ASSIUT UNIVERSITY



Computer Science Undergraduate Program

2023-2024





Faculty of Computers and Information

Dept. of Computer Science





Assiut University

Faculty of Computers & Information

Computer Science Undergraduate Program

(Credit Hours System)

2023 - 2024



Assiut University Faculty of Computers & Information Department of Computer Science Quality Assurance Unit



CS Undergraduate Program

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Assiut University



Faculty of Computers & Information Department of Computer Science Quality Assurance Unit



CS Undergraduate Program Specifications

A. Basic Information

- 1. Program Title: Computer Science
- 2. **Program Type:** Single
- 3. Faculty (Faculties): Faculty of Computers and Information
- 4. **Department:** Computer Science
- 5. Assistant Coordinator: Amal Abdelazim Mohamed
- 6. Coordinator: Prof. Khaled Fathy Hussain
- 7. Last date of program specifications approval: 2023- 2024

B. Professional Information

1. Program Aims

The program aims to provide the student with both breadth and depth of knowledge in the concepts and techniques related to the design, programming, and application of computing systems. Specifically, based on the constitutions of the Computing Curricula (ACM/IEEE CS2001 and CS2008) out CS program aims to provide the student with:

I. System-level perspective.

The objectives associated with individual units in the body of knowledge tend to emphasize isolated concepts and skills that can lead to a fragmented view of the discipline. Graduates of a computer science program must develop a high-level understanding of systems as a whole. This understanding must transcend the implementation details of the various components to encompass an appreciation for the structure of computer systems and the processes involved in their construction and analysis.

II. Appreciation of the interplay between theory and practice.

A fundamental aspect of computer science is the balance between theory and practice and the essential link between them. Graduates of a computer science program must understand not only the theoretical underpinnings of the discipline but also how that theory influences practice.

III. Familiarity with common themes and principles.

In the course of an undergraduate program in computer science, students will encounter many recurring themes such as abstraction, complexity, and evolutionary change. They will also encounter principles, e.g. those associated with caching, (e.g. the principle of locality), with sharing a common resource, with security, with concurrency, and so on. Graduates should recognize that these themes and principles have broad application to the field of computer science and

must not compartmentalize them as relevant only to the domains in which they were introduced.

IV. Significant project experience.

To ensure that graduates can successfully apply the knowledge they have gained, all students in computer science programs must be involved in at least one substantial software project. Such a project (usually positioned late in a program of study) demonstrates the practical application of principles learned in different courses and forces students to integrate material learned at different stages of the curriculum. Student need to appreciate the need for domain knowledge for certain applications, and that this may necessitate study within that domain.

V. Attention to rigorous thinking.

This may be formal but need not be but should include discipline epitomized by the use of sound practices which include planning, tracking progress, measuring and generally managing quality; these needs to be seen to complement sound design and sound choice of techniques.

VI. Adaptability.

One of the essential characteristics of computer science over its relatively brief history has been an enormous pace of change. Graduates of a computer science program must possess a solid foundation that allows and encourages them to maintain their skills as the field evolves.

2. Graduate attributes

The Computer Science program is designed to provide the student with the foundations of the discipline as well as the opportunity for specialization. After successfully completing the Computer Science program, the graduate should be able to:

- I. Demonstrate knowledge and competence in fundamental areas of computer science such as: algorithms, design and analysis, computational theory, computer architecture and software based systems.
- **II.** Apply mathematical foundations, algorithmic principles, and computer science theory in the modeling and design, implementation, evaluation and evolution of computer-based systems.
- **III.** Apply knowledge of mathematics and science to real world problems; as well as to analyze and interpret data.
- **IV.** Demonstrate the analytic skills necessary to effectively evaluate the relative merits of software and computer systems, and algorithmic approaches.
- **V.** 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.
- **VI.** Understand and apply a wide range of principles and tools of natural language processing and data mining.
- VII. 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.
- VIII. 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.
- **IX.** Design, implement, and evaluate a computer-based systems, process, component or program.
- **X.** 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.

3. Intended Learning Outcomes (ILOs)

a. Knowledge and Understanding

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

- a1. Recognize the essential mathematics relevant to computer science.
- a2. Explain code written in high-level programming languages.
- a3. Demonstrate basic knowledge and understanding of a core of mathematical analysis.
- a4. Demonstrate basic knowledge and understanding of a core of statistics.
- a5. Interpret and analyze data qualitatively and/or quantitatively.
- a6. Describe 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, and pattern recognition.
- a8. Define the fundamental topics in computer systems, including hardware architectures and operating systems.
- a9. Define the fundamental topics in computer science, including software architectures, software engineering principles and methodologies, and software tools.
- a10. Define advanced topics to provide a deeper understanding of some aspects of the hardware systems design, operating systems, computer security and compiler theory.
- a11. Discuss advanced topics to provide a deeper understanding of some aspects of object-oriented analysis and design, and software engineering.
- a12. Identify advanced topics to provide a deeper understanding of some aspects of the artificial intelligence, image processing, and computer graphics and animation.
- a13. Express strong knowledge of fundamentals of programming and the construction of computer-based systems.
- a14. Describe strong knowledge of fundamentals of data structures and algorithms.
- a15. Show a critical understanding of the broad context within computing including issues such as quality, reliability, enterprise, employment law and accounting.
- a16. Provide a deeper understanding of legal, professional and moral aspects of the exploitation of computing.
- a17. Recognize the knowledge of tools, practices and methodologies used in the specification, design, implementation and critical evaluation of computer software systems.
- a18. Define and assess criteria for measuring the extent to which a computer system is appropriate for its current deployment and future evolution.
- a19. Define the current and underlying technologies that support computer processing and inter-computer communication.
- a20. Define the principals of generating tests which investigate the functionality of computer programs and computer systems and evaluating their results.

b. Intellectual Skills

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

- b1. Formulate traditional and nontraditional problems, set goals towards solving them, and observe results.
- b2. Compare between (algorithms, methods, techniques...etc).
- b3. Classify (data, results, methods, techniques, algorithms.. etc.).
- b4. Identify attributes, components, relationships, patterns, main ideas, and errors.
- b5. Conclude the result of the proposed solutions.
- b6. Restrict solution methodologies upon their results.
- b7. Compose 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. Formulate and model computer systems at different and appropriate levels of abstraction.
- 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. Analyze problem from written descriptions; derive requirements specifications from an understanding of problems (analysis, synthesis).
- b15. Outline the concepts, principles, theories and practices underpinning computing as an academic discipline.
- b16. Develop 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. Create 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.

c. Professional and Practical Skills

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

- c1. Use appropriate programming languages and design methodologies.
- c2. Use appropriate web-based systems, tools and design methodologies.
- c3. Use appropriate database systems.
- c4. Perform independent information acquisition and management, using the scientific literature and Web sources.
- c5. Specify, design, and implement computer-based systems.
- c6. Evaluate systems in terms of general quality attributes and possible tradeoffs presented within the given problem.
- 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.
- 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.
- c9. Identify any risks or safety aspects that may be involved in the operation of computing equipment within a given context.
- 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.
- c11. Make effective use of general computing facilities, plan and manage a project to complete within budget and schedule.
- c12. Appreciate and manage the need for continuing professional development in recognition of the need for lifelong learning.
- c13. Address and apply professional, moral and ethical issues within the discipline.
- c14. Operate computing equipment efficiently, taking into account its logical and physical properties.
- c15. Use investigative skills to research new and novel aspects of their work.
- c16. Apply tools and techniques for the design and development of applications.

d. General and Transferable Skills

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

- d1. Communicate effectively by oral, written and visual means.
- d2. Work effectively as an individual and as a member of a team.
- d3. Collaborate effectively within multidisciplinary team.
- d4. Work in stressful environment and within constraints.
- d5. Prepare and present seminars to a professional standard.
- d6. Prepare technical reports, and a dissertation, to a professional standard; use IT skills and display mature computer literacy.
- d7. Demonstrate efficient IT capabilities.
- d8. Lead and motivate individuals.
- d9. Manage tasks and resources.
- d10. Search for information and adopt life-long self-learning.
- d11. Acquire entrepreneurial skills.
- d12. Manage one's own learning and development.
- d13. Prepare their work in the form of reports.
- d14. Communicate effectively with team members, managers and costumers.
- d15. Exhibit appropriate numeracy skills in understanding and presenting cases involving a quantitative dimension.
- d16. Develop a range of fundamental research skills, through the use of online resources, technical repositories and library-based material.

4. Academic standards

4a. External references for standards

The academic standards invoked in this specification are driven based on the National Academic Reference Standards (NARS) for "Computing" approved by the National Authority of Quality Assurance and Accreditation of Education on October 2010.

4b. Comparison of provision to external references

See the attached document "Program Matrices".

5. Curriculum Structure and Contents

- 5a. Program duration: 144 credit hours.
- **5b.** Program structure
 - No. of credit hours of Compulsory (100), Elective (44)
 - No. of program Levels (in credit-hours system): 4 levels.

The following table summarizes the program structure.

Subject Area	Credit	CS Program	Tolerance
	Hours	%	
Humanities, ethical and Social Sciences (Univ.	18	12.5 %	8-10 %
Req.)			
Mathematics and Basic Sciences	28	19.44 %	16-18 %
Basic Computing Sciences (institution req.)	42	29.17 %	26-28 %
Applied Computing Sciences (specialization)	42	29.17 %	28-30 %
Projects and Training	14	9.72%	6-10 %
Subtotal	144	100 %	84-96 %
Optional (Institution character-identifying	15	N/A	4-16 %
subjects)			
Total	N/A	N/A	100 %

6. Program Courses

6a. Compulsory Courses

		(General 1	equire	ments					
Course Code	Course name	Prerequisites	Credit		No. of urs/w		Progra	m ILC	S Cover	ed (by No.)
Code		_		Lect.	Lab	Exer.	a's	b's	c's	d's
HUM111	English Language I	-	2	2	-	-	-	4,14	4,10,12	1,3,6,10,12,13
HUM121	Social Context of Computing	-	1	1	-	-	1- 2,15,16	1-2	1-2,13	1-4
HUM132	Interpersonal Communication	-	2	2	-	-	1-5	1-4	1-5	1-2
HUM231	Business Administration	-	2	2	-	-	1,2,15,16	1-3	1-3,13	1-7
HUM232	Technical Writing	HUM111	2	2	-	-	1-3	1-3	1-3	1-9
HUM241	Computers and Ethics	-	1	1	_	-	1- 2,15,16	1-3	1-3,13	1-9

		Institution	requiren	nents						
Course	Course name	Prerequisites	Credit	No. of	f hours,	/week	Prog	ram IL (bv.)	OS Co No.)	vered
Code		1		Lect.	Lab	Exer.	a's	b's	c's	d's
MATH101	Mathematics I	-	3	3	-	2	1,2	1,6	1-3	1-3
MATH102	Mathematics II	MATH101	3	3	-	2	1-5	1-6	1-4	1-3
MATH202	Probability and Statistics	MATH102	2	2	2 H ^T	-	1,2,5	1-6	1-4	1-3
CS201	Discrete Structures	MATH102	3	3	-	2	1,2	1-6	1-4	1-4
PHYS101	Physics I	-	3	2	2 H ^s	-	1-6	1-4	1-6	1-6
PHYS102	Physics II	-	3	2	2 H ^s	-	1-5,7	1-4	1-5	1-6
EE101	Electronics	-	3	2	2 Hs	-	1-5	1-6	1-5	1-6
EE102	Digital Circuits EE101		2	3	2 H ^s	-	1-8	1,3-8	1-6	1-5

		Basic Comput	ting Scier	nces (Ir	stitutio	n Require	ments)			
Course	Course name	Prerequisites	Credit	No.	of hou	rs/week	Prog	gram ILOS ((by No.)		Ĺ
Code		_		Lect.	Lab	Exer.	a's	b's	c's	d's
CS141	Programming Fundamentals	IT101	3	3	3 H ^T	-	1-7,11-14	1-5	1-3	1-5
CS211	Data Structures and Algorithms	CS241	3	3	2 H ^T	-	1-5	1,2,10,11	1-6	1-6
CS241	Object-Oriented Programming	CS141	3	3	2 H ^T	-	1-4	1-5	1,2	1-6
CS321	Operating Systems	CE221	3	3	2 H ^T		1-3,5-8	1-5	1-5	1,2
CS351	Computer Graphics	IT101, CS201	3	3	2 H ^T		_	5, 6	_	8
CS361	Artificial Intelligence	IT101, CS201	3	3	2 H ^T		1-7	1-6,8	1-6	1-8
CS391	Software Engineering	CS211	3	3	-	2	1-10 ,17,20	1-3 ,6,9,10, 12,14-18	1-6,	1- 6,14- 16
IS212	Databases	IS201	3	3	2 H ^T	-	1-7	1-5	1-6	3,5, 6,1,4
IT101	IT Fundamentals	-	3	3	3 H ^T		1-6,8,9	1-3	1-4	1-4
IT251	Data Communications	IT101	3	3	-	2	1-4,6-7,19	1-6	1-5	1-6
IT351	Computer Networks	IT251, CE221	3	3	2 H ^T		1-10,19	1-15	1-6	1-6
CE221	Computer Architecture	CS141, CS201	3	3	2 H ^T		1-8,18,19	1-5	1-3	1-4

		6 . 1								
	T	Speciali	zation re	equiren			T			
Course					No. of		Progra	m ILOS (Covered (by No.)
Code	Course name	Prerequisites	Credit	ho	urs/w	eek				
Code				Lect.	Lab	Exer.	a's	b's	c's	d's
		1st	Level C	ourses	•	•				
601.11	Programming	TITIA OA			OT TT		1-7,11-	1-5	1-3	1-5
CS141	Fundamentals	IT101	3	3	3 H ^T		14			
IT101	IT Fundamentals	_	3	3	3		1-9	1,2	1-4	1-4
11101			3	3	H^{T}					
MATH101	Mathematics I	_	3	3	-		1,2	1,6	1-3	1-3
MATH102	Mathematics II	MATH101	3	3	-		1-5	1-6	1-4	1-3
PHYS101	Physics I	_	3	2	2 H ^s		1-6	1-4	1-6	1-6
PHYS102	Physics II	_	3	2	2 H ^s		1-5,7	1-4	1-5	1-6
EE101	Electronics	_	3	2	2 H ^s		1-5	1-6	1-5	1-6
EE102	Digital Circuits	EE101	2	2	2 Hs		1-8	1,3-8	1-6	1-5
					-		-	4,14	4,10,12	1,
HUM111	English Language I		2	2						3,6,
помии	English Language I	_		2						10,12
										,13
	•	Level C	ourses			•				
CS201	Discrete Structures	MATH102	3	3	-	2	1,2	1-6	1-4	1-4
CS211	Data Structures and	CS241	3	3	2	-	1,4,5,	2-	1-6	1-6
C3211	Algorithms	C5241	3	3	H^{T}		2,3	10,11,1		

CS241	Object-Oriented Programming	CS141	3	3	2 H ^T	-	1-4	1-5	1,2	1-6
IS212	Databases	IS201	3	3	2 H ^T	-	1-7	1-5	1- 6,9,11	1,3- 6,11,14- 16
IS221	Project Management	IT101	2	2	2 H ^o	-	1,2,15- 17,20	1,2	1	1-6
IT251	Data Communications	IT101	3	3	-	2	1-4, 6,7	2-6	1-5	1-6
CE221	Computer Architecture	CS141, CS201	3	3	2 H ^T	-	1- 8,18,19	1-5	1-3	1-4
MATH202	Probability and Statistics	MATH102	2	2	2 H ^T		1-5	1-6	1-4	1-3

		Specialization r	equirem	ents						
Course	_				No. of		Progra	am ILOS		ed (by
Code	Course name	Prerequisites	Credit		urs/w		a's	No.) c's	d's
		3rd Level (0111505	Lect.	Lab	Exer.	a S	DS	C S	as
		3 Level C					1-5	2-11	1-	1-6
CS311	Algorithm Design and Analysis	CS211	3	3	_	2			7,14-	
	,								16	
CS321	Operating Systems	CE221	3	3	2 H ^T	-	1-8	1-5	1-5	1,2
CS342	Automata and Language Theory	CS141,	3	3	_	2,18	1-5	1-5	1-5	1-
C0012	Tratoliuta and Earlyauge Theory	CS201				2,1 0				3,5
CS351	Computer Graphics	IT101, CS201	3	3	2	-	1-7	1,3,5	1-4	1-
	1				H ^T 2	_	1-8	,6,8 1-6	1-5	6,8 1-6
CS352	Image Processing	CS211	3	3	HT	_	1-0	1-0	1-5	1-0
660.4	A 17 . 11:	TET 04 CC204			2	_	1-6	1-8	1-6	1-8
CS361	Artificial Intelligence	IT101, CS201	3	3	H^T					
CS381	Software Development and	CS211,	3	3	3	-	1-10	1-15	1-6	1-6
	Professional Practice	CS391		3	Ho					
CS382	Field Training	IS221	3	-	-	-	1-8	1-10	1-8	1-6
						2	1 10	1-3		1-
CS391	Software Engineering	CS211	3	3	-		1-10 ,17,20	,6,9,10, 12,14-	1-6,	6,14-
							,17,20	18		16
TEIO E 4		IT251,			2	_	1-	1-5	1-7	1-9
IT351	Computer Networks	CE221	3	3	H^T		10,19			
		4th Level (Courses	_						•
CS431	Parallel Computation	CS311, CS321	3	-	-	1	1-9	1-5	1-4	1-4
		CS211,				-	1-6	3-6	1-4	1-4
CS441	Compiler Construction	CS341,	3	-	-					
		CE221					1.0	2 (0.4	4.4
CS471	Introduction to Computer Security	CS211, IT351	3	3	2 H ^o	-	1-8	2-6	3,4 ,6,7	1-4
CS481	Capstone Project I	CS381, IS221	3	1	4 Hs	-	1-8	1-10	1-8	1-6
CS482	Capstone Project II	CS381, IS221	3	1	4 Hs	-	1-8	1-10	1-8	1-6

6b. Elective Courses

	General requirement	nts								
Course	Course name	Prerequisites	Credits		No. of urs/w		Progra	m ILC (by N	OS Cove Io.)	ered
Code		_		Lect.	Lab	Exer.	a's	b's	c's	d's
HUM112	English Language II	HUM111	2	2	-	-	1,2	1-3	1-3	1-7
HUM122	Intellectual Property	-	1	1			1,2	1-3	1-3	1-7
HUM131	Organizational Behavior		2	2			1,2	1-3	1-3	1-7
HUM133	Computing Economics	-	2	2			1,2	1,2	1,2	1,2
HUM141	Computer Law	-	2	2			1,2,15,16	1,2	1,2,13	1-7
HUM142	Privacy and Civil Liberties		1	1			1-5	1-4	2,3	1-3
HUM151	Hand Drawing		2	2	3 Hs		13, 5-14	1-3	1,2	1-4
HUM152	History of Computing		2	2			2,4,5, 6,9	1,3	2-4	1-3
HUM153	Islamic Culture		1	1			1,2	1,2	1,2	1,2
HUM154	Scientific Thinking		1	1			1-4	1-5	1,2	1-4

		Institution	n require:	ments						
Course Code	Course name	Prerequisites	Credit		No. of urs/w		Progra	m ILC (by N	OS Cov No.)	ered
Code		_		Lect.	Lab	Exer.	a's	b's	c's	d's
MATH201	Mathematics III	MATH102	3	3	-	2	-	6,8	16	1,2
MATH301	Numerical Analysis	MATH102	3	3	-	2	1-3	1-6	1-7	1-7
CS301	Operation Research	CS201	3	3	2 H ^T	-	1,2,3, 4-7, 9	1-4	1-3	1-5
CS302	Simulation and Modeling	MATH202	3	3	2 H ^T	-	1,2,3,4- 7, 8,9	1-4	1-3	1-5
EE201	Digital Signal Processing	MATH201	3	3	2 H ^T	-	1-3	1-5	4	1-4

		Basic	Computi	ng Sino	ce requ	iiremen	nts			
Course Code	Course name	Prerequisites	Credit		No. of urs/w		Program II	LOS Cove	red (by	No.)
Code		_		Lect.	Lab	Exer.	a's	b's	c's	d's
CS341	Visual Programming	CS211	3	3 2 H ^T		1-6	1-5	1-5	1-6	
IS201	Foundations of Information Systems	IT101	3	3	2 H ^T		1-8	1-11	1-6,8	1,3,4-7
IS211	File Organization	CS241	3	2	2 H ^T		2,8	2,4,8	1,5,7, 9,14	1,2,4, 8,9,11
IS231	Systems Analysis and Design	IT101	3				3,5,6,9 11,13,15,17,20	1,2, 4-8, 12,14,17	5,6,9	2,3,4,6, 8-10, 13,14
IT371	Web Programming	CS141, IT251	3				1-8	1-3	1-5	1-7

MM301	Introduction to Multimedia Technology	CS24	! 1	3									
			1	Special	ization re	equirer			1				
Course	_		_				No. of		Prog	grame II		overed ((by
Code	Course nai	me F	rereq	uisites	Credit		urs/w		a's		No.) b's	-/-	1/
				1 e	Level C	Lect.	Lab	Exer.	a's		b's	c's	d's
HUM112	2 English Langu	ıago II	HUN		2	2	_		1	,2	2,3	1-3	1-7
	Intellectual	iage II	1101	1111					1,2	<i>,</i> ∠	1-3	1-3	1-7
HUM122	Property		-		1	1							
HUM131	Behavior	1	-		2	2	-		1,2		1-3	1-3	1-7
HUM133	Computing Economics		_	•	2	2	-		1-6		1,2	1-3	1-7
HUM141	Computer Lav	V			2	2	-		1,2,1	15,16	1-5	1,3,13	1-4
HUM142	Privacy and C Liberties	ivil	_	•	1	1	-		1-3		1-4	2-3	1-3
HUM151	Hand Drawin	g	-		2	1	3 Hs		1-4		1,3 ,4	1,3	1-3
HUM152	History of Computing		_	•	2	2	-		2-6,9		1,3	2-4	1-3
HUM153	Islamic Cultur	e	_		1	1	-		1,2		1,2	1,2	1,2
HUM154	Scientific Thin	king	-		1	1	-		1-4		1-5	1,2	1,2
				2nd	Level C	Courses	5	•				_	
	Foundations of	of							1-10		1-10	1-6,8	
IS201	Information		IT1	01	3	3	2 H ^T	-					3-7
10044	Systems			\ 1.1		2	0 T TT		1.0		1.4	1.6	1
IS211	File Organizat		CS2	241	3	3	2 H ^T	-	1-9	,6,9	1-4	1-6 1-5	1-6
IS231	Systems Analy and Design	VS1S	IT1	01	3	3	_	2		,6,9 .5,17,20	1- 6,2-	1-5	1-8
	o o								,,	,,	15		
MATH20		II	MAT	H102	3	3	-	2	1-3		1-6	1-7	1-7
EE201	Digital Signal Processing		MATI	H201	3	3	2 H ^T	-	1-3		1-5	4	1-4
	11000001116			3rd	Level C	ourses	<u> </u> 					<u> </u>	
CS301	Operation Res	earch (CS201		3	3	2 H ^T	_	1-7,9		1-4	1-3	1-5
	Simulation and	d		202		3			1-9		1-4	1-3	
CS302	Modeling	N	MATH	1202	3		2 H ^T	ı					1-5
CS341	Visual Programming		CS211		3	3	2 H ^T	-	1-6		1-5	1-5	1-6
00050	Advanced		20054		2	_	2		1-7		1,3,6	1-4	
CS353	Computer Gra	phics (CS351		3	3	Но	-			,8		8
IT371	Web Programs		CS141,	IT251	3	3	2 H ^T		1-8		1-3	1-5	1-7
	Introduction to	0											
MM301	Multimedia		CS241		3	3	2 H ^T						
	Technology					_							
MATH30	1 Numerical An	alysis N	MATH		3	3	-		1-3		1-6	1-7	1-7
	A .1 1	<u> </u>		4 th	Level C	ourses	} 		1-4		1-5	2 =	
CS421	Advanced Operating Sys	tems	CS321		3	2	3 Hs					2-5	1-6
CS442	Programming Language Des		CS211, CE221		3	3	2 H ^T		1-6		1-5	1-6	1-6
CS451	Computer Animation	(CS352		3	3	2 H ^T		1-5		1-3	1-6	1-4

CS452	Computer Vision	CS241, PHYS102	3	3	2 H ^T	1-3	1-4	1-3	1-5
CS461	Intelligent Systems	CS361	3	3	2 H ^o	1-4	1-3	1-6	1-4
CS462	Machine Learning	CS361	3	3	2 H ^o	1-4	1-3	1-6	1-4
CS463	Pattern Recognition	CS361	3	3	2 H ^o	1-4	1-3	1-6	1-4
CS472	Software Quality Assurance and Testing	CS211, IT351	3	3	2 Ho	1-10	1- 6,16- 18	1-5	1-7
CS491	Advanced Database	CS391	3	3	2 H ^o	1-4	1-6	1-2	1-6
IS411	Distributed and Object Databases		3	3	2 H ^o	1-4	1-6	1-2	1-6
IS412	Data Mining and Business Intelligence	IS212	3	3	2 H°	1-5	1-8	1-6	1-5
IS414	Wireless and Mobile Computing		3	3	2 H ^o	1-9	1-6	1-5	1-7
IT431	Network Programming	IT251	3	3	2 H ^o	1-6	1-6	1-5	1-7
IT432	Web Programming	IT351	3	3	2 H ^o	1-8	1-3	1-5	1-7
IT371	Virtual Reality	CS141, IT251	3	3	2 H ^o				
MM411	Advanced Computer Architecture		3	3	2 H ^o	1-6	1-5	1-3	1-4
CE421	Embedded Systems	CE221	3	3	2 H ^o	1-6,8	1-5	1,3-5	1,2
CE422	Software Quality Assurance and Testing	CE221	3	3	2 H ^T	1-10	1- 6,16- 18	1-5	1-7

7. Contents of Courses

Syllabus: See the below

8. Program Admission Requirements

High score in secondary school education certificate in (Mathematical Section).

9. Regulations for progression and program completion

Please, refer to faculty bylaw (Curriculum of Undergraduate Programs), 2004, pages 4-5.

10. Student Assessment (Methods and rules for student assessment)

Method (tool)	Intended leaning outcomes assessed
1- Written examinations	Knowledge and Understanding - Intellectual Skills - Professional Skills - General Skills
2- Oral examination	Knowledge and Understanding - Intellectual Skills
3- Laboratory examination	Professional Skills - General Skills
4- Graduation project	Professional Skills - General Skills

5- Reports and homework	Knowledge and Understanding
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11. Program Evaluation

Evaluator	Tool	Sample
1- Senior students	Questionnaires	
2- Alumni	Questionnaires	
3- Stakeholders	Questionnaires,	
	Joint Discussion	
4-External Evaluator(s) (External Examiner(s))	Review Reports	

CS Program Matrices



Assiut University Faculty of Computers & Information Department of Computer Science Quality Assurance Unit



CS Undergraduate Program Matrices

The main description of Computer Science Program can be summarized in different types of matrices. These matrices are:

1. Academic Standards Matrix

This matrix shows the ILOs invoked in CS Program Specifications and those existing in NARS and the corresponding between them.

- Program Matrix I (Courses NARS General)
 This matrix shows how CS Program Courses can cover the NARS general ILOs.
- 3. Program Matrix II (Courses NARS Special)
 This matrix shows how CS Program Courses can cover the NARS special ILOs.
- 4. Program Matrix III (Courses Knowledge and Understanding Skills)
 This matrix shows how CS Program Courses can cover Knowledge and
 Understanding Skills invoked in CS Program Specifications.
- 5. Program Matrix IV (Courses Intellectual Skills)
 This matrix shows how CS Program Courses can cover Intellectual Skills invoked in CS Program Specifications.
- 6. Program Matrix V (Courses Professional and Practical Skills)
 This matrix shows how CS Program Courses can cover Professional and Practical Skills invoked in CS Program Specifications.
- 7. Program Matrix VI (Courses Transferable Skills)
 This matrix shows how CS Program Courses can cover Transferable Skills invoked in CS Program Specifications.
- 8. Program Matrix VII (Aims ILOs)
 This matrix shows how CS Program ILOs can cover the program aims.
- 9. Teaching and Learning Methods Matrix VIII (ILOs-Teaching and Learning Methods)

This matrix shows what teaching methods are covered by CS Program ILOs.

10. Assessment Methods Matrix VIIII (ILOs-Assessment Methods)
This matrix shows what assessment methods are covered by CS Program ILOs

Academic Standards (Knowledge and Understanding Skills) (October 2010) Computer Sciences

CS Program ILOs		ponding NARS	NARS ILOs - General	NARS ILOs - Special
a1. Recognize the essential mathematics relevant to computer science.a2. Explain code written in high-level programming languages.		A1 A2	1. Essential facts, concepts, principles and theories relating to computing and information and computer applications as appropriate to the program of study.	A1. Understand the essential mathematics relevant to computer science.
a3. Demonstrate basic knowledge and understanding of a core of mathematical analysis.	K4	A3	2. Modeling and design of computer-based systems bearing in mind the trade-offs.3. Tools, practices and methodologies used	A2. Use high-level programming languages. A3. Demonstrate basic knowledge and
a4. Demonstrate basic knowledge and understanding of a core of statistics	K4	A3	in the specification, design, implementation and evaluation of computer software systems.	understanding of a core of analysis, algebra, applied mathematics and statistics.
a5. Interpret and analyze data qualitatively and/or quantitatively.		A4	4. Criteria and specifications appropriate to specific problems, and plan strategies for	A4. Interpreting and analyzing data qualitatively and/or quantitatively.
a6. Describe the principles and techniques of a number of application areas informed by the research directions of computer science.	K5	A5	their solution. 5. The extent to which a computer-based system meets the criteria defined for its	A5. Know and understand the principles and techniques of a number of application areas
a7. Show a critical understanding of the principles of artificial intelligence, image, and pattern recognition.	K1	A6	current use and future development. 6. The current and underlying technologies that support computer processing and inter-computer communication.	informed by the research directions of the subject, such as artificial
a8. Define the fundamental topics in computer systems, including hardware architectures and operating systems.	K1	A7	7. Principals of generating tests which investigate the functionality of computer programs and computer systems and	intelligence, databases and computer graphics. A6. Show a critical understanding of
a9. Define of fundamental topics in computer science, including software architectures, software engineering principles and methodologies, and software tools.	K1	A7	evaluating their results. 8. Management and economics principles relevant to computing and information disciplines.	the principles of artificial intelligence, image, and pattern recognition. A7. Understanding of fundamental
a10. Define advanced topics to provide a deeper understanding of some aspects of the hardware systems design, operating systems, computer security and compiler theory.		A8	9. Professional, moral and ethical issues involved in the exploitation of computer technology and be guided by the	topics in Computer Science, including hardware and software architectures, software engineering
a11. Discuss advanced topics to provide a deeper understanding of some aspects of object-oriented analysis and design, and software engineering.		A8	appropriate professional, ethical and legal	principles and methodologies, operating systems and software tools.

CS Program ILOs	Corresp in N	onding ARS	NARS ILOs - General	NARS ILOs - Special
a12. Identify advanced topics to provide a deeper understanding of some aspects of the artificial intelligence, image processing, and computer graphics and animation. a13. Express strong knowledge of fundamentals of programming and the construction of computer-based systems. a14. Describe strong knowledge of fundamentals of data structures and algorithms. a15. Show a critical understanding of the broad context within computing including issues such as quality, reliability, enterprise, employment law	K1,K2 K1	A8	practices relevant to the computing and information industry. 10. Current developments in computing and information research. 11. Requirements, practical constraints and computer-based systems	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.
and accounting. a16.Provide a deeper understanding of legal, professional and moral aspects of the exploitation of computing.	K8,K9			
a17. Recognize the knowledge of tools, practices and methodologies used in the specification, design, implementation and critical evaluation of computer software systems.	K3			
a18. Define and assess criteria for measuring the extent to which a computer system is appropriate for its current deployment and future evolution.	K5			
a19. Define of the current and underlying technologies that support computer processing and inter-computer communication.	K6			
a20. Define of the principals of generating tests which investigate the functionality of computer programs and computer systems and evaluating their results.	K7			

Academic Standards (Intellectual Skills)

CS Program ILOs	Corresponding in NARS	NARS ILOs - General	NARS ILOs - Special
b1. Formulate traditional and nontraditional problems, set goals towards solving them, and observe results.	B1	I1. Analyze a wide range of problems and provide solutions related to the design and construction of computing systems through	B1. Define traditional and nontraditional problems, set goals towards solving them,
b2. Compare between (algorithms, methods, techniquesetc). b3. Classify of (data, results, methods, techniques, algorithms etc.).	B2 B3	suitable algorithms, structures, diagrams, and other appropriate methods. I2. Apply the concepts, principles, theories and	and. observe results. B2. Perform comparisons between (algorithms,
b4. Identify attributes, components, relationships, patterns, main ideas, and errors.	B4	practices underpinning computing as an academic discipline. I3. Understand and analyze problems and	methods, techniquesetc). B3. Perform classifications of (data, results, methods,
b5. Conclude the result of the proposed solutions.b6. Restrict solution methodologies upon their results.	B5 B6	evaluate computer software systems for their solution.	techniques, algorithms etc.).
b7. Compose criteria, and verify solutions.	B7	I4. Define and assess criteria to measure the appropriateness of a computer system for its current deployment and future evolution, and	B4. Identify attributes, components, relationships, patterns, main ideas, and
b8. Identify a range of solutions and critically evaluate and justify proposed design solutions.	B8	to interpret the results thereof. 15. Analyze, propose and evaluate alternative computer systems and processes taking into	errors. B5. Summarize the proposed solutions and their results.
b9. Solve computer science problems with pressing commercial or industrial constraints.	В9	account limitations, constraints, fit-for- purpose, general quality, and possible trade- offs within the parameters of the problem.	B6. Restrict solution methodologies upon their results.
b10. Generate an innovative design to solve a problem containing a range of commercial and industrial constraints.	B10	I6. Synthesize ideas, proposals and designs effectively using rational and reasoned	B7. Establish criteria, and verify solutions.
b11. Formulate and model computer systems at different and appropriate levels of abstraction.		arguments for presentation to a range of audiences. I7. Generate and evaluate the results of tests to	B8. Identify a range of solutions and critically evaluate and justify proposed design
b12. Create and/or justify designs to satisfy given requirements (synthesis, evaluation, application).	13, 18	investigate the functionality of computer systems. I8. Reach computing judgments considering	solutions. B9. Solve computer science problems with pressing
b13. Analyze and evaluate a range of options in producing a solution to an identified problem.	15	balanced costs, benefits, safety, quality, reliability, and environmental impact.	commercial or industrial constraints.

b14. Analyze problem from written descriptions; derive requirements	I1	I9. To be guided by the professional, legal, moral	B10. Generate an innovative
specifications from an understanding of problems (analysis,		and ethical issues relevant to the computing	design to solve a problem
synthesis).		industry.	containing a range of
		I10. Read and evaluate research papers in a range	commercial and industrial
b15. Outline the concepts, principles, theories and practices	12	of knowledge areas.	constraints.
underpinning computing as an academic discipline.			
b16. Develop and assess criteria to measure the appropriateness of a	I4		
computer system for its current deployment and future evolution,	17		
and to interpret the results thereof.			
and to interpret the results dicreor.			
b17. Create ideas, proposals and designs effectively using rational and	I6		
reasoned arguments for presentation to a range of audiences.			
b18. Evaluate the results of tests to investigate the functionality of	I7		
computer systems.			
	1		

Academic Standards (Professional and Practical Skills)

CS Program ILOs	Correspor	_	NARS ILOs - General	NARS ILOs - Special
c1. Use appropriate programming languages and design methodologies.		C1	P1. Operate computing equipment effectively, recognizing its logical and	C1. Use appropriate programming languages, web-based systems and tools, design methodologies, and database systems.
c2. Use appropriate web-based systems, tools and design methodologies.	(C1	physical properties, capabilities and limitations.	C2. Communicate effectively by oral, written and visual means. C3. Perform independent information acquisition and
c3. Use appropriate database systems.	(C1	P2. Effectively deploy computers to solve	management, using the scientific literature and Web sources.
c4. Perform independent information acquisition and management, using the scientific literature and Web sources.	(C3	practical problems. P3. Deploy effectively the knowledge and tools used	C4. Prepare and present seminars to a professional standard.C5. Perform independent information acquisition and management, using the scientific literature and Web
c5. Specify, design, and implement computer-based systems.	P2 (C7	for the construction and documentation of	sources. C6. Prepare technical reports, and a dissertation, to a
c6. Evaluate systems in terms of general quality attributes and possible tradeoffs presented within the given problem.		C8	computer applications.	professional standard; use IT skills and display mature computer literacy.

 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. 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. c9. Identify any risks or safety aspects that may be involved in the 	P7	C9 C10 C11	P4. Work effectively individually, under direct supervision and/or as part of a team. P5. Use an appropriate mix of tools and aids in preparing and presenting reports for a range of audiences, including management, technical, users or the	 C7. Specify, design, and implement computer-based systems. C8. Evaluate systems in terms of general quality attributes and possible tradeoffs presented within the given problem. 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. 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
operation of computing equipment within a given context.			academic community.	multimedia systems.
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.	Р3	C12	P6. Commercialize knowledge and skills to computing community and industry. P7. Assess the implications, risks or safety aspects	 C11. Identify any risks or safety aspects that may be involved in the operation of computing equipment within a given context. C12. Deploy effectively the tools used for the construction and documentation of software, with particular emphasis on
c11. Make effective use of general computing facilities, plan and manage a project to complete within budget and schedule.	P1		involved in the operation of computing equipment within a specific context.	understanding the whole process involved in using computers to solve practical problems. C13. Prepare technical reports, and a dissertation, to a
c12. Appreciate and manage the need for continuing professional development in recognition of the need for lifelong learning.		СЗ	widini a specific context.	professional standard.
c13. Address and apply professional, moral and ethical issues within the discipline.	I9			
c14. Operate computing equipment efficiently, taking into account its logical and physical properties.	P1			
c15.Use investigative skills to research new and novel aspects of their work.	I10			
c16.Apply tools and techniques for the design and development of applications.	P2			

Academic Standards (Transferable Skills)

CS Program ILOs	_	onding in ARS	NARS ILOs - General	NARS ILOs - Special
d1. Communicate effectively by oral, written and visual means.d2. Work effectively as an individual and as a member of	T6	C2	T1. Demonstrate the ability to make use of a range of learning resources and to manage one's own learning. T2. Demonstrate efficient skills in team management, time	-
a team.			management and organizational skills. T3. Show effective information-retrieval. T4. Work in stressful environment and within constraints,	
d3. Collaborate effectively within multidisciplinary team.	P4		cope with multiple tasks.	
d4. Work in stressful environment and within constraints.	T4		T5. Exhibit appropriate numeracy skills in understanding and presenting cases involving a quantitative dimension.	
d5. Prepare and present seminars to a professional standard.	P5	C4	T6. Exhibits communication skills, public speaking and Presentation skills, and delegation, writing skills, oral delivery, and effectively using various media for a variety	
d6. Prepare technical reports, and a dissertation, to a professional standard; use IT skills and display mature computer literacy.		C6	of audiences. T7. Display effective use of general computing facilities. T8. Develop a range of fundamental research skills, through	
d7. Demonstrate efficient IT capabilities.	T3, T7		the use of online resources, technical repositories and library-based material.	
d8. Lead and motivate individuals.			T9. Demonstrate an appreciation of the need to continue professional development in recognition of the	
d9. Manage tasks and resources.	T2		requirement for Life Long Learning.	
d10. Search for information and adopt life-long self-learning.	T3, T9	C5		
d11. Acquire entrepreneurial skills.	P6			
d12. Manage one's own learning and development	T1, T9			
d13. Prepare their work in the form of reports	P5	C13		
d14. Communicate effectively with team members, managers and costumers.	Т6	C2		

d15. Exhibit appropriate numeracy skills in understanding	T5	
and presenting cases involving a quantitative		
dimension.		
d16. Develop a range of fundamental research skills,	Т8	
through the use of online resources, technical		
repositories and library-based material.		

Academic Standards Matrix

	Knowledge and Un	nderstanding Sk	ills
NARS ILOs General	Covering ILOs in CS Program	NARS ILOs Special	Covering ILOs in CS Program
K1	a7, a8, a9, a13, a14	A 1	a1
K2	a13	A2	a2
К3	a17	A3	a3, a4
K4	a3, a4	A 4	a5
K5	a6, a18	A 5	a6
К6	a19	A 6	a7
K 7	a20	A 7	a8, a9
K8	a15	A8	a10, a11, a12
К9	a16		

	Intellectu	al Skills	
NARS ILOs General	Covering ILOs in CS Program	NARS ILOs Special	Covering ILOs in CS Program
General	30 1 1081	орсски	30 1 10814111
I1	b14	B1	b1
I2	b15	B2	b2
I3	b12	В3	b3
I4	b16	B4	b4
I5	b13	B5	b5
I6	b17	В6	b6
I7	b18	B 7	b7
I8	b12	В8	b8
I 9	c13	В9	Ь9
I10	c15	B10	b10

	Professional and	l Practical Skill	s
NARS ILOs	Covering ILOs in	NARS ILOs	Covering ILOs in
General	CS Program	Special	CS Program
P1	c11, c14	C1	c1, c2, c3
P2	c5, c16	C2	d1, d14
Р3	c10	C3	c4, c12
P4	d3		
P5	d5, d13	C4	d5
P6	d11	C5	d10
P 7	c 9	C6	d6
		C 7	c5
		C8	с6
		C9	c 7
		C10	c8
		C11	c9
		C12	c10
		C13	d13

Tran	sferable skills
NARS ILOs	Covering ILOs in CS
General	Program
T1	d12
Т2	d2, d9
Т3	d7, d10
Т4	d4
Т5	d15
Т6	d1, d14
T 7	d7
Т8	d16
Т9	d10, d12

CS Program Courses

	Course Code	Course Title		Course Code	Course Title
	CS141	Programming Fundamentals		CS311	Algorithm Design and Analysis
	IT101	IT Fundamentals		CS321	Operating Systems
	MATH101	Mathematics I		CS342	Automata and Language Theory
_	MATH102	Mathematics II	_	CS351	Computer Graphics
vel	PHYS101	Physics I	evel	CS352	Image Processing
[e]	PHYS102	Physics II	Ĺe	CS361	Artificial Intelligence
1st]	EE101	Electronics	3rd]	CS381	Software Development and Professional Practice
7	EE102	Digital Circuits	60	CS382	Field Training
	HUM111	English Language I		CS391	Software Engineering
	HUM121	Social Context of Computing		IT351	Computer Networks
	HUM132	Interpersonal Communication			
	CS201	Discrete Structures		CS431	Parallel Computation
	CS211	Data Structures and Algorithms		CS441	Compiler Construction
	CS241	Object-Oriented Programming		CS471	Introduction to Computer Security
160	IS212	Databases	7	CS481	Capstone Project I
evel	IS221	Project Management	evel	CS482	Capstone Project II
	IT251	Data Communications	\vdash		
2nd	CE221	Computer Architecture	4th		
0	MATH202	Probability and Statistics	4		
	HUM231	Business Administration			
	HUM232	Technical Writing			
	HUM241	Computers and Ethics			

		Elective	e Courses	}	
	Course Code	Course Title		Course Code	Course Title
	HUM112	English Language II		CS301	Operation Research
	HUM122	Intellectual Property		CS302	Simulation and Modeling
	HUM131	Organizational Behavior		CS341	Visual Programming
6	HUM133	Computing Economics	el	CS353	Advanced Computer Graphics
1st Level	HUM141	Computer Law	3rd Level	IT371	Web Programming
Ĭ	HUM142	Privacy and Civil Liberties	\mathbf{T}_{1}	MM301	Introduction to Multimedia Technology
1st	HUM151	Hand Drawing	3^{rd}	MATH301	Numerical Analysis
	HUM152	History of Computing			
	HUM153	Islamic Culture			
	HUM154	Scientific Thinking			
	IS201	Foundations of Information Systems		CS421	Advanced Operating Systems
	IS211	File Organization		CS442	Programming Language Design
	IS231	Systems Analysis and Design		CS451	Computer Animation
	MATH201	Mathematics III	1	CS452	Computer Vision
	EE201	Digital Signal Processing	4 th Level	CS461	Intelligent Systems
			Le	CS462	Machine Learning
			th]	CS463	Pattern Recognition
el			4	CS472	Cryptography
2nd Level				CS491	Software Quality Assurance and Testing
				IS411	Advanced Database
				IS412	Distributed and Object Databases
				IS414	Data Mining and Business Intelligence
				IT431	Wireless and Mobile Computing
				IT432	Network Programming
				IT371	Web Programming
				MM411	Virtual Reality
				CE421	Advanced Computer Architecture
				CE422	Embedded Systems

Program Matrix I (Courses - NARS General)

							_							_											era							_				
		K1	K2		K4	K5	K6	K7	K8	K9		I2	I3	I4	I5	I6	I7	I8	I9	10	P1	P2	P3	P4	P5	P6	P7	T1	T2	Т3		T5	T6	Г7	Т8	Т9
	CS141	✓		✓						Ш	✓	✓			✓						✓	✓						✓	✓	Ш	✓		✓			
	IT101	✓									\checkmark																	\checkmark		Ш		\checkmark		\checkmark		
	MATH101																					\checkmark							✓				\checkmark			
	MATH102																					\checkmark														
	PHYS101										√										✓						✓		✓				\checkmark			
	PHYS102	✓							\checkmark		\checkmark						\checkmark				✓				✓		✓		✓				✓			
	EE101																				√						✓	√	✓		√		✓			√
	EE102	✓																			П						✓	✓	✓				✓			✓
	HUM111										√									П			✓	√	√			\checkmark		√			✓			✓
'el	HUM112										✓												√	✓	√			✓		✓			✓			
1st Level	HUM121								✓	√													√	✓	✓			✓		✓			✓			
st I	HUM122																	Ì						√				√	√		V		√		V	√
	HUM131														T						T					√			√		√		√	T		√
	HUM132																			T			√	√	√		\blacksquare						√	T	V	
	HUM133			√															√	T							√	П	√			√		T		
	HUM141								√	√							T			Ħ				√				П	√		√		√	T	T	
	HUM142															\neg	\dashv		\neg	ヿ								П			✓		\neg	\dashv	\dashv	\dashv
	HUM151																十			T							\exists		√					\dashv	十	\dashv
	HUM152	√															\dashv			Ħ							$\overline{}$						√		\dashv	
	HUM153																\dashv							√			\dashv	Н	√					\dashv	\dashv	
	HUM154																\dashv							•			\dashv	Н			√			\dashv	\dashv	
	CS201	√							√								\dashv							√	√				√	√	√		√	√	\dashv	\dashv
	CS211	· ✓						√	H						\dashv	\dashv	\dashv		\dashv		\dashv			·	·		\neg		·	·	·	\dashv	·	·	\dashv	\dashv
	CS241		√							\vdash		√			\dashv	\dashv	+		\dashv	\dashv	\dashv	√		\dashv			-		√	√	√		√	√	+	\dashv
	IS201	√					√	\vdash		\vdash	√	-	√		\dashv	\dashv	+	√	\dashv	\dashv	\dashv	√		\dashv		√	√		· ✓	· ✓			√	√	+	\dashv
	IS211	· ✓									-				\dashv	\dashv	\dashv		\dashv	\dashv	√	√		\dashv		· ✓	· ✓	Н	· ✓		√		√	+	\dashv	\dashv
	IS211	· ✓											√			\dashv	+	√	\dashv	\dashv		✓	√	\dashv		· ✓			· ✓	√			√	√	+	\dashv
	IS212			√				√	√	\vdash					\dashv	\dashv	\dashv		\dashv	\dashv		-		√		· ✓		Н	· ✓		V		√	·	\dashv	\dashv
vel	IS231	√		· ✓			√	1 🗸	·	\vdash	V		√		\dashv	√	+	V	\dashv	\dashv	\dashv	√		· ✓	√	Ť	√		· ✓	√	·	\dashv	·	$\dot{+}$	+	V
2nd Level	IT251	·		•			· √	H	H	\vdash	•		·		\dashv	$\dot{\dashv}$	\dashv	·	\dashv		\dashv	· ✓			·	√		√	· ✓	·	·	\dashv		√	\dashv	· ✓
pu.	CE221	√	√			√	,	\vdash					,		\dashv	\dashv	\dashv	·	\dashv	\dashv	√	v		\dashv		• ✓	√	· √	· √	· √	v	\dashv		· /	\dashv	·
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	HUM241						✓		√	√					\dashv	\dashv	\dashv	_	√	\dashv			V	=	V	√	=	Н	✓ ✓	V	√		✓ ✓	V	V	\dashv
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	CS302 CS311		٧					\vdash	V	\vdash					\dashv	\dashv	\dashv		\dashv	–	\dashv	√	\dashv	\dashv			\dashv	√		V	\vdash	\dashv	\dashv	+	∨	./
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	CS321	V				./				\vdash	√	٧		٧	V	\dashv	\dashv	_	\dashv	\dashv	\dashv			٧	٧	٧	-	٧		$\vdash\vdash$	\vdash	\dashv		\dashv	*	v
	CS342					✓		\vdash		\square	٧					\dashv	\dashv	√	\dashv	4	\dashv	√		\dashv	$\vdash \vdash$		\dashv	Н	√	$\vdash\vdash$	\vdash	\dashv	√	+	\dashv	\dashv
/el	CS341	V	√					\vdash		Н		√	√		✓	\dashv	\dashv	٧	\dashv	\dashv	\dashv	V	√	=		√	_	\vdash	√		\vdash	\dashv		\rightarrow	\dashv	_
3rd Level	CS351							\vdash		\blacksquare					\dashv	\dashv	\dashv	-	\dashv	4	\dashv		\dashv	\dashv		√	_	Н	√	√	\vdash	\dashv	√	√	+	4
rd]	CS352								V	Ш						\dashv	\dashv		\dashv	4	\dashv			\square		√	_	Н	√	√	\vdash	\dashv	V	√	+	_
κ	CS353									Ш						\dashv	\dashv	_	\dashv	4	\dashv			\dashv		✓	_	Н	√	√	\vdash	\dashv	√	√	\dashv	\dashv
	CS361						Щ		Ш	Ш						\dashv	_		_	4	\dashv	V		\square		√	_	Ц	V	V	\dashv	_	✓	√	\dashv	_
	CS381	V		√				√		Щ		✓			V	\dashv	√	√	\dashv	4				\dashv		✓	V		√	Ш	V	\dashv		\dashv	\dashv	_
	CS382								Щ	Ш						_	_		_	4	V		V				V	Ц	✓	Ш	V	_	V	_	_	
	CS391	\checkmark	\checkmark	✓		✓	[✓	1 ✓		Ш	\checkmark	\checkmark	\checkmark				\checkmark	\checkmark		Ī		\checkmark					✓		\checkmark	✓			\checkmark			✓
	IT351				√		√	-	$\overline{}$	_			-		$\overline{}$	\rightarrow			\rightarrow	_	√	$\overline{}$	$\overline{}$	$\overline{}$	$\overline{}$	√	√	$\overline{}$		√	√	$\overline{}$	√	_		√

	IT371	√	1	Т	Τ	T	T																								√	√	1		✓		٦
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	MATH301	П										Т									╗		√							√					√		٦
	CS421	П		,	/							Т			√						╗				√			√		√	√	√		√	√		٦
	CS431	✓	v																				✓							√				✓			
	CS441												✓											√						√				✓			
	CS442		v										✓										✓				√			√	√			✓	√		
	CS451																													✓						√	
	CS452	✓																											Т		√	✓			√		
	CS461																						√				√			✓	√			√	√		
	CS462									√											✓				√				Т	√				✓			
	CS463	✓																													√	✓			√		
	CS471			,	1										✓													✓		√		✓		✓			
'el	CS472	✓										✓	✓										✓		√					√			✓	√			
4th Level	CS481	√								√							√	√		√	✓		√	√	√	√		✓		√		√		√		√	٦
th I	CS482	√								√							√	√		√	✓		√	√	√	√		✓		√		√		√		√	٦
4	CS491	√								√											T				√	√				√	√	√		√	√		٦
	IS411	√												√					√				√	√			√			√	√			√	√		
	IS412									√											✓				√					✓				√			
	IS414									√											✓				√					√				√			
	IT431			,	/				√				√											√						√				√		✓	
	IT432	√																													√	√			√		
	IT371	✓																													√	√			√		
	MM411	√																													√	√			√		
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	CE422							✓							√				√									√		√						V	
		K1	K2	K3	K4	4 K	.5 I	K6	K7	K8	K9	I1	I2	13	I4	I5	I6	17	I8	I9	I10	P1	P2	Р3	P4	P5	P6	P7	T1	T2	Т3	T4	Т5	Т6	T7	Т8 Т	9

Program Matrix II (Courses - NARS Special)

I –			2	3	4	5	6	7 8						B6	В7			0								C8		C1 0	1	2	C1 3
	CS141	✓	√	V	√	√	√	V	√	√	√	√	√						√	√		√									
<u>ا</u>	IT101	✓	√	V	√	√		✓	✓	√	√								✓	√	✓										
	MATH101	✓	√						√					✓					√	√											П
]	MATH102	✓	√	✓	V				V	√	√	√	√	✓					√	√	✓						П				П
	PHYS101	✓	√	√	√	√			√	√	√	✓							√	√	✓	V		✓	√	√	√				П
	PHYS102	✓	√	· V	√		√		√	√	√	√							√	√	✓	√		√	√		П				П
	EE101	✓	√	V	√				√	√	√	√	√	✓					√	√	✓	√		✓	√		П				П
	EE102	✓	√	V	✓	√	√	✓	√		√	✓	✓	✓	✓	✓			√	✓	✓	V			√	√	П				
	HUM111			V								✓							П	√	✓			✓	√					√	V
[e]	HUM112	✓	√						√	√	√								√	√		V		✓							П
eV.	HUM121	✓	√						√	√									√	√							П				П
st I	HUM122	✓	√						√	√	√								√	√		√		√							Н
-	HUM131	√	√						√	√	√								√	√		√		√			П				Н
	HUM132	√	√	✓	V				√	√	√	√							√	√	√				√		Н				Н
	HUM133	√	√						√	√									√	√							Н				Н
	HUM141	✓	√						√	√									√	√		√		√			Н		H		Н
	HUM142	√	√	· V	V	√			√	√	√	√							√	√							Н		H		
	HUM151				√		√	√ ∨	√	√	√								√	√				Н			Н				Н
l ⊢	HUM152		√	· V	√	✓		√	√		√								· ✓	· ✓	✓			Н			Н				Н
	HUM153	√	√						√	√									√	√				Н			Н				Н
l ⊢	HUM154	· ✓	· •	· V	V				· •	· •	√	√	√						· •	· •		=		Н			Н		=		Н
	CS201	· ✓	·		·				· ✓	· •	· ✓	· ✓	· •	√					· •	· •	√			Н			\vdash				Н
l ⊢	CS211	· ✓	·	· V	V				· •	· •	Ė							√	· •	· •	· ✓	√		√	√	√	Н		=		
l ⊢	CS241	· ✓	·	· V					· •	· ✓	√	√	√						· •	· •	· ✓	· •		V	· ✓	· ✓	\vdash				Н
l ⊢	IS201	• •	,	· ·		✓	√	√ √	· ✓	· •	· ✓	• •	• •	√	√	√	√	√	· ✓	• •	• •	· ✓		· ✓	· ✓	· ✓	Н	√	=		Н
l ⊢	IS211	Ť	·	H	Ť	Ť	·	√ ·	Ě	· ✓	Ť	· ✓	Ť	Ť	,	· ✓		Ť	· •	· ✓	Ť	Ť		Ė	· ✓	Ė	√	Ť			Н
l ⊢	IS211	√	▼	· V	√	✓	√	•	√	• ✓	√	∨	√			•			· ✓	• •	√	√		√	· ✓	√	H				Н
 	IS212	• ✓	· ✓	Ľ	Ť	Ť	•		· ✓	• ✓	Ť	Ť	Ť						· ✓	• •	Ť	· ✓		· ✓	Ť	Ť	Н				Н
- e	IS231	٧	•	-/	√	✓		√ √	v	⋄		√	√	✓	√	√			Ť	∨		ď	√	v	√	√	$\vdash\vdash$		√		
	IT251	✓	√	✓		∨	✓	V	V	∨	√	∨	∨	∨	٧	•			✓	∨	✓	√	٧	v √	• •/	ľ	$\vdash\vdash$		•		V
_ [CE221	∨	∨					√	v v	∨	∨	∨	∨	٧					∨		٧	•		ď	٧	H	Н		\blacksquare		Н
I —	MATH201	٧	٧	V	٧	٧	٧	٧	·	٧	٧	٧	٧	/		√			·	√		\blacksquare		Н		H	Н		\blacksquare		Н
_	MATH202	✓	√											✓		V				√				Н			Н				
I –									V	v		V	V	V					V	V				Н			Н				
l ⊢	EE201 HUM231	✓	√	-					V	√	√	√	√						Н	✓	٧						Н				Н
l ⊢	HUM232	✓	√						V	√	√								V	√		√		√			Н				
l ⊢	HUM241	✓	√		-				V	√	√								V	✓		√		✓			Н		\blacksquare		Н
		✓	√					-	V	√	√								V	✓		√		✓			Н				Н
_	CS301	√	√				√	√	V	√	√	√							V	✓		√		Н			Н				Н
I ⊢	CS302	√	√	-			√	✓	V	√	√	✓							V	✓		√									Н
I –	CS311	√	√					,		√	√	√	√	✓	✓	√	✓	√	Н	✓		✓		√	√	√	✓				Н
I –	CS321	√	√			_	√	✓	V	√	√	√	√						V	√	✓			Ш	√		Ш				Ш
	CS342	√	√	-			Н		V	√	√	√	√	Н					V	√	√	√		Н	√		Ш	Н	Ш		Н
> _	CS341	✓	✓	✓	√	√			V	√	✓	√	✓	Щ					√	✓	✓	√		√	✓		Ш	Щ	Ш		Ц
<u> </u>	CS351	Щ							Н			Щ	√	✓					Ц		Щ	Ш		Щ			Ш	Щ	Ш		Ц
<u>~</u>	CS352	✓		-				✓	V	√	√	√	✓	✓					V	✓		√		√	✓		Ш	Щ	Ш		Ц
	CS353	✓	√	-			√		V		✓	Щ		✓		√			V		✓	Ш		Щ			Ш	Щ	Ш		Ц
I –	CS361	✓	√				√		✓	✓	✓	✓	✓	✓		√			V	✓	✓	✓		✓	✓	✓	Ш	Ш	Щ		Ц
l ⊢	CS381	✓	✓	-				√ ✓	✓	✓	✓	✓	✓	✓	√	√	√		Н	✓	✓	✓		✓	✓	✓					Ш
_	CS382	✓	√				√	✓	✓	✓	✓	✓	✓	✓	✓	√	√	✓	Н	✓	✓	✓		✓	✓	✓	✓	✓	Щ		Ц
'	CS391	✓	√	V	√	✓	✓	√ ✓	✓	✓	✓			✓			✓	V	✓	✓	✓	✓		✓	✓	✓					

	IT351							/							/	√	√												$\overline{}$	$\overline{}$	
		V	_	✓	√	✓	√	√ ∨		√	√	✓	√	✓	✓	V	V	_	V	V	√	V		V	V	√			\dashv	-	_
	IT371	✓	✓	✓		✓	✓	√ ∨	V	✓	✓							_	V	√		V		V	√				_	_	
	MATH301	✓	√	✓					✓	✓	✓	✓	✓	✓					✓	✓	✓	V		✓	✓	✓	✓		_	_	
	CS421	√	√	✓					✓	✓	✓	✓	✓						✓	✓	✓	✓		✓	✓						
	CS431	✓	√	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓						✓	✓	✓										
	CS441	✓	✓	✓	✓	✓					✓	✓	✓	✓					✓	✓	✓										
	CS442	√	✓	✓	✓	V			✓	✓	✓	✓	✓						✓	✓	✓	√		✓	✓	✓			П		
	CS451	✓	√	✓	✓				✓	✓	✓								✓	√	√				√	✓					
	CS452	√	√	V					✓	✓	✓	✓						П	✓	√		√							\Box		
	CS461	✓	√	√					✓	√	√							П	✓	√	V				√	✓			\neg	\neg	
	CS462	V	√	√					✓	√	√							П	✓	√	V				V	✓			\neg	\neg	
	CS463	V	√	√					✓	√	✓							П	√	V	V				V	✓			\exists	\neg	
	CS471	√	✓	√	√	V	√	✓		√	√	√	V	√				П	V	V	V					✓	V		T	\exists	
eJ	CS472	V	√	√	✓	√	√	√ v	√	√	√	√	V	V				┪	√	V	V	V		V	V				\dashv	\dashv	
evel	CS481	√	√	√	✓	√	√	√	√	√	√	√	V	V	√	√	√	V	√	V	V	V		V	V	√	√	√	\dashv	\dashv	
l H	CS482	√	√	√	√	✓	√	√	√	√	√	√	√	V	✓	√	√	V	√	√	√	V		V	√	√	√	√	\dashv	\dashv	
4 th	CS491	√	√	√					√	√	√	√	√	V				\exists	√	√	\exists	V		V	\exists				\dashv	\dashv	
	IS411	√	√	√					✓	√	√	√	√	V	$\overline{}$			\exists	√	√	\dashv	V		√	\dashv				\dashv	\dashv	
	IS412	· V	·	·	√	_			· •	· •	· •	· •	· •	· •	√	√		-	· •	· •	√	· •	\dashv		√	√			\dashv	\dashv	
	IS414	· ✓	·	·	· ✓	H	√	√	· •	· ✓	· •	· •	· •	· •	Ť	•		\dashv	· √	· •	· •	· ✓		V	· •	Ť	=		\dashv	\dashv	
	IT431	· •		H				V	v	v	v	∨	V	v V	-			-	v	-		v		v 	·				+	\dashv	
	IT431 IT432			H	∨	_ v	√	√	Ľ.			٧	٧	v	-			\dashv		√					v √				\dashv	\dashv	
		V		√		H	٧	V	V	√	√				_			-	V		√	✓		V	V				\dashv	\dashv	_
	MM411	V	√	√		✓			V	√	√	√			_			_	V	√									\dashv	\dashv	
	CE421	V	✓	✓	√	√		✓	V	√	√	√	√					_	V	√	√				√				4	_	
	CE422	√	√	√	√	· V	√	✓ ✓		√	√	√	√	√	Do	DO.	D10 1	C1	√	√	√	√	C(√	√	CO	C1	C1	01	C1	_
	A1	A 2	A 3	A 4	A 5	A 6	A 7	A B1 8	В2	В3	B4	B5	В6	B7	B8	В9	B10 (CI	C2	C3	C4	C5	C6	C7	C8	<u> </u>	C1 0	C1 1	C1 (C1 3	

Program Matrix III (Courses - Knowledge and Understanding Skills)

	Code	Course	a1	a2	a3	a4	a5	a6	a7	a8	a9	a10	a11	a12	a13	a14	a15	a16	a17	a18	a19	a20
	CS141	Programming Fundamentals	✓	✓	V	√	✓	√	✓				√	√	√	√						
	IT101	IT Fundamentals	✓	✓	V	√	✓	√		√	✓											
	MATH101	Mathematics I	✓	✓																		
	MATH102	Mathematics II	✓	✓	V	√	✓															
el	PHYS101	Physics I	✓	✓	V	√	✓	√														
1st Level	PHYS102	Physics II	✓	✓	~	√	√		√													
1st]	EE101	Electronics	√	√	√	>	\															
	EE102	Digital Circuits	✓	√	✓	~	✓	~	✓	✓												
	HUM111	English Language I																				
	HUM121	Social Context of Computing	√	>													√	>				
	HUM132	Interpersonal Communication	√	>	~	>	>															
	CS201	Discrete Structures	✓	✓																		
	CS211	Data Structures and Algorithms	√	√	~	√	√															
	CS241	Object-Oriented Programming	✓	√	✓	√																
	IS212	Databases	✓	√	√	√	√	√	√													
el	IS221	Project Management	√	√													√	√	√			√
2nd Level	IT251	Data Communications	√	√	~	√		√	✓												✓	
T pi	CE221	Computer Architecture	✓	√	√	√	√	√	√	V										✓	√	
2	MATH202	Probability and Statistics	√	√	~	√	√															
	HUM231	Business Administration	√	√													✓	√				
	HUM232	Technical Writing	√	√	✓																	
	HUM241	Computers and Ethics	✓	✓													✓	✓				
																						<u> </u>
	CS311	Algorithm Design and Analysis	✓	✓	~	~	√															<u> </u>
	CS321	Operating Systems	√	√	✓	~	√	~	√	✓												<u> </u>
	CS342	Automata and Language Theory	√	✓	✓	✓	✓													√		
	CS351	Computer Graphics	✓	√	✓	~	√	~	✓													
7	CS352	Image Processing	√	~	✓	~	✓	~	✓	✓												
Level	CS361	Artificial Intelligence	✓	√	✓	~	√	~														
3rd L	CS381	Software Development and Professional Practice	✓	✓	✓	~	✓	~	V	✓	✓	✓										
	CS382	Field Training	√	√	√	√	√	√	✓	√												
	CS391	Software Engineering	√	√	√	√	✓	√	✓	√	✓	√							√			✓
	IT351	Computer Networks	✓	√	V	√	√	√	✓	V	√	√									\checkmark	
	CC421	Danillal Commutation	√	√	✓	✓	√	√	· ·	✓	√											
	CS431	Parallel Computation								Ľ	v									Щ		
'el	CS441	Compiler Construction	✓				√	✓												Щ		
4th Level	CS471	Introduction to Computer Secur ity	✓	>	✓	✓	√	✓	<u> </u>	✓												L
4	CS481	Capstone Project I	✓	✓	✓	~	√	✓	√	✓												
	CS482	Capstone Project II	✓	✓	✓	~	√	✓	√	√												

Program Matrix IV (Courses - Intellectual Skills)

	Code	Course	b1	b2	b3	b4	b5	b6	b7	b8	b9	b1 0	b1 1	b1 2	b1 3	b1 4	b1 5	b1 6	b1 7	b1 8
	CS141	Programming Fundamentals	√	√	√	~	√					U	1		3	4	3	0		0
-	IT101	IT Fundamentals	√	√	√															
	MATH101	Mathematics I	√					V												
_	MATH102	Mathematics II	√	√	√	✓	✓	V												
el	PHYS101	Physics I	✓	✓	^	~														
ev	PHYS102	Physics II	✓	^	^	~														
1st Level	EE101	Electronics	✓	\	\	<	~	\												
	EE102	Digital Circuits	✓		\	✓	\	~	\	✓										
	HUM111	English Language I				✓										✓				
	HUM121	Social Context of Computing	\	✓																
	HUM132	Interpersonal Communication	\	✓	✓	~														
	CS201	Discrete Structures	\	√	√	<	✓	~												
	CS211	Data Structures and Algorithms	✓	✓	\	\	~	√	<	✓	✓	√	✓	√						
	CS241	Object-Oriented Programming	✓	√	√	√	√													
	IS212	Databases	✓	√	√	√	√													
	IS221	Project Management	✓	√																
vel	IT251	Data Communications		√	√	✓	√	V												
Le	CE221	Computer Architecture	✓	√	V	√	√													
2nd Level	MATH20	Probability and Statistics	√	√	√	√	✓	~												
	2																		ļ	
-	HUM231	Business Administration	V	√	√															
	HUM232	Technical Writing	√	_	√														ļ	
_	HUM241	Computers and Ethics	√	√	√															
	CS311	Algorithm Design and		√	√	✓	√	√	√	✓	√	√	√	√						
		Analysis																		
	CS321	Operating Systems	✓	~	V	✓	✓												İ	
	CS342	Automata and Language	✓	✓	<	~	\													
		Theory																		
vel	CS351	Computer Graphics	√	√	√		V	V		✓										
3rd Level	CS352	Image Processing	√	√	√	√		√												
3rd	CS361	Artificial Intelligence	√	√	√	✓		V	√	√										
	CS381	Software Development and	√	√	√	✓	✓	~	√	√	✓	✓	✓	✓	✓	✓	✓			
_	CC202	Professional Practice										/							_	
-	CS382	Field Training	√	_			V			_		√	✓	 		✓	√	 	√	✓
-	CS391	Software Engineering	v	√		_		•		•		•		_ v	· ·	_ v		•	Ľ	•
	IT351	Computer Networks	v	Y	v		V												-	
	CS431	Parallel Computation	V	√		\		_											_	<u> </u>
/el	CS441	Compiler Construction			v		_	\												
4th Level	CS471	Introduction to Computer Se curity		√	√	√	√	V												
4 th	CS481	Capstone Project I	√	√	√	~	√	√	√	✓	√	√								_
-	CS482	Capstone Project II	√	✓	√	√														
	C0102	Cupstoffe i Toject II				•								<u> </u>	<u> </u>	l	l		Щ	Щ

Program MatrixV (Courses - Professional and Practical Skills)

	Code	Course	c1	c2	сЗ	c4	c5	с6	c7	c8	с9	c10	c11	c12	c13	c14	c15	C1
1st Level	CS141	Programming Fundamentals	✓	√	√													6
	IT101	IT Fundamentals	√	√	√	√											 	<u> </u>
	MATH10	Mathematics I	✓	√	√												 	
	1	Mathematics 1																
	MATH10	Mathematics II	√	√	√	√												
	2																	
	PHYS101	Physics I	✓	✓	~	✓	>	>										
	PHYS102	Physics II	✓	√	~	✓	>											
	EE101	Electronics	✓	√	~	✓	>											
	EE102	Digital Circuits	✓	√	✓	✓	√	~										
	HUM111	English Language I				✓						✓		✓				
	HUM121	Social Context of Computing	√	√											√			
	HUM132	Interpersonal Communication	√	√	√	√	√											
	CS201	Discrete Structures	√	√	√	√												
	CS211	Data Structures and Algorithms	√	√	√	√	√	√										
	CS241	Object-Oriented Programming	√	√														
	IS212	Databases	√	V	√	√	✓	√										
	IS221	Project Management	√								√		✓					
vel	IT251	Data Communications	√	√	√	√	√											
Level	CE221	Computer Architecture	√	√	√													
2nd	MATH2	Probability and Statistics	√	√	√	√												
	02	-																
	HUM231	Business Administration	✓	✓	~										√			
	HUM232	Technical Writing	√	√	✓													
	HUM241	Computers and Ethics	√	√	✓										✓		<u></u>	
																	L,	ļ.
	CS311	Algorithm Design and	√	√	√	~	✓	~	V							V	^	✓
	00001	Analysis				L												
	CS321	Operating Systems	√	_	√	V	√											
	CS342	Automata and Language	✓	√	√	~	√											
	CC0 5 4	Theory				<u> </u>											<u> </u>	<u> </u>
	CS351	Computer Graphics	V	V	·	V											<u> </u>	<u> </u>
Level	CS352	Image Processing	'	V	·	V	√	_									<u> </u>	<u> </u>
3rd Le	CS361	Artificial Intelligence	V	V	√	V	√	V										
	CS381	Software Development and	✓	V	✓	^	~	'										
	CCOOO	Professional Practice	✓		./		./		✓	√	_						\vdash	<u> </u>
	CS382	Field Training	∨	√ √	√ √	√ √	√	✓	Ľ								\vdash	<u> </u>
	CS391	Software Engineering	./	· /	./	_ <u> </u>	./								_		-	\vdash
	IT351	Computer Networks	*	v	·	ľ			· ·						-			\vdash
																		-
4th Level	CS431	Parallel Computation	√	√	√	~												
	CS441	Compiler Construction	√	✓	√	✓												
	CS471	Introduction to Computer Se			√	√		√	✓									
		curity																
	CS481	Capstone Project I	√	√	√	✓	✓	~	✓	√	1							
	CS482	Capstone Project II	√	√	✓	✓	√	√	✓	√	1							

Program Matrix VI (Courses - Transferable Skills)

	Code	Course				d4						d1		d1	d1	d1	d1	d1
	CS141	Programming Fundamentals	✓	✓	√	 	√					0	1	2	3	4	5	6
1st Level	IT101	IT Fundamentals	· /	•	· -/	· /	_									-		-
	MATH10	Mathematics I	· √	· ·/	· ·	_												<u> </u>
	1	iviatientatics i	•	•	•													
	MATH10	Mathematics II	✓	√	√													
	2	Tyrachematics II																
	PHYS101	Physics I	√	√	√	✓	√	√										
	PHYS102	Physics II	√	√	√	√	√	√										
	EE101	Electronics	√	√	√	~	√	√										
	EE102	Digital Circuits	√	√	√	~	√	√										
	HUM111	English Language I	√		√			√				√		√	√			
	HUM121	Social Context of Computing	√	√	√	✓												
	HUM132	Interpersonal Communication	√	✓														
	CS201	Discrete Structures	√	√	√	✓												
			✓			L,												-
	CS211	Data Structures and Algorithms	∨	· /	./	· /	√ √	√ √										<u> </u>
	CS241 IS212	Object-Oriented Programming Databases	∨	•	./	\ \ \ ./	∨		√									_
					•	Ľ			ľ								<u></u>	
-	IS221	Project Management	√	√	√	✓	√	~					✓					
evel	IT251	Data Communications	✓	✓	✓	✓	✓	✓										
1	CE221	Computer Architecture	✓	✓	✓	✓												
2nd	MATH2	Probability and Statistics	√	√	√													
	02																<u> </u>	
	HUM231	Business Administration	√	_	✓	_	✓	~	√								<u> </u>	<u> </u>
	HUM232	Technical Writing	V	√	√	\	√	~	V	V	V							
	HUM241	Computers and Ethics	V	V	V	_	V	V	V	V	V							
	CC011	A1 '(1 D ' 1	✓	./	√		√	✓										
	CS311	Algorithm Design and	٧	V	V	\ \	V	ľ										
	CC001	Analysis	✓	✓														-
	CS321 CS342	Operating Systems	· ·/	•	√		√											
	CS342	Automata and Language	•	٧	٧		٧											
-	CC2E1	Theory Granting	✓	✓	·/	1	√	√		/								
	CS351	Computer Graphics				ľ												
Level	CS352	Image Processing	√	_	✓	_	~	✓									<u> </u>	
1 Le	CS361	Artificial Intelligence	√	_	✓	_	~	✓	√	√								
3^{rd}	CS381	Software Development and	✓	~	√	^	√	✓										
	00000	Professional Practice						L.								igspace	<u> </u>	ļ
	CS382	Field Training	√	_	√	_	√	V								L		<u> </u>
	CS391	Software Engineering	V		V	Ľ	V		L	L	L					V	√	✓
	IT351	Computer Networks	V	V	✓		√		_	_	√							<u> </u>
																		-
4th Level	CC 421	Downlial Communication	✓	./	./	✓												-
	CS431	Parallel Computation	∨	✓	✓	∨												-
	CS441	Compiler Construction	∨	∨	./	· ./												_
	CS471	Introduction to Computer Se	*	•	•													
	CS481	Canstona Project I	✓	•/	,/	,,	√	√										<u> </u>
		Capstone Project I	, ,	✓	√	✓	· ·											
	CS482	Capstone Project II	•	٧	٧	Ľ	٧										Щ	<u> </u>

Program Matrix (Courses - CS Program)

																		21	o.1													L1	L1	L 1	L1	L1	L 1		b
			a2	a3	a4	a5	a6	a7	a8	a9	a10					a 15	a16	a1 7	8	a19	U			b3	b4		b6	b7	b8	b9	b10	b1 1					b 1 16 1	ע	18
	CS141	✓ ✓		✓	✓ ✓	✓ ✓	√	~	√	√		√	~	√	√							√ /	√	√	V	√							\dashv		\dashv	_		_	
	IT101	·		,	·	1	Ľ			,												·		·			√						\dashv	_	_	\dashv			_
	MATH10	·		√	√	✓																· /	√	√	√	√	·						\vdash			_			_
	MATH10			· ·	· ·	✓ ✓	V															√	· /	·	·	·	·						\vdash	_	\dashv	\dashv	_		_
	PHYS101	√				V	Ť																										\dashv	_	\dashv	\dashv		_	
	PHYS102	V		V	✓			~														V	V	V	V										\Box	_	_		_
	EE101	V	√	V	V	V															_	V	V	V	V	V	V								\Box	_	_		_
	EE102	✓	√	√	√	√	V	√	√												_	~		✓	V	√	✓	✓	✓				Щ			\dashv			_
	HUM111	L																			_				V								Щ		V	\dashv			
Pyzel	HUM112	V																			_	√	V	✓									Щ			ightharpoonup			
I.p.	HUM121	_														√	√					√	V																
1st I	HUM122	✓	~																			✓	✓	√															
,	HUM131	√	√																			✓	√	√															
	HUM132	√	V	V	√	√																√	√	√	√														
	HUM133	✓	√																			✓	✓																
	HUM141	V	V													√	√					✓	✓																
	HUM142	√	✓	√	√	√															П	✓	✓	V	V											Т			
	HUM151					√								V	√							✓	✓	V															
	HUM152		~		√	✓	✓			✓												✓		V															
	HUM153	√	~																			✓	✓																
	HUM154	√	✓	√	√														Ť	Ť	T	✓	✓	√	√	✓										\Box		Ť	
	CS201	√	V																	i	T	✓	✓	√	√	✓	√									\Box			
	CS211	✓	✓	√	✓	V																✓	✓								✓	✓				\Box			
	CS241	√	V	√	√																	✓	✓	√	√	✓										\Box			
	IS201	✓	V	√	✓	√	✓	√	√													✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	П		\Box	\top			
	IS211	Г	~						✓												T		√		√				✓				П		\Box	\neg			
	IS212	√	~	√	√	V	√	V													T	✓	√	√	√	√							П		\Box	\neg			
_	IS221	√	~															✓			✓	✓	√										П			\neg			
Pyzel	IS231			√		V	√			√		√		V		✓		√			√	✓	√		√	✓	√	√	✓				V		V	\top		√	\neg
Ι.	IT251	√	V	✓	√		√	V												√		✓	√	√	√	✓	√									\top			\neg
J puC	CE221	✓	~	√	√	√	√	V	V										✓	√		✓	✓	√	√	√									\Box	\top	\top	\top	
	MATH20	Т																	i								✓		✓							\top			
	MATH20	✓	~			√																✓	√	√	√	√	√								\Box	\top	\top	\top	
	EE201	√	✓	√																	T	✓	✓	√	√	✓													
	HUM231	✓	√													√	√				7	√	√	√											\dashv	\dashv		\dashv	
	HUM232	✓	√	√																	7	✓	√	√											\dashv	\dashv		\dashv	
	HUM241	√	✓													√	√				7	√	√	√															
	CS301	√	✓	√	√	√	√	√		✓											7	✓	√	√	√											\dashv		\dashv	
	CS302	√	√	√	√	√	√	V	√	√											7	✓	√	√	√														\neg
	CS311	√	✓	√	√	√													\dashv				√	√	√	√	√	√	✓	✓	√	√			\dashv	+	+	$^{+}$	\neg
	CS321	√	√	√		√	√	√	√										\dashv	+	\forall	√	√	√	√	√				Н				\dashv	\dashv	+		\dashv	\dashv
٦		√	√	√	√	√													✓		+	√	√	√	√	√						\vdash	\dashv	\dashv	\dashv	+	+	\dashv	-
Pyzel	CS341	✓	√	√	√	√	√											\dashv	\dashv		\dagger	√	√	√	√	√				Н			\dashv	\dashv	\dashv	+	+	\perp	\dashv
3rd I	CS351	✓	√	√	√	√	√	V										\dashv			+	✓		√		✓	√		✓			\vdash	\dashv	\dashv	\dashv	+	+		-
$\gamma_{ m r}$	CS352	✓	√									\dashv		+	+	√	√	√	√	√	√					Н	\dashv	\dashv	\dashv	+	+		-						
	CS353	✓	√	√	√	√	√	√											\dashv	+	+	✓		√			√		✓				\dashv		\dashv	+		+	\dashv
	CS361	✓	√	√	√	√	√	√										\dashv			+	√	✓			Н	\dashv		\dashv	+	+	\dashv	-						
	CS381	√	✓								\dashv		+	✓	√	√	√	√	√	√	✓	✓	✓	√	√	√	V	√		\dashv	-								
	C0001		1	1	1	I	I	I	1	l					1	1		1	1			- 1			1							1			.			- 1	

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	CS382	V	~	~	√	~	~	√	~													√	√	√	√	~	√	~	√	√	V								
	CS391	√	√	√	~	√	√	√		√	✓							✓			✓	√	✓	√			✓			✓	√		✓		V	✓	√	✓	✓
	IT351	√		~	✓	√	√	√	~	√	✓									√		√	✓	✓	✓	√	✓	√	✓	✓	√	√	✓	✓	V	√			
	IT371	√		~	√	√	√	√	√													√	✓	√															
	MM301	√	√		~								√					√			√	√		√				√		√						√		√	
	MATH30	√	√	V																		√	✓	√	✓	V	✓												
	CS421	V	V	V	V																	V	V	V	V	V													
	CS431	√		~	√	√	V	√	√	√												✓	√	√	✓	~													
	CS441	√		~	~	√	~																	√	✓	V	✓												
	CS442	√	√	V	√	√	√															√	√	√	√	√													
	CS451	√	V	V	√	√																√	√	√															
	CS452	√	✓	~																		√	√	√	√														
	CS461	√	✓	√	~																	√	√	√															
	CS462	√	✓	√	√																	√	√	√															
	CS463	√	√	√	✓																	✓	✓	√												П			
	CS471	√	√	√	√	√	V	√	√														√	√	√	√	✓												
701	CS472	✓	√	✓	V	√	V	√	V	√	√											√	✓	√	✓	√	√								\Box				
Φ	CS481	√	√	√	√	√	~	✓	✓													✓	√				H												
th I	CS482	√	√	✓	✓	✓	√	√	√													√	✓	✓	✓	√	✓	✓	√	✓	√								1
4	CS491	√	✓	✓	√																	√	✓	✓	✓	√	✓								H		✓	✓	✓
	IS411	√	√	√	√																	✓	√	√	√	√	✓								\Box				
	IS412	√	√	✓	✓	✓																√	✓	✓	✓	√	✓	✓	✓										1
	IS414	√	√	√	√	√	~	✓	✓	√												✓	√	√	√	√	√								H				
	IT431	√	√	√	✓	✓	√															√	✓	✓	✓	√	✓												1
	IT432	√	√	√	√	√	~	✓	✓													✓	√	√											\Box				
	IT371											√	√	✓			√	✓	✓	✓	✓									✓	√		√		\Box	✓		✓	✓
	MM411	√	√	√	√	√	V															√	√	√	√	✓													
	CE421	√	√	✓	✓	√	V		✓													√	✓	√	✓	√									\Box				
	CE422	√	√	√	✓	√	✓	√	√	√	✓											√	√	√	√	√	✓												
7		T							_	_								a1	a1		a2											b1	b1	b1	b1	b1	b1	b1	b1
		a1	a2	a3	a4	a5	a6	a7	a8	a9	a10	a11	a12	a13	a14	a15	a16	7	8	a19	0	b1	b2	ь3	b4	b5	b6	b7	b8	Ь9	b10	1	2	3				7	8

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		c1	c2	c3	c4	c5	c6	c7	c8	c9	c10	c11	c12	c13	c14	c15	c16	d1	d2	d3	d4	d5	d6	d7	d8	d9	d10	d11	d1 2	d1 d 3 1	d d 4 5	d16 5	6
	CS141	V	✓	V														√	√	√	√	√											
	IT101	✓	√	V	√													√	√	V	√												
'	MATH101	√	V	V														√	V	V													
	MATH102	√	V	√	V													√	√	V													
'	PHYS101	√	V	V	V	V	√											√	√	√	√	√	√										
'	PHYS102	√	V	V	√	V												√	√	√	V	√	√										
1	EE101	✓	√	V	V	√												√	√	✓	√	√	✓								T		
	EE102	✓	√	V	√	√	√											√	√	√	✓	√									T		
[e]	HUM111				√						V		✓					√		√			√				√		✓	✓	T	\top	1
1st Level	HUM112	✓	√	√														√							T		1						
st [HUM121	√	√											V				√	√	√	√										T	\top	1
1	HUM122	✓	√	√														√	√	√	✓	√	√	√								\top	
	HUM131	✓	√	√														✓	✓	✓	√	√	✓	✓							Ť	T	٦
	HUM132	V	√	~	√	V												V	√													T	٦
	HUM133	√	√															✓	√														٦
	HUM141	√	~											√				√	√	√	√	√	✓	√							Ť	T	٦
	HUM142		√	✓														✓	√	√													٦
	HUM151	V	√															V	√	√	√												
	HUM152		✓	√	✓													✓	√	√													٦

	I II IN #152	√	√	I		ı	ı	I	ı			ı	I	ı		I		√	√	ı					ı	ı		ı	П	$\overline{}$	$\overline{}$	
	HUM153	· ·	· ·															· ·	· ·	√	√								\vdash	+	+	+
	HUM154	· ·	· ·	√	√													·	· ·	· ·	·								H	-	\dashv	+
	CS201	√	V	V	v √	✓	√										_	√	√	√	√	√	√						$\vdash \vdash$	+	+	+
	CS211	√	√															√					$\vdash \vdash$	+	+	+						
	CS241	✓	√	✓	√	✓	√		√								_	√		√	√	√	√	√					$\vdash \vdash$	+	+	+
	IS201	· ·				· ·		√		√					√		_	· ·	√		√ ·				√	√		√	$\vdash \vdash$	+	+	+
	IS211	· /	√	√	√	· ·	√											· /		√	·	√	√	$\vdash \vdash$					$\vdash \vdash$	+	+	+
	IS212	· /								√		√						· /	√	· ·	·	· ·	· ·					√	$\vdash \vdash$	+	✓ v	/ /
/el	IS221	<u> </u>			<u> </u>	√	V			·		·						_	<i>,</i>	· ·	· ·		· ·	\square	√	√	√		$\vdash \vdash$		·	+
2nd Level	IS231	_	√	V	√	· ·				·								√	· ·	·	· ·	√	· ·		·		·		$\vdash \vdash$	$\dot{+}$	\dotplus	+
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2	CE221	Ľ	Ť	Ţ	<u> </u>												V	∀	√	Ť	Ť								Н	+	+	+
	MATH201	V	-/-	./	1													√	√	√				\square					\sqcup	+	\bot	+
	MATH202	·	√	~	√																								Ц	4	_	44
	EE201	Ļ	,		√													√	V	√	V			Ļ					Ц	4	\bot	4
	HUM231	√	√	√										√				√	√	V	√	√	√	√					Ц	4	_	44
	HUM232	V	V	V														√	V	√	V	√	√	√	√	√			Ц	4	_	44
	HUM241	V	V	V										√				√	V	√	V	√	√	√	√	√			Ц	4	_	44
	CS301	1	1	1														1	1	1	1	1							Щ	\dashv	\bot	\bot
	CS302	V	1	1		,	,	,										1	1	1	1	1							Щ	\dashv	\bot	\bot
	CS311	<u> </u>	V	V	√	V	~	~							√	√	~	√	V	√	√	√	√	Ш					Ц	\dashv	\perp	$\perp \!\!\! \perp$
	CS321	1	1	1	√ -/	1												1	1										Щ	\dashv	\bot	\bot
	CS342	V	V	V	√	V												V	V	√		√	,						Щ	\dashv	\bot	\bot
	CS341	V	√	V	√	V												√	√	√	√	√	√						Ц	\perp		\perp
	CS351	V	√	V	√													√	√	V	√	√	√		√				Ц	\perp		\perp
vel	CS352	√	V	V	√	√												√	√	√	√	√	√						Ц	4	\perp	\perp
Le	CS353	V	√	V	√																				√				Ц	\perp	\perp	Ш
3rd Level	CS361	V	√	V	√	V	√											√	V	V	√	√	√	√	√				Ц	4	\perp	\perp
` '	CS381	V	√	V	√	\	V											V	V	V	V	√	√						Ц	\perp	\perp	\perp
	CS382	<u> </u>	V	V	√	V	V	√	√									V	V	V	V	√	√						Щ	ightharpoonup	\perp	4
	CS391	V	V	V	√	V	V											✓	V	√	V	V	√						Ц	_	✓ V	/ /
	IT351	V	√	√	√	V	✓											√	√	√	√	V	√						Щ	\rightarrow		$oldsymbol{\perp}$
	IT371	V	V	√	✓	√												√	V	V	√	V	√	√					Щ	\rightarrow	\perp	1
	MM301	V							√		√		√					V	V	V	√	V	√						Ц	_	✓ v	/ /
	MATH301	√	V	V	√	V	✓	√										V	V	V	V	V	√	√					Щ	\rightarrow	\bot	Щ
	CS421		√	√	√	✓												V	√	√	√	√	✓						Ш	\dashv	\bot	\bot
	CS431	V	√	V	√													√	V	V	√								Ц	\perp	\bot	Ш
	CS441	V	√	V	V													Ý	√	V	√	√	√						Ш	_	+	\sqcup
	CS442	✓ ✓	1	1	√ -/	√ -/	1											√ ✓	1	1	1	v	· ·						Ш	\dashv	\bot	\bot
	CS451	·	√	✓ ✓	√	′	√											·	✓ ✓	✓ ✓	√	√							Ш	\perp	_	\sqcup
	CS452	√	√	√	√	✓	√											V	√	√	√	v							Ш	\dashv	\bot	\bot
	CS461	√					√											·			√								Ш	_	+	\sqcup
	CS462		V	V	√	V													√	√									Ш	\dashv	\bot	\bot
el	CS463	√	√	V	√	V	√											√	√	√	√								Ш	_	+	\sqcup
4th Level	CS471			V	√		√	V										V	√	√	√								Ш	\dashv	\bot	\bot
l H	CS472	V	V	V	√	V												V	V	V	V	V	√	√					Щ	_	_	Щ
4	CS481	√	V	√	√	V	√	√	√									V	√	√	√	V	√	√	√	V	√		Щ	_	_	Щ
	CS482	V	√	√	√	√	✓	✓	✓									V	√	√	√	V	√	✓	√	√	√		Щ	_	_	Щ
	CS491	V	√															V	V	V	√	V	√						Щ	_	_	Щ
	IS411	√	√															V	√	√	√	V	✓						Щ	_	_	Щ
	IS412	V	√	V	√	√	✓											V	V	V	V	V							Щ	_	_	Щ
	IS414	V	V	√	√	V												√	√	√	√	V	√	√					Ц	_	_	Щ
	IT431	√	√	V	V	V												V	√	√	√	V	√	√					Ш			Ш
	IT432	√	√	√	√	√												√	√	√	√	√	✓	✓					Ш			Ш
	IT371	✓	✓			√		✓	√																		√	√	V	✓	✓ v	✓

MM411	✓	√	√														✓	√	✓	√										
CE421	√		√	✓	√												✓	✓												
CE422	√	√	√	√	V												√	✓	√	✓	√	✓	√							
	c1	c2	сЗ	c4	c5	с6	c7	c8	с9	c10	c11	c12	c13	c14	c15	c16	d1	d2	d3	d4	d5	d6	d7	d8	d9	d10	d11	d1 d 2 3	d1 5	d16

Program Matrix VII (Aims - ILOs)

TEACHING AND LEARNING METHODS

			Tea	ching M	g and Ietho		ning	
	Intended Learning Outcomes (ILO's) of the program	Lecture	Tutorials exercises	Practical exercises	Workshops	Projects	Case study	Data collection
	a.1) Recognize the essential mathematics relevant to computer science.	√	✓					
	a.2) Explain code written in high-level programming languages	√	√	√				
	a.3) Demonstrate basic knowledge and understanding of a core of mathematical analysis.	✓			✓			
	a.4) Demonstrate basic knowledge and understanding of a core of statistics.	✓	✓					
	a.5) Interpret and analyze data qualitatively and/or quantitatively.		✓				✓	
	a.6) Describe the principles and techniques of a number of application areas informed by the research directions of computer science.	✓					✓	✓
ding	a.7) Show a critical understanding of the principles of artificial intelligence, image, and pattern recognition.	✓	√	✓		✓		✓
stan	a.8) Define the fundamental topics in computer systems, including hardware architectures and operating systems.	✓	√	√	✓		✓	
Under	a.9) Define the fundamental topics in computer science, including software architectures, software engineering principles and methodologies, and software tools.	✓	√	✓	✓			✓
dge and Understanding	a.10) Define advanced topics to provide a deeper understanding of some aspects of the hardware systems design, operating systems, computer security and compiler theory	✓	✓	✓	✓	✓	✓	✓
Knowlec	a.11) Discuss advanced topics to provide a deeper understanding of some aspects of object-oriented analysis and design, and software engineering.	✓	√			√		✓
K	a.12) Identify advanced topics to provide a deeper understanding of some aspects of the artificial intelligence, image processing, and computer graphics and animation.	✓	✓	✓		✓		✓
	a.13) Express strong knowledge of fundamentals of programming and the construction of computer-based systems	✓	✓	✓		✓		
	a.14) Describe strong knowledge of fundamentals of data structures and algorithms.	✓	✓	✓	✓		✓	
	a.15) Show a critical understanding of the broad context within computing including issues such as quality, reliability, enterprise, employment law and accounting	✓			✓		√	
	a.16) Provide a deeper understanding of legal, professional and moral aspects of the exploitation of computing	✓			✓			

			Teac	_	and letho		ning	
	Intended Learning Outcomes (ILO's) of the program	Lecture	Tutorials exercises	Practical exercises	Workshops	Projects	Case study	Data collection
	a.17) Recognize the knowledge of the tools, practices and methodologies used in the specification, design, implementation and critical evaluation of computer software systems	√	✓	✓		√	√	
	a.18) Define and assess criteria for measuring the extent to which a computer system is appropriate for its current deployment and future evolution.	>			✓			✓
	a.19) Define of the current and underlying technologies that support computer processing and inter-computer communication	✓	√	√				
	a.20) Define the principals of generating tests which investigate the functionality of computer programs and computer systems and evaluating their results.	✓	✓	✓		✓		✓
	b.1)Formulate traditional and nontraditional problems, set goals towards solving them, and observe results.		✓	✓			√	
	b.2) Compare between (algorithms, methods, techniquesetc).		✓			✓	✓	
	b.3) Classify (data, results, methods, techniques, algorithms etc.).		✓			✓	✓	
	b.4) Identify attributes, components, relationships, patterns, main ideas, and errors.		✓				✓	
S	b.5) Conclude the result of the proposed solutions.			✓		✓		
Sill	b.6) Restrict solution methodologies upon their results.			✓		✓		
	b.7) Compose criteria, and verify solutions.			√		√	√	
Intellectual Skills	b.8) Identify a range of solutions and critically evaluate and justify proposed design solutions		✓	✓		•	•	
Intell	b.9) Solve computer science problems with pressing, commercial or industrial constraints.			✓		✓	✓	
	b.10) Generate an innovative design to solve a problem containing a range of commercial and industrial constraints.			✓		✓		
	b.11) Formulate and model computer systems at different and appropriate levels of abstraction.		√	√				
	b.12) Create and/or justify designs to satisfy given requirements (synthesis, evaluation, application).			✓			√	√
	b.13) Analyzes and evaluate a range of options in producing a solution to an identified problem.		✓	√		✓		

			Teac		and letho		ning	
	Intended Learning Outcomes (ILO's) of the program	Lecture	Tutorials exercises	Practical exercises	Workshops	Projects	Case study	Data collection
	b.14) Analyze problem from written descriptio derive requirements specifications from an understanding of problems (analysis, synthes		√	✓		√	✓	
	b.15) Outline the concepts, principles, theories and practices underpinning computing as an academic discipline.		✓	√	√		✓	
	b.16) Develop 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.17) Create ideas, proposals and designs effectively using rational and reasoned arguments for presentation to a range of audiences.		✓	✓		>		
	b.18) Evaluate the results of tests to investigate the functionality of computer systems			✓	✓	✓	✓	
	c.1) Use appropriate programming languages and design methodologies.		√	✓		✓		
	c.2) Use appropriate web-based systems, tools and design methodologies.	n	√	√		✓		
	c.3) Use appropriate database systems.		\checkmark	√		\checkmark		
	 c.4) Perform independent information acquisition and management, using the scientific literature and Web sources. 	✓					✓	✓
Ills	c.5) Specify, design, and implement computer-based systems.	✓	✓	✓		✓		
I Sk	c.6) Evaluate systems in terms of general quality attribut and possible tradeoffs	es 🗸	✓		✓			✓
Professional Skills	c.7) Apply the principles of effective information management, information organization, and information-retrieval skills to information of various kinds, including text, images, sound, and video	i .	✓	✓	✓			✓
Pro	c.8) Apply the principles of human-computer interaction the evaluation and construction of a wide range of materials including user interfaces, web pages, and multimedia systems	to	✓	✓	✓			✓
	c.9) Identify any risks or safety aspects that may be involved in the operation of computing equipment within a given context.	√			√			✓
	c.10) Deploy effectively the tools used for the construction and documentation of software, with particular emphasis on understanding the whole process involving using computers to solve practical problems.		✓	✓		✓	✓	

			Teac		and letho	Lear ds	ning	
	Intended Learning Outcomes (ILO's) of the program	Lecture	Tutorials exercises	Practical exercises	Workshops	Projects	Case study	Data collection
	c.11) Make effective use of general computing facilities, plan and manage a project to complete within budget and schedule.		✓		√			✓
	c.12) Appreciate and manage the need for continuing professional development in recognition of the need for lifelong learning.	√			√			✓
	c.13) Address and apply professional, moral and ethical issues within the discipline.	√			✓			
	c.14) Operate computing equipment efficiently, taking into account its logical and physical properties.		✓	✓		✓		
	c.15) Use investigative skills to research new and novel aspects of their work	✓			✓			✓
	c.16) Apply tools and techniques for the design and development of applications		✓	✓		✓		✓
	d.1) Communicate effectively by oral, written and visual means.		✓	✓		✓		
	d.2) Work effectively as an individual and as a member of a team.		✓			✓		
	d.3) Collaborate effectively within multidisciplinary team.		✓			✓		
	d.4) Work in stressful environment and within constraints.			✓		✓		
	d.5) Prepare and present seminars to a professional standard.		✓	✓		✓		
ıl Skills	d.6) Prepare technical reports, and a dissertation, to a professional standard; use IT skills and display mature computer literacy.		✓	✓		✓		
General	d.7) Demonstrate efficient IT capabilities.		√	√	√	✓		
Te	d.8) Lead and motivate individuals.		✓			✓		
Ğ	d.9) Manage tasks and resources.		✓	✓		✓		
	d.10) Search for information and adopt life-long self-learning.		✓	✓		✓		√
	d.11) Acquire entrepreneurial skills.			√		✓		
	d.12) Manage one's own learning and development.		✓	✓		✓		
	d.13) Prepare their work in the form of reports.		✓	✓		✓		
	d.14) Communicate effectively with team members, managers and costumers.		✓	✓		✓		
	d.15) Exhibit appropriate numeracy skills in understanding and presenting cases involving a quantitative dimension.		✓	✓				
	d.16) Develop a range of fundamental research skills, through the use of online resources, technical repositories and library-based material.		✓	✓		✓		✓

				essn etho		
	Intended Learning Outcomes (ILO's) of the program	Final Exam	Mid-Term Exam	Practical Exam	Class Work	Oral Exam
	a.1) Recognize the essential mathematics relevant to computer science.	✓	✓			
	a.2) Explain code written in high-level programming languages	✓	√	√	✓	
	a.3) Demonstrate basic knowledge and understanding of a core of mathematical analysis.	✓	✓		✓	
	a.4) Demonstrate basic knowledge and understanding of a core of statistics.	✓	✓		✓	
	a.5) Interpret and analyze data qualitatively and/or quantitatively.	✓	✓		✓	
	a.6) Describe the principles and techniques of a number of application areas informed by the research directions of computer science.	✓	✓			
	a.7) Show a critical understanding of the principles of artificial intelligence, image, and pattern recognition.	√	√	√	√	
	a.8) Define the fundamental topics in computer systems, including hardware architectures and operating systems.	√	√		√	
lding	a.9) Define the fundamental topics in computer science, including software architectures, software engineering principles and methodologies, and software tools.	√	√	√	√	
erstar	a.10) Define advanced topics to provide a deeper understanding of some aspects of the hardware systems design, operating systems, computer security and compiler theory	✓	✓	√	√	
Knowledge and Understanding	a.11) Discuss advanced topics to provide a deeper understanding of some aspects of object-oriented analysis and design, and software engineering.	✓	✓		√	
dge an	a.12) Identify advanced topics to provide a deeper understanding of some aspects of the artificial intelligence, image processing, and computer graphics and animation.	√	√	√	√	
owle	a.13) Express strong knowledge of fundamentals of programming and the construction of computer-based systems	✓	✓	✓	✓	
Kno	a.14) Describe strong knowledge of fundamentals of data structures and algorithms.	✓	✓	✓	✓	
	a.15) Show a critical understanding of the broad context within computing including issues such as quality, reliability, enterprise, employment law and accounting	√	√		√	
	a.16) Provide a deeper understanding of legal, professional and moral aspects of the exploitation of computing	✓	✓			
	a.17) Recognize the knowledge of the tools, practices and methodologies used in the specification, design, implementation and critical evaluation of computer software systems	✓	√		√	
	a.18) Define and assess criteria for measuring the extent to which a computer system is appropriate for its current deployment and future evolution.	✓	✓			
	a.19) Define of the current and underlying technologies that support computer processing and inter-computer communication	✓	✓		✓	

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	Intended Learning Outcomes (ILO's) of the program	Final Exam	Mid-Term Exam	Practical Exam	Class Work	Oral Exam
	a.20) Define the principals of generating tests which investigate the functionality of computer programs and computer systems and evaluating their results.	√	✓		✓	
	b.1) Formulate traditional and nontraditional problems, set goals towards solving them, and observe results.	✓	√		✓	
	b.2) Compare between (algorithms, methods, techniquesetc).	\checkmark	\checkmark		✓	
	b.3) Classify (data, results, methods, techniques, algorithms etc.).	✓	✓		✓	
	b.4) Identify attributes, components, relationships, patterns, main ideas, and errors.	✓	✓		✓	
	b.5) Conclude the result of the proposed solutions.	\checkmark	✓		✓	
	b.6) Restrict solution methodologies upon their results.	\checkmark	✓		\checkmark	
	b.7) Compose criteria, and verify solutions.	✓	✓		✓	
	b.8) Identify a range of solutions and critically evaluate and justify proposed design solutions	✓	✓		✓	
ills	b.9) Solve computer science problems with pressing, commercial or industrial constraints.	✓	✓		✓	
Intellectual Skills	b.10) Generate an innovative design to solve a problem containing a range of commercial and industrial constraints.	✓	✓		✓	
ectus	b.11) Formulate and model computer systems at different and appropriate levels of abstraction.	✓	✓	✓	✓	
ntelle	b.12) Create and/or justify designs to satisfy given requirements (synthesis, evaluation, application).	✓	✓	✓	✓	
I	b.13) Analyzes and evaluate a range of options in producing a solution to an identified problem.	✓	√		✓	
	b.14) Analyze problem from written descriptions; derive requirements specifications from an understanding of problems (analysis, synthesis).	✓	✓		✓	
	b.15) Outline the concepts, principles, theories and practices underpinning computing as an academic discipline.	✓	✓	✓	✓	
	b.16) Develop 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.17) Create ideas, proposals and designs effectively using rational and reasoned arguments for presentation to a range of audiences.				✓	
	b.18) Evaluate the results of tests to investigate the functionality of computer systems			✓	✓	
aills	c.1) Use appropriate programming languages and design methodologies.	✓	✓	✓	✓	
al Sk	c.2) Use appropriate web-based systems, tools and design methodologies.	√	√	√	√	
	c.3) Use appropriate database systems.	✓	✓	√	✓	
Professional Skills	c.4) Perform independent information acquisition and management, using the scientific literature and Web sources.	/		√	√	
fof	c.5) Specify, design, and implement computer-based systems.	✓	✓	✓	✓	
P	c.6) Evaluate systems in terms of general quality attributes and possible tradeoffs	✓	✓		✓	

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	Intended Learning Outcomes (ILO's) of the program	Final Exam	Mid-Term Exam	Practical Exam	Class Work	Oral Exam
	c.7) Apply the principles of effective information management, information organization, and information-retrieval skills to information of various kinds, including text, images, sound, and video	✓	✓	✓	✓	
	c.8) 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	✓	✓	√	✓	
	c.9) Identify any risks or safety aspects that may be involved in the operation of computing equipment within a given context.	✓	✓		✓	
	c.10) 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.	√	✓	√	√	
	c.11) Make effective use of general computing facilities, plan and manage a project to complete within budget and schedule.	✓	✓		√	
	c.12) Appreciate and manage the need for continuing professional development in recognition of the need for lifelong learning.	✓	✓			
	c.13) Address and apply professional, moral and ethical issues within the discipline.	✓	✓			
	c.14) Operate computing equipment efficiently, taking into account its logical and physical properties.	✓	✓	✓	✓	
	c.15) Use investigative skills to research new and novel aspects of their work	✓	✓		✓	
	c.16) Apply tools and techniques for the design and development of applications	✓	✓	✓	✓	
	d.1) Communicate effectively by oral, written and visual means.	✓	√	✓	✓	✓
	d.2) Work effectively as an individual and as a member of a team.			√	√	
	d.3) Collaborate effectively within multidisciplinary team.			√	√	
	d.4) Work in stressful environment and within constraints.			√	√	
	d.5) Prepare and present seminars to a professional standard.			✓	✓	
S	d.6) Prepare technical reports, and a dissertation, to a professional standard; use IT skills and display mature computer literacy.		✓ ✓	✓	√	
<u> </u>	d.7) Demonstrate efficient IT capabilities.		V		√	
S	d.8) Lead and motivate individuals.	√	√	√	✓ ✓	\vdash
[a]	d.9) Manage tasks and resources.	∨	∨	∨	∨	√
	d.10) Search for information and adopt life-long self-learning. d.11) Acquire entrepreneurial skills.	-	· ·	✓ ✓	∨	V
General Skills	d.11) Acquire entrepreneurial skins. d.12) Manage one's own learning and development.			∨	∨	\vdash
	d.12) Manage one's own learning and development. d.13) Prepare their work in the form of reports.			∨	∨	$\vdash \vdash \vdash$
	d.14) Communicate effectively with team members, managers and					
	costumers.			✓	✓	
	d.15) Exhibit appropriate numeracy skills in understanding and presenting cases involving a quantitative dimension.	✓	✓	✓	✓	
	d.16) Develop a range of fundamental research skills, through the use of online resources, technical repositories and library-based material.			✓	✓	

Program Coordinator: Prof. Khaled Fathy Hussain

Signature:

Approved by the Dean: Prof. Taysir Hassan Soliman

Signature: