,D9
CS 405	Geographic Information System	A2, A11, A13, A20	B3, B4	C1, C5, C10, C16	D5
CS 418	Parallel Processing	A2, A11, A13, A20	B3, B4	C1, C5, C10, C16	D5
CS 432	Distributed Systems	A10,A15, A19	B3, B15	C4, C6, C11, C14	D3, D10, D11, D12,
CS 433	Cloud Computing	A3,A9,A10,A15,A19	B1, B2	C1	D1
CS 444	Virtual Reality	A3,A7	,B2,B12	C8.C14	D1,D2
CS 445	Computer Vision Systems	A6, A7, A9, A18	B1, B3, B7, B15	C2, C10, C16	D1, D4, D9
CS 463	Introduction to embedded systems	A8, A9, A10, A15, A20	B1, B10, B11, B12, B13	C1 , C16	D2, D12
CS 470	Data warehousing	A1 , A3, A5, A9 , A12	B1, B3, B9, B10,B20	C1, C5, C7	D1, D2, D8, D9
CS 498	Senior Project 1	A3, A9, A11, A15, A16, A17, A18, A20, A21, A22	B1, B2, B3, B4, B5, B6, B7, B8, B9, B10, B11, B12, B13, B14, B17, B18, B19	C1, C3, C4, C5, C6, C7, C8, C9, C10, C11, C12, C13, C15, C17, C19	D1, D2, D3, D4, D6, D7, D8, D9, D10
CS 499	Senior Project 2	A3, A9, A11, A15, A16, A17, A18, A20, A21, A22	B1, B2, B3, B4, B5, B6, B7, B8, B9, B10, B11, B12, B13, B14, B17, B18, B19	C1, C3, C4, C5, C6, C7, C8, C9, C10, C11, C12, C13, C15, C17, C19	D1, D2, D3, D4, D6, D7, D8, D9, D10

**A1.3.2.5 Courses- Program ILOs Matrix**

**The Courses- Program ILOs Matrix is provided in an attached Excel file.**

## C. APPENDICES

### Appendix (1): Program Matrices

#### Appendix A1.4 Teaching and Learning Methods vs. Program Courses

The following Matrix represents Teaching and learning strategies and teaching and learning activities for computer science courses:

code	Courses	Teaching and learning strategies											
		cooperative learning	Brainstorming	Self-education	experiential learning	indirect learning	E-learning	Problem solving	Inductive	Concept Map	Asy.-Elearning	Synch-Elearning	Blended Learning
H 101	English Language	√	√			√	√				√	√	√
H 102	Creative Thinking and Communication Skills	√	√			√	√		√		√	√	√
BS 101	Calculus	√				√	√	√	√		√	√	√
CS 101	introduction to computer science	√		√	√	√	√	√	√	√	√	√	√
CS 103	Intro to Information Systems	√		√	√	√	√		√	√	√	√	√
BS 131	Electronic	√	√	√	√	√	√	√	√	√	√	√	√
H 103	Technical Report Writing	√	√			√	√		√		√	√	√
BS 121	Physics	√			√	√	√	√	√		√	√	√
CS 102	Computer Programming	√	√	√	√	√	√	√	√		√	√	√
BS 102	Linear Algebra	√				√	√	√	√	√	√	√	√
BS 103	Discrete Mathematics	√				√	√	√	√		√	√	√
CS 121	Logic Design	√	√	√		√	√	√	√	√	√	√	√

H 201	Work Ethics	√		√		√	√				√	√	√
CS 203	Object-Oriented Programming	√	√	√	√	√	√	√	√		√	√	√
BS 205	Operations Research	√				√	√	√			√	√	√
BS 210	Statistics and Probabilities	√	√		√	√	√	√			√	√	√
CS 211	File Processing	√	√	√	√	√	√	√	√		√	√	√
CS 220	Computer Organization & Assembly Language	√	√	√	√	√	√	√			√	√	√
H 202	Business Administration	√	√	√	√	√	√	√	√		√	√	√
CS 201	Data Structure	√	√	√	√	√	√	√	√		√	√	√
H 204	Human Rights	√			√	√	√				√	√	√
CS 210	System Analysis and Design	√	√	√	√	√	√	√			√	√	√
CS 250	Computer Networks	√	√	√	√	√	√	√		√	√	√	√
CS 206	Web Programming	√	√	√		√	√	√			√	√	√
CS 307	Logic Programming	√	√		√	√	√	√			√	√	√
CS 309	Mobile App Development	√	√	√	√	√	√	√			√	√	√
CS 315	Software Engineering	√	√	√	√	√	√	√			√	√	√
CS 331	Theory of Operating Systems	√		√	√	√	√	√	√		√	√	√
CS 323	IntroDuction to Database	√		√	√	√	√	√	√	√	√	√	√
CS 314	Human Computer Interaction	√	√	√	√	√	√	√			√	√	√
CS 312	Analysis of Algorithm	√	√	√	√	√	√	√		√	√	√	√
CS 321	Compiler Design & Theory	√	√	√	√	√	√			√	√	√	√

CS 340	Computer Graphics	√	√	√	√	√	√	√	√		√	√	√
CS 353	Fundamentals of Multimedia	√	√	√	√	√	√	√	√		√	√	√
CS 360	Artificial Intelligence	√	√	√	√	√	√	√			√	√	√
CS 313	Game Design & Development	√	√	√	√	√	√	√			√	√	√
CS 332	Real Time Systems	√	√	√	√	√	√	√	√		√	√	√
CS 351	Simulation and Modeling	√	√	√	√	√	√			√	√	√	√
CS 361	Neural Network	√	√	√	√	√	√	√	√		√	√	√
IS 405	Geographic Information Systems	√	√	√	√	√	√	√	√		√	√	√
CS 413	Computer Security	√	√	√	√	√	√	√	√		√	√	√
CS 443	Digital Image	√	√	√	√	√	√	√			√	√	√
CS 418	Parallel Processing	√	√	√	√	√	√	√		√	√	√	√
CS 432	Distributed Systems	√	√	√	√	√	√	√	√	√	√	√	√
CS 433	Cloud Computing	√	√	√	√	√	√	√			√	√	√
CS 498	Senior Project 1	√	√	√	√	√	√			√	√	√	√
CS 462	Machine Learning	√	√	√	√	√	√	√		√	√	√	√
CS 455	Internet of Things (IoT)	√	√	√	√	√	√	√	√		√	√	√
CS 444	Virtual Reality	√	√	√	√	√	√	√	√		√	√	√
CS 445	Computer Vision Systems	√	√	√	√	√	√	√			√	√	√
CS 463	Introduction to Embedded Systems	√	√	√	√	√	√	√			√	√	√
CS 470	Dataware house	√	√	√	√	√	√	√	√		√	√	√
CS 499	Senior Project 2	√	√	√	√	√	√			√	√	√	√



## C. APPENDICES

### Appendix (1): Program Matrices

#### Appendix A1.5 Assessment Methods vs. Program Courses

The following Matrix represents Teaching and learning strategies and Teaching and learning activities for computer science courses:

Code	Course Name	Assessment Strategies			
		Midterm Exam	Final Exam	Practical Exam	Electronic quiz
H 101	English Language	√	√		√
H 102	Creative Thinking and Communication Skills	√	√		√
BS 101	Calculus	√	√		√
CS 101	Intro to computer Science	√	√	√	√
CS 103	Intro to Information Systems	√	√	√	√
BS 131	Electronics	√	√	√	√
H 103	Technical Report Writing	√	√		√
BS 121	Physics	√	√	√	√
CS 102	Computer Programming	√	√	√	√
BS 102	Linear Algebra	√	√		√
BS 103	Discrete Mathematics	√	√		√
CS 121	Logic Design	√	√	√	√
H 201	Work Ethics	√	√		√
CS 203	Object-Oriented Programming	√	√	√	√
CS 206	Web Programming	√	√	√	√
BS 205	Operations Research	√	√		√
BS 210	Statistics and Probabilities	√	√		√
CS 211	File Processing	√	√	√	√
CS 220	Computer Organization & Assembly Language	√	√	√	√

H 202	Business Administration	√	√		√
CS 201	Data Structure	√	√	√	√
H 204	Human Rights	√	√		√
CS 210	Systems Analysis and Design	√	√	√	√
CS 250	Computer Networks	√	√	√	√

Code	Course Name	Assessment Strategies			
		Midterm Exam	Final Exam	Practical Exam	Electronic quiz
CS 323	Intro to Databases	√	√	√	√
CS 307	Logic Programming	√	√	√	√
CS 309	Mobile App Development	√	√	√	√
CS 312	Analysis of Algorithms	√	√	√	√
CS 315	Software Engineering	√	√	√	√
CS 321	Compiler Design & Theory	√	√	√	√
CS 331	Theory of Operating Systems	√	√	√	√
CS 340	Computer Graphics	√	√	√	√
CS 353	Fundamentals of Multimedia	√	√	√	√
CS 360	Artificial Intelligence	√	√	√	√
CS 313	Game Design & Development	√	√	√	√
CS 314	Human Computer Interaction	√	√	√	√
CS 332	Real Time Systems	√	√	√	√
CS 351	Simulation and Modeling	√	√	√	√
CS 361	Neural Networks	√	√	√	√
CS 413	Computer Security	√	√	√	√
CS 443	Digital Image Processing	√	√	√	√
CS 455	Internet of things	√	√	√	√
CS 462	Machine Learning	√	√	√	√
CS 405	Geographic Information System	√	√	√	√
CS 418	Parallel Processing	√	√	√	√
CS 432	Distributed Systems	√	√	√	√
CS 433	Cloud Computing	√	√	√	√
CS 444	Virtual Reality	√	√	√	√
CS 445	Computer Vision Systems	√	√	√	√
CS 463	Introduction to embedded systems	√	√	√	√
CS 470	Data warehousing	√	√	√	√
CS 498	Senior Project 1				
CS 499	Senior Project 2				

## C. APPENDICES

### Appendix (2): Contents of Program Courses

#### *First Level*

CS 101	Introduction to Computer Science	مقدمة في علوم الحاسب (إجباري)	١٠١ ح ع
Prerequisites:	None		
Course Content:	This course introduces the components of a computer system that includes Types of computers – Computer hardware and software components – Data representation and number systems – Branches of computer science - Introduction to networking – Introduction to internet – Algorithm development – algorithm representation – flowcharts – stepwise refinement – problem solving methods and tools. Other recent related topics.		
CS 102	Computer Programming	برمجة الحاسبات (إجباري)	١٠٢ ح ع
Prerequisites:	CS 101 Introduction to Computer Science		
Course Content:	Introduction to elementary data types & related operations & expressions syntax & semantics of high-level language. Built in functions in the used programming language, operator precedence, assignment statements, input-output statement, Boolean expressions, relational operators, control statements, defined functions, scope & parameter matching, structures, use of arrays. Recursion. Other recent related topics.		
CS 103	Introduction to Information Systems	مقدمة في نظم المعلومات (إجباري)	١٠٣ ح ع
Prerequisites:	None		
Course Content:	This course is designed to provide an overview of computer and information systems concepts along with a working knowledge of some of the most popular software tools currently available. Typical systems such as management information systems (MIS), geographical information systems (GIS), business intelligence, and decision support systems. Other recent related topics.		
CS 121	Logic Design	تصميم منطقي (إجباري)	١٢١ ح ع
Prerequisites:	BS 131 Electronics		
Course Content:	Identifying & understanding of physical components used in computer hardware. Logic gates are introduced Minimization methods including Boolean algebra & expressions, and graphical simply combinational circuits; latches & flip-flops: analysis & design of synchronous sequential circuits; registers & counters, storage elements are introduced to aid the computer logic design. Other recent related topics.		

BS 101	Calculus	التفاضل والتكامل (إجبارى)	١٠١٤ع
Prerequisites:	None		
Course Content:	Functions, Limits and Continuity, Definition of the derivative, Higher order derivatives, the chain rule, implicit differentiation, differentials, parametric differentiation, nth- derivative of a function and Leibentz theorem. Roll`s theorem and the mean value theorem, Taylor and Maclaurin series, indeterminate forms, and L` Hopital rule, maximum and minimum values, curve sketching. Anti-derivative and indefinite Integral, Techniques of integration-Definite integrals–the fundamental theorem of calculus, improper integrals-Area between curves – solids of revolution, arc length, surface areas of revolution.		
BS 102	Linear Algebra	الجبر الخطى (إجبارى)	١٠٢٤ع
Prerequisites:	BS 101 Calculus		
Course Content:	Matrices: linear equations and matrices, solution of linear systems, Eigen vectors and eigen values, Determinants: Properties of determinant, inverse of matrix using determinant, Vector space, linear independence, dimension, linear transformations, Inner products and orthogonality and projection.		
BS 103	Discrete Mathematics	الرياضيات غير المتصلة (إجبارى)	١٠٣٤ع
Prerequisites:	BS 101 Calculus		
Course Content:	Topics include number theory, Sets, sequence, algorithms & pseudo code, induction & recursion. Relation & function. Graphs, Trees, Posts, Lattices & Boolean Algebra. Semi groups & groups, matrices. Fundamental principles of counting (permutations, combinationaries), Other recent related topics.		
BS 121	Physics	فيزياء (إجبارى)	١٢١٤ع
Prerequisites:	None		
Course Content:	Units & Dimensions, Electric charge; Coulomb's law; Electric field, Gauss law; Electric Potential; Electric capacitance & capacitor; Electric current; Resistors; Kirchoff's law; magnetic field & forces; magnetic induction & inductors; Basic circuit theory & circuit analysis; fundamentals of three phase circuits & transformers.		
BS 131	Electronics	الالكترونيات (إجبارى)	١٣١٤ع
Prerequisites:	None		
Course Content:	Passive components: Resistance, Inductance, Capacitance; series, parallel combinations; Kirchoff's law: voltage, current; assumptions for the models; linearity, definition. Signaling sources: voltage and current sources; non-ideal sources; representation under assumption of linearity; DC circuit analysis: node and loop analysis; Choice of nodes and branches for efficient analysis (Graph theoretic representation of circuit). Superposition theorem; Thevenin's theorem; Norton's theorem. Time domain response of RL and RC circuits. Sinusoidal steady state response; phasor; impedance; transfer function of two port networks. Frequency response: concept; amplitude and phase response. Passive filter circuits; computation of transfer function. Discrete electronic devices: Diode, Zener diode, BJT (Bipolar junction transistor), LED, Diode		

BS 131	Electronics	الالكترونيات (اجبارى)	ع ١٣١
Prerequisites:	None		
	circuits; clipper, clamper circuits. DC power supply: rectifier- half wave, full wave (center tapped, bridge), Zener regulated power supply, regulation.		
H 101	English Language	اللغة الإنجليزية (اجبارى)	إن ١٠١
Prerequisites:	None		
Course Content:	This course focuses on the Development of basic composition & reading skills. Reading materials must be chosen from technical sources related to computer technology today and computers tomorrow. The activities aim to develop listening, speaking and writing skills through a communicative, functional approach, with suggested topics for discussion and exercises in summary writing and composition. Other recent related topics.		
H 102	Creative Thinking and Communication Skills	التفكير الإبداعي ومهارات الإتصال (اجبارى)	إن ١٠٢
Prerequisites:	None		
Course Content:	Meta-cognition (thinking about thinking) – Vertical and lateral thinking approaches – Creative thinking tools. Theories of communication – How to translate theories into complete strategies to communicate with diverse audience – Written Communications: Memoranda, Letters, Executive summaries, Business and research reports – Oral Communications: Listening, Presentation skills, Interviewing, conducting meetings Interpersonal communication – Negotiation – Intercultural communication – Importance of communication in team building. Other recent related topics.		
H 103	Technical Report Writing	كتابة التقارير الفنية (اجبارى)	إن ١٠٣
Prerequisites:	H 101 English Language		
Course Content:	Technical report Writing introduces the basic requirements of report writing – the rationale for report writing – the structure of reports and such details as physical appearance and linguistic style – writing reports and prepares students to design effective technical documents for both written and digital media, with particular emphasis upon technical memos, problem-solving and decision-making reports. Other recent related topics.		

## Second Level

CS 201	Data Structure	هياكل بيانات (إجباري)	٢٠١ ح ٤
Prerequisites:	CS 102 Computer Programming		
Course Content:	This course investigates abstract data types (ADTs), including lists, tacks, queues, priority queues, trees, and graphs. The emphasis is on the trade-offs associated with implementing alternative data structures for these ADTs. There will be four or five substantial programming assignments		
CS 203	Object-Oriented Programming	البرمجة الشيئية (إجباري)	٢٠٣ ح ٤
Prerequisites:	CS 102 Computer Programming		
Course Content:	The conceptual basis of Object Orientated Programming. Primitive data types and data types as objects. Data Abstraction and encapsulation. Object oriented programming: Inheritance Access control, Method hiding. Virtual methods and dynamic binding, method overriding. Object oriented programming: Polymorphism. Classes and object as abstract data types. Message passing. Operators, Operator overloading, delegates, and events. Object-oriented programming language syntax, creating objects from class definitions. Exception handling. Other recent related topics.		
CS 206	Web Programming	برمجة الويب (إجباري)	٢٠٦ ح ٤
Prerequisites:	CS 102 Computer Programming		
Course Content:	Overview of network, understanding of internet services and protocols (HTTP, FTP, SMTP, POP3) and how these protocols can be used in programs. Basic concepts of URL form and IP address and its applications in programs. Implementation of socket (TCP/UDP client-server programming). The fundamentals of web page design and web site development. Using HTML to construct static web pages (fonts, colors, lists, hyperlinks, tables, images, creating animated GIFS, clickable image map, sound, video, frames). PHP web programming server-side environment. Programming for IoT Applications. Other recent related topics.		
CS 210	Systems Analysis and Design	تحليل وتصميم النظم (إجباري)	٢١٠ ح ٤
Prerequisites:	CS 103 Introduction to Information Systems		
Course Content:	This course focuses on the systems analysis and design techniques in the development of software applications. System analysis fundamentals. Information requirements analysis. The analysis processes. Structured and object-oriented analysis. Introduction to system design. Defining the basic terms and how to build the system technical architecture. Designing the system inputs and system outputs. Designing interface screens, design patterns, re-use and component-based design. Analysis and design will be covered from structured and object-oriented perspectives. Other recent related topics.		

CS 211	File Processing	معالجة الملفات (إجبارى)	ع ٢١١
Prerequisites:	CS 102 Computer Programming		
Course Content:	This course gives an overview of files: file design, file manipulation, blocking and buffering (both single & double buffering). Types of storage devices (magnetic tapes, magnetic disks) are presented. Space and time calculation, Sequential file, relative file, indexed sequential file, multiple key file, and direct access file. External sort / merge algorithms. File systems-disk scheduling.		
CS 220	Computer Organization & Assembly Language	تنظيم الحاسب ولغة التجميع (إجبارى)	ع ٢٢٠
Prerequisites:	CS 121 Logic Design		
Course Content:	Computer basic unit organization: Memory, control, arithmetic & logic unit. Computer cycles: Fetch, indirect addressing, execute & interrupt. Hardwired versus microprogramming control organization. I/O devices & interrupt handing. Interfacing and Communication. Assembly language is used in the lab, to demonstrate most of the above concepts, as well as developing the student's skills in Assembly language programming. Other recent related topics.		
CS 250	Computer Networks	شبيكات الحاسب (إجبارى)	ع ٢٥٠
Prerequisites:	CS 101 Introduction to Computer Science		
Course Content:	Introduction to computer networks and their origin. Uses of computer networks, structure & architecture of networks and distributed systems. Computer networks protocols and reference models (ISO-OSI & TCP/IP). Generic internet networks & intranet in layers (standard 7 layers). Physical layer, data link layer, network layer, transport layer, session layer, presentation layer and application layer. Routing algorithms. Survey of known networks. Other recent related topics.		
BS 205	Operations Research	بحوث العمليات (إجبارى)	ع ٢٠٥
Prerequisites:	BS 101 Calculus		
Course Content:	Linear programming: Formulation & graphical solution & Algebraic solution. Transportation & assignment problems. Project scheduling by PERT-CPM, Markov state diagram, and introduction of the linear programming model. Formulation & graphical solution. Standard forms & simplex method. Special cases of simplex method. Duality & sensitive analysis. Transportation & assignment problem. Project scheduling by PERT & CPM. Introduction to queuing model. Other recent related topics.		



BS 210	Statistics and Probabilities	إحصاء واحتمالات (إجبارى)	٢١٠ أ ع
Prerequisites:	BS 101 Calculus		
Course Content:	Define statistics (types of data – types of statistics – population versus sample-Measurement's levels), Describing Data (Frequency tables – Graphic Presentation – Numerical Measures – Displaying and Exploring Data), Survey of Probability Concept (Rules of probability – Conditional probability-Total Probability Theory and Bays Rule) , Random Variables and its probability distribution with some properties – Discrete probability distribution (Binomial – Poisson – Negative Binomial – Geometric- Hyper geometric) , Continuous Probability distribution (Normal – Exponential).		

H 201	Work Ethics	أخلاقيات العمل (إجبارى)	٢٠١ إن
Prerequisites:	None		
Course Content:	Social context of computing, methods and tools of analysis of ethical argument, professional and ethical responsibilities, risks and liabilities of safety-critical systems, intellectual property, privacy and civil liberties, social implications of the Internet, computer crime, philosophical foundations of ethics. Other recent related topics.		

H 202	Business Administration	إدارة الأعمال (إجبارى)	٢٠٢ إن
Prerequisites:	None		
Course Content:	Introduction to Management - Management functions - Business Functions - Organizational Structure - Strategic Management – Motivation - Leadership - Decision Making: Tools & Techniques - Human Resource Management - Effective communication in modern organizations - Team management - Development of management thought- Creative Problem Solving- Presentation & Negotiation Skills – modes of thinking. Other recent related topics.		

H 204	Human Rights	حقوق الإنسان (إجبارى)	٢04 إن
Prerequisites:	None		
Course Content:	تعريفات ومفومات وأهمية حقوق الإنسان – الإطار الفلسفى والتاريخى – نشأتها وتطورها من العصور الإسلامية إلى التنظيم الدولى . مصادر حقوق الإنسان الدولية والوطنية – أنواع حقوق الإنسان وواجباتها : الحقوق المدنية – السياسية – الإقتصادية – الإجتماعية والثقافية . كيفية حماية حقوق الإنسان – دور الأجهزة الغير حكومية فى حمايتها . التعريف بالسكان والبيئة – دراسة الوضع السكانى فى مصر وتطوره وأثاره – علاقة النظريات السكانية بالتنمية البشرية . أثر النمو السكانى على البيئة – مناقشة قضايا السكان والصحة .		

### Third Level

CS 300	Selected Topics-Level 3	موضوعات مختارة – مستوى ٣ (إختياري)	٣٠٠ ح ع
Prerequisites:	To Be Determined		
Course Content:	This course is intended to cover trending topics not covered by other courses specified herein. Its syllabus and prerequisite are to be specified by the course instructor and must get approval by both department and institute councils.		
CS 307	Logic Programming	البرمجة المنطقية (إجباري)	٣٠٧ ح ع
Prerequisites:	CS 102 Computer Programming		
Course Content:	Introduction: Facts, objects & predicates. Prolog variables: Using variables, bound & free variables, anonymous variables, compound goals, backtracking, variables rules. Variables in rules, prolog execution rules, using the trace, unification, execution control, the built-in predicate. Simple I&O. Controlling execution: Success through failure, the fail predicate, execution using the fail predicate, recursion & the cut. Arithmetic operations. Compound objects. Dynamic database, lists. String operations. Other recent related topics.		
CS 309	Mobile App Development	تطوير تطبيقات الجوال (إجباري)	٣٠٩ ح ع
Prerequisites:	CS 206 Web Programming		
Course Content:	This course deals with developing mobile apps of various types. Emphasis is placed on the processes, tools and frameworks required to develop applications for current and emerging mobile computing platforms. Emphasis is placed on the processes, tools and frameworks required for current and emerging mobile computing devices. Students will work at all stages of the software development life cycle from inception through to implementation and testing. Other recent related topics.		
CS 312	Analysis of algorithms	تحليل الخوارزميات (إجباري)	٣١٢ ح ع
Prerequisites:	CS 201 Data Structure		
Course Content:	This course covers the following topics: problem solving strategies, principles of algorithm design, metrics for evaluating designs, iterative and recursive algorithms, structured and object-oriented paradigms. Algorithms for sorting and selection, randomized techniques, search structures (heaps, balanced trees, hash tables), dynamic programming and greedy algorithms, amortized analysis and graph algorithms (breadth- and depth-first search, MSTs, shortest paths).		
CS 313	Game Design & Development	تطوير وتصميم الألعاب (إختياري)	٣١٣ ح ع
Prerequisites:	CS 312 Analysis of algorithms		
Course Content:	This course covers many of the concepts involved in game design, beginning with the history of gaming and an examination of the software engineering aspects of game design. Other topics include the programming environment, game hardware, mathematical concepts, physical concepts, graphics, player motivation, game elements, storytelling, characters, game play, level design, interface design, audio, project management, production, marketing and maintenance. Other recent related topics.		

CS 314	Human Computer Interaction	طرق اتصال الإنسان بالحاسب (إختياري)	ع ح ٣١٤
Prerequisites:	CS 102 Computer Programming		
Course Content:	Theory, design procedure, and programming practices behind effective human interaction with computers. Interaction design, implementation, and evaluation. The design process, theory behind successful human-computer interaction, awareness of established procedures for good user interface design, the 'usability engineering' process, Iterative evaluation, prototyping and evaluation using scenario-based case studies. Apply practical assignments using the Android ecosystem that highlight selected portions of the design cycle, as well as familiarize with sound programming practices and effective tools and techniques to create successful user interface. Other recent related topics.		
CS 315	Software Engineering	هندسة برمجيات (إجباري)	ع ح ٣١٥
Prerequisites:	CS 210 Systems Analysis and Design		
Course Content:	Software Engineering Concepts & Historical Perspective. Software Life Cycle Paradigms. Software project management. The software process models. System models. Software Requirements Engineering. Architectural design. Software design methodologies: object-oriented design & software reusability. Rapid Application Development, Agile software development. Software Testing Techniques. Software measurements and metrics. Software Maintenance. Release Management and version control. Other recent related topics.		
CS 321	Compiler Design & Theory	نظرية وتصميم المترجمات (إجباري)	ع ح ٣٢١
Prerequisites:	CS 220 Computer Organization & Assembly Language		
Course Content:	This course aims to acquire the student the practical skills to write a simple compiler for an imperative programming language. It allows the student to understand the concepts of scanning, parsing, name management in nested scopes, and code generation. Also it aims to transfer the skills to general software engineering tasks (e.g. parsing of structured data files or argument lists).		
CS 323	Introduction to Databases	مقدمة في قواعد البيانات (إجباري)	ع ح ٣٢٣
Prerequisites:	CS 103 Introduction to Information Systems		
Course Content:	Introduction to Databases and database systems, database models, Data Modeling Using the Entity-Relationship (ER) Model. The Relational Data Model and Relational Database Constraints. Relational Database Design by ER- to-Relational Mapping. Query Languages and processing: Data Definition, Constraints, Schema Changes, Specifying Updates, and Retrieval Queries. Views and data base programming. Functional Dependencies and Normalization. Other recent related topics.		

CS 331	Theory of Operating Systems	نظريات نظم التشغيل (إجباري)	ع ٣٣١ ح
Prerequisites:	CS 220 Computer Organization & Assembly Language		
Course Content:	This course covers in detail many advanced topics in operating system design and implementation. It starts with topics such as operating systems structuring, multithreading and synchronization and then moves on to systems issues in parallel and distributed computing systems. The course will also introduce topics such as virtual memory management, file systems, protection and security, operating system extension techniques, fault tolerance, and the history of systems programming.		
CS 332	Real Time Systems	نظم الزمن الحقيقي (إختياري)	ع ٣٣٢ ح
Prerequisites:	CS 331 Theory of Operating Systems		
Course Content:	Introduction to real time systems; Typical real time applications; Hard versus soft real time systems; A reference model of real time systems; Commonly used approaches to hard real time scheduling; Clock-driven scheduling; Priority-driven scheduling of periodic tasks; Scheduling periodic and Sporadic tasks; Resources and resource access control; Multiprocessor scheduling and resource access control; Scheduling flexible computations and tasks with temporal distance constraints; Real time communications; Real time operating system; Real time programming languages. Other recent related topics.		
CS 340	Computer Graphics	الرسم بالحاسب (إجباري)	ع ٣٤٠ ح
Prerequisites:	CS 220 Computer Organization & Assembly Language		
Course Content:	Basic Elements of Computer Graphical Picture, Mapping Real to Device and Vice Versa, Rasterizing Polylines, Polygon, General Functions Drawing, Regions Filling Techniques, 2D Transformations, 3D Transformations, Lightening and Shading, Projection Models, Containment, Clipping. Lab works focus on Open GL as well as a selected game engine to perform simple game. Other recent related topics.		
CS 351	Simulation and Modeling	النمذجة والمحاكاة (إختياري)	ع 351 ح
Prerequisites:	CS 312 Analysis of algorithms		
Course Content:	Basic concepts and terminology of simulation, probability and distribution theory, estimation and statistical tests, and generation of random numbers. Introduction to queuing theory, discrete system simulation, examples such as M/M/ 1, Time management methods such as time driven and event driven simulation. Simulation languages, introduction to continuous systems simulation and examples. Other recent related topics.		
CS 353	Fundamentals of Multimedia	أساسيات الوسائط (إجباري)	ع ٣٥٣ ح
Prerequisites:	CS 102 Computer Programming		
Course Content:	Multimedia System components, Sampling Theorem, Entropy Encoding, Arithmetic Encoding, Huffman Encoding, Shannon Fanon Method, Run Length, Vector Quantization, Uniform Quantization, Fractal Encoding, JPEG, Motion Prediction Encoding (MPEG), Video Compression. Other recent related topics.		

CS 360	Artificial Intelligence	الذكاء الاصطناعي (إجباري)	360 ع ح
Prerequisites:	CS 312 Analysis of algorithms		
Course Content:	Search techniques to problems solving. Heuristic search such as: generate and test, hill climbing, best-first search... etc. Knowledge representation such as: predicate logic, production rules, semantic networks, frames, etc. planning: components of a planning system, goal stack planning, hierarchical planning. Common sense reasoning: commonsense ontologism, case – based reasoning. Natural language processing: syntactic processing, semantic analysis, discourse pragmatic processing. Other recent related topics.		

CS 361	Neural Networks	الشبكات العصبية (إختياري)	361 ع ح
Prerequisites:	CS 307 Logic Programming		
Course Content:	The course will explain both the classical and the new techniques of neural networks in supervised, unsupervised and reinforcement learning schemes. Particularly, a single perceptron and neurons, feed-forward convolution neural networks(CNN), Korhonen's maps, associative memories, Hopfield's, and many other recurrent networks will be considered. Primary and advanced examples of the presented neural techniques will give the student skills and understanding required to apply these techniques in many engineering applications. Other recent related topics.		

## Fourth Level

CS 400	Selected Topics-Level 4	موضوعات مختارة – مستوى ٤ (إختياري)	٤٠٠ ح ع
Prerequisites:	TBD		
Course Content:	This course is intended to cover trending topics not covered by other courses specified herein. Its syllabus and prerequisite are to be specified by the course instructor and must get approval by both department and institute councils.		
CS 405	Geographic Information Systems	نظم المعلومات الجغرافية (إختياري)	٤٠٥ ح ع
Prerequisites:	CS 323 Introduction to Databases		
Course Content:	Geographic Information Systems (GIS) are systems of hardware and procedures designed to support the capture, management, manipulation, analysis, modeling, and display of spatially referenced data for solving complex planning problems. This course covers underlying geographic concepts (world coordinate system and projections, vector map topology, tiled and layers maps, standard computer map file formats, urban applications, etc.) and provides computer lab tutorials and case studies on the leading GIS software. Other recent related topics.		
CS 413	Computer Security	أمان الحاسب (إجباري)	ح ع ٤١٣
Prerequisites:	CS 312 Analysis of algorithms		
Course Content:	Overview: Characteristics of computer intrusion, point of security vulnerability, methods of defense. Basic encryption and decryption methods handling different types of ciphers, characteristics of good ciphers, crypt analysis. Secure encryption system including hard problems & complexity. Properties of arithmetic, public-key systems, single-key systems by using different encryption algorithms to enhance cryptographic security. Security involving programs: information access problems, malicious code such as viruses and worms, controls against attack, operating system control, administrative controls. Block chain principles and security architecture. Other recent related topics.		
CS 418	Parallel Processing	المعالجة المتوازية (إختياري)	٤١٨ ح ع
Prerequisites:	CS 250 Computer Networks		
Course Content:	The spectrum of knowledge and skills presented in the course provides the solid basis for developing parallel software system and includes the following topics: Overview of parallel computer architectures, Modeling and analysis of parallel computations, Parallel algorithm and software design, Technologies of parallel program development, Parallel algorithms for solving time-consuming problems. Other recent related topics.		
CS 432	Distributed Systems	الأنظمة الموزعة (إختياري)	٤٣٢ ح ع
Prerequisites:	CS 331 Theory of Operating Systems		
Course Content:	This course introduces students to key concepts and techniques underlying the design and engineering of distributed computing systems. Technical topics covered in this course include inter-process communication, remote invocation,		

CS 432	Distributed Systems	الأنظمة الموزعة (إختياري)	ع ح ٤٣٣
Prerequisites:	CS 331 Theory of Operating Systems		
	distributed naming, distributed file systems, security, distributed clocks, process coordination, concurrency control, replication, and fault-tolerance. Types of systems discussed in this course include computational clouds, grid computing, storage systems, peer-to-peer networks and Web services.		

CS 433	Cloud Computing	الحوسبة السحابية (إختياري)	ع ح ٤٣٣
Prerequisites:	CS 250 Computer Networks		
Course Content:	<p>Introduction to Cloud Computing: Cloud computing properties and characteristics, service models, deployment models.</p> <p>Attributes of Cloud computing: multi-tenancy – a single instance of software or other computing resource serving several clients, massive scalability – ability to support hundreds of thousands of clients at the same time, elasticity – ability to grow or contract on demand, on-demand self-provisioning of resources.</p> <p>Infrastructure-as-a-Service (IaaS): Introduction to IaaS, resource (i.e., server, storage and network) virtualization.</p> <p>Platform-as-a-Service (PaaS): Introduction to PaaS. Cloud platform, management of computation and storage.</p> <p>Software-as-a-Service (SaaS): Introduction to SaaS, Web services, Web 2.0, Web OS.</p> <p>Cloud issues and challenges: Cloud provider lock-in or vendor lock-in, security of Cloud computing.</p> <p>Other recent related topics.</p>		

CS 443	Digital Image processing	معالجة الصور الرقمية (إجباري)	ع ح ٤٤٣
Prerequisites:	CS 340 Computer Graphics		
Course Content:	<p>This course focuses on the properties of digital images, design of display systems and algorithms, time and frequency representations, filters, image formation and enhancement, image sampling and quantization, color, point operations, segmentation, linear image filtering and correlation, image transforms (DCT, Fourier), nonlinear filtering, image enhancement in frequency domain, morphological image processing, noise reduction and restoration, simple feature extraction and recognition tasks, Students write and investigate image processing algorithms. Other recent related topics.</p>		

CS 444	Virtual Reality	الواقع الافتراضي (إختياري)	ع ح ٤٤٤
Prerequisites:	CS 312 Analysis of algorithms		
Course Content:	<p>The main objective of the course is to give an introductory to virtual reality and to give the student the basic skills to understand and evaluate VR systems, applications and simulators and its impact on future digital systems and user interfaces. This course suits for students of all fields. It gives the basic skills to understand and evaluate VR systems, applications and simulators and its impact on future digital systems and user interfaces. Other recent related topics.</p>		

CS 445	Computer Vision Systems	نظم الرؤية بالحاسب (إختياري)	ع ح ٤٤٥
Prerequisites:	CS 443 Digital Image processing		
Course Content:	<p>The aim of this course is to introduce the principles, models and applications of computer vision, as well as some mechanisms used in biological visual systems that may inspire design of artificial ones.</p> <p>The course will cover: image formation, structure, and coding; edge and feature detection; neural operators for image analysis; texture, color, stereo, and motion; wavelet methods for visual coding and analysis; interpretation of surfaces, solids, and shapes; data fusion; probabilistic classifiers; visual inference and learning. Other recent related topics.</p>		

CS 455	Internet of Things (IoT)	انترنت الأشياء (إجباري)	ع ح ٤٥٥
Prerequisites:	CS 250 Computer Networks		
Course Content:	<p>IoT definitions, overview, applications, potential and challenges, and architecture. Layers, protocols, packets, services, performance parameters of a packet network as well as applications such as web, Peer-to-peer, sensor networks, and multimedia. LANs, MAC level, link protocols such as: point-to-point protocols, Ethernet, Wi-Fi 802.11, cellular Internet access, and Machine-to-machine. IoT case studies, e.g. sensor, body-area-network and control of smart home. Real-time data collection, cloud storage and analysis. Power management and system sustainability. Scalability and costing, IOT roadmap. Other recent related topics.</p>		

CS 462	Machine Learning	تعلم الآلة (إجباري)	ع ح ٤٦٢
Prerequisites:	BS 210 Statistics and Probabilities		
Course Content:	<p>This course emphasizes supervised learning algorithms, including concept, decision tree, random forest, neural network, Naïve Bayes, K nearest neighbors, and support vector machines. Training and test data are discussed. Concept of learning as search through a hypothesis space. Overfitting, noisy data, and pruning.</p> <p>Comparing learning algorithms: cross validation, learning curves, and statistical hypothesis testing. Hidden Markov models and their use speech recognition. This course includes also unsupervised learning, including from unclassified data and K means partitioned clustering. Other recent related topics.</p>		

CS 463	Introduction to embedded systems	مقدمة في النظم المدمجة (إختياري)	ع ح ٤٦٣
Prerequisites:	CS 220 Computer Organization & Assembly Language		
Course Content:	<p>An introduction to micro controllers and the design of embedded systems, with an emphasis on understanding the interaction between hardware, software, and the physical world. Topics covered include embedded programming languages, interrupts, I/O, concurrency management, scheduling, resource management, and real-time constraints. Other recent related topics.</p>		



CS 470	Data Warehousing	مستودعات البيانات (إختبارى)	ع ح ٤٧٠
Prerequisites:	CS 323 Introduction to Databases		
Course Content:	In this course, students study the issues involved in planning, designing, building, population, and maintaining a successful data warehouse. Students learn the reasons why data warehousing is a compelling decision-support solution in today's business climate. Upon course completion, the student should be able to explain how a data warehouse can be used to support all levels of management when making strategic, tactical, and operational decisions that affect the organization. Other recent related topics.		

CS 498	Senior Project 1	مشروع التخرج ١ (إجبارى)	ع ح ٤٩٨
Prerequisites:	CS 315 (The student must pass at least 70% of the hours required for graduation)		
Course Content:	This course is intended to give a chance to practical use all the knowledge acquired since starting the program. It focuses on a specific problem, preferably a real life one, and culminates in an innovative software/hardware solution. This course in particular should develop the groundwork for the required solution, especially a meticulous systems analysis study. A system design phase should be carried out, with a prototype or some preliminary implementation highly recommended. The student can work individually or within a group of a reasonable size.		

CS 499	Graduation Project 2	مشروع التخرج ٢ (إجبارى)	ع ح ٤٩٩
Prerequisites:	CS 498 Senior Project 1		
Course Content:	This course aims at implementing the system designed in CS 498. A software/hardware product should be targeted, taking the good look and modest cost into consideration. A judging committee should be formed to evaluate the work and assign the student a suitable grade.		

## C. APPENDICES

### Appendix (3): Characteristics of computer science graduates

#### A3.1 General Characteristics

At a broad level, these characteristics can be expressed as follows:

1. Higher-level understanding of systems as a whole.
2. Understand not only the theoretical underpinnings of the discipline but also how that theory influences practice.
3. Significant project experience.
4. Adaptability: possess a solid foundation that allows them to maintain their skills as the field evolves.

#### A3.2 Abilities and skills

##### 1. Cognitive abilities and skills

- Knowledge and understanding. Demonstrate knowledge and understanding of essential facts, concepts, principles, and theories relating to computer science and computer applications.
- Modeling. Use such knowledge and understanding in the modeling and design of computer-based systems in a way that demonstrates comprehension of the trade-off involved in design choices.
- Requirements. Analyze criteria and specifications appropriate to specific problems, and plan strategies for their solution.
- Critical evaluation and testing. Analyze the extent to which a computer-based system meets the criteria defined for its current use and future development.
- Methods and tools. Deploy appropriate theory, practices, and tools for the specification, design, implementation, and evaluation of computer-based systems.
- Professional responsibility. Recognize and be guided by the social, professional, and ethical issues involved in the use of computer technology.

##### 2. Practical abilities and skills

- Design and implementation. Specify, design, and implement computer-based systems.
- Evaluation. Evaluate systems in terms of general quality attributes and possible tradeoffs presented within the given problem.
- Information management. Apply the principles of effective information management, information organization, and information-retrieval skills to information of various kinds, including text, images, sound, and video.
- Human-computer interaction. Apply the principles of human-computer interaction to the evaluation and construction of a wide range of materials including user interfaces, web pages, and multimedia systems.
- Tools. Deploy effectively the tools used for the construction and documentation of computer applications, with particular emphasis on understanding the whole process involved in using computers to solve practical problems.
- Operation. Operate computing equipment and software systems effectively.

##### 3. Additional transferable skills

- Communication. Make succinct presentations to a range of audiences about technical problems and their solutions.
- Teamwork. Be able to work effectively as a member of a development team.
- Numeracy. Understand and explain the quantitative dimensions of a problem.
- Self management. Manage one's own learning and development, including time management and organizational skills
- Professional development. Keep abreast of current developments in the discipline to continue one's own professional development.

## C. APPENDICES

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### Appendix (5): Computer Science Jobs

The work of computer scientists falls into four categories: designing and implementing software; devising new ways to use computers; developing effective ways to solve computing problems; and planning and managing organizational technology infrastructure.

1. **Software Development:** This is a broad field that involves designing, coding, testing, and maintaining software applications. Roles within software development include:
    - a. **Software Engineer:** Develops, designs, and implements software applications and systems.
    - b. **Web Developer:** Specializes in creating websites and web applications.
    - c. **Mobile App Developer:** Focuses on developing applications for mobile devices.
    - d. **Game Developer:** Designs and develops video games for various platforms.
  2. **Data Science and Analytics:** Involves the analysis, interpretation, and visualization of large datasets to derive valuable insights. Roles in this field include:
    - a. **Data Scientist:** Uses statistical and machine learning techniques to analyze data and make predictions.
    - b. **Data Analyst:** Focuses on examining data to identify trends and patterns.
    - c. **Business Intelligence (BI) Developer:** Creates reports and dashboards to assist in decision-making.
  3. **Artificial Intelligence and Machine Learning:** Involves developing algorithms and models that enable computers to perform tasks without explicit programming. Roles include:
    - a. **Machine Learning Engineer:** Designs and builds machine learning systems and models.
    - b. **Natural Language Processing (NLP) Engineer:** Focuses on developing systems that understand and process human language.
    - c. **Computer Vision Engineer:** Works on applications involving image and video analysis.
  4. **DevOps and Cloud Computing:** Focuses on streamlining the development and deployment of software applications. Roles include:
    - a. **DevOps Engineer:** Combines software development with IT operations to improve efficiency.
    - b. **Cloud Engineer:** Manages cloud-based infrastructure and services.
  5. **Cybersecurity:** Involves protecting computer systems and networks from security breaches and attacks. Roles include:
    - a. **Security Analyst:** Monitors and responds to security incidents.
    - b. **Penetration Tester (Ethical Hacker):** Assesses the security of systems by attempting to exploit vulnerabilities.
  6. **Quality Assurance (QA) and Testing:** Focuses on ensuring software products meet quality standards. Roles include:
    - a. **QA Engineer:** Designs and executes test cases to identify and report defects.
    - b. **Test Automation Engineer:** Develops automated test scripts to speed up testing processes.
  7. **UX/UI Design:** Involves creating user-friendly and visually appealing interfaces for software applications. Roles include:
    - a. **UX Designer:** Focuses on user experience and usability of software products.
    - b. **UI Designer:** Designs the graphical elements and layout of user interfaces.
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