Republic of Yemen

Ministry of Higher Education & Scientific Research

Council of Academic Accreditation & Quality Assurance of Higher Education(CAQA)

21 September University for Medical and Applied Sciences

Faculty of Engineering and Computer

Department of Information Technology

Program of Information Technology

Course Specification of

Data structures and algorithms

Course Code. (07.01. 732)

2024

T4: This Template is Developed and Approved by CAQA-Yemen, 2023

Prepared by:	Reviewed by:	Head of the Department:	Quality Unit:	Dean
Dr. ---------	Dr. -----			

I. General Information:

1.	Course Title:	Data structures and algorithms				
	Course Code:	07.01. 732				
2.	Credit Hours:	Credit Hours	Theory Contact Hours		Practical Contact Hours	
			Lecture	Tutorial/ Seminar	Lab	Clinical
		3	2	--	2	--
3.	Level/ Semester at which this Course is offered:	3 Level / 2 Semester				
4.	Pre –Requisite (if any):	Introduction to Information Technology, programming 1, programming 2, o.s				
5.	Co –Requisite (if any):	Non				
6.	Program (s) in which the Course is Offered:	Bachelor of Information Technology				
7.	Language of Teaching the Course:	English/Arabic				
8.	Location of Teaching the Course:	Faculty of Medical Technology				
9.	Prepared by:					
11	Date and Number of Approval by Council:					

II. Course Description:

Data structures and algorithms aims to provide students with foundational knowledge in data structures and algorithms, emphasizing their relevance and application within health information technology. It covers essential topics, including data organization, storage techniques, sorting, searching, and optimizing algorithms for health data processing. The course focuses on developing analytical and practical skills to design efficient, healthcare -focused solutions, enhancing students' ability to address complex challenges in medical information technology.

III. Course Intended Learning Outcomes (CILOs): Upon successful completion of the course, students will be able to:		Referenced PILOs		
	A. Knowledge and Understanding:	**I, P or M/A**		
a1	Identify and explain fundamental data structures, algorithms, and mathematical concepts relevant to Health Information Technology.		A1	Demonstrate an understanding of appropriate models, theories, mathematical foundations, and techniques related to Health Information Technology discipline.
a2			A2	
a3	Apply appropriate data structures and algorithms to solve specific computing problems in healthcare settings.		A3	Demonstrate a profound knowledge in utilizing and adapting IT tools, techniques, practices, and methods for solving computing problems in Health environment.
a4	Analyze data organization and storage strategies to optimize healthcare information system efficiency.		A4	Demonstrate a sound understanding the computing concept related to analysis, design, implementation, and evaluation of Health information system.

	B. Cognitive/ Intellectual Skills:			
b1	Evaluate and select suitable algorithms for addressing computational challenges in health data management.		**B1**	Critically analyse complex computing problems and propose appropriate information technology based solutions and integrate them effectively into the uses and organization Health.
b3	Formulate efficient data processing techniques to meet the needs of healthcare information systems.		**B3**	Explore variety of challenges and problems related to Health Information Technology to select the optimal solution.
b4	Assess the effectiveness of different algorithmic solutions in meeting healthcare-specific requirements.		**B4**	Evaluate IT based solution to meet a given set of Health requirements in the context of Health Information Technology discipline
	C. Practical and Professional Skills:			
c1			**C1**	
c2	Test algorithmic solutions and their performance within health information applications		**C2**	design, implement, and test a computing-based solution to meet a given set of computing requirement in the context of Health Information Technology.
c3				
c4			**C4**	
	D. General and Transferable Skills:			
d1			**D1**	

d2			D2	
d3			D3	
I= Introduced, P=Practiced or M/A= Mastered/Advanced				

	(A) Alignment of Course Intended Learning Outcomes (Knowledge and Understanding) to Teaching Strategies and Assessment Methods:		
	Course Intended Learning Outcomes	Teaching Strategies	Assessment Strategies
a1	Identify and explain fundamental data structures, algorithms, and mathematical concepts relevant to Health Information Technology.	▪ Lectures ▪ Discussion ▪ Presentation ▪ Self-learning	▪ Written exam (mid and final terms and quizzes) ▪ Final practical exam ▪ Assignments
a2			▪ Written exam (mid and final terms and quizzes) ▪ Final practical exam ▪ Assignments ▪ Programming
a3	Apply appropriate data structures and algorithms to solve specific computing problems in healthcare settings.	▪ Lectures ▪ Discussion ▪ Presentation ▪ Self-learning	▪ Written exam (mid and final terms and quizzes) ▪ Final practical exam ▪ Assignments ▪ Programming
a4	Analyze data organization and storage strategies to optimize healthcare information system efficiency.	▪ Lectures ▪ Discussion ▪ Presentation ▪ Self-learning	▪ Written exam (mid and final terms and quizzes) ▪ Final practical exam ▪ Lab assignments ▪ Practical exams
	(B) Alignment of Course Intended Learning Outcomes (Intellectual Skills) to Teaching Strategies and Assessment Methods:		
	Course Intended Learning Outcomes	Teaching Strategies	Assessment Strategies

b1	Evaluate and select suitable algorithms for addressing computational challenges in health data management.	▪ Lectures ▪ Tutorials ▪ Discussion ▪ Self-Learning	▪ Written exam (mid and final terms and quizzes) ▪ Final practical exam ▪ Assignments ▪ Lab assignments ▪ Practical exams
b2		▪	▪
b 3	Formulate efficient data processing techniques to meet the needs of healthcare information systems.	▪ Lectures ▪ Tutorials ▪ Discussion ▪ Self-Learning	▪ Written exam (mid and final terms and quizzes) ▪ Final practical exam ▪ Assignments ▪ Lab assignments ▪ Coding projects
b 4	Assess the effectiveness of different algorithmic solutions in meeting healthcare-specific requirements.	▪ Lectures ▪ Tutorials ▪ Discussion ▪ Self-Learning	▪ Written exam (mid and final terms and quizzes) ▪ Final practical exam ▪ Assignments ▪ Lab assignments ▪ Project presentations
		▪	▪

(C) Alignment of Course Intended Learning Outcomes (Professional and Practical Skills) to Teaching Strategies and Assessment Methods:

	Course Intended Learning Outcomes	Teaching Strategies	Assessment Strategies
c1		▪	▪
c2	Test algorithmic solutions and their performance within health information applications	▪ Tutorials ▪ Training ▪ Lab work ▪	▪ Written exam (mid and final terms and quizzes) ▪ Final practical exam ▪ Assignments ▪ Project evaluation
		▪	▪
c4		▪	▪

	(D) Alignment of Course Intended Learning Outcomes (Transferable Skills) to Teaching Strategies and Assessment Methods:		
	Course Intended Learning Outcomes	Teaching Strategies	Assessment Strategies
d1		▪	▪
d2		▪	▪
	…	▪	▪

IV. Course Contents:

A. Theoretical Aspect:

No.	Units/Topics List	Sub Topics List	Number of Weeks	Contact Hours	Learning Outcomes (CILOs)
1	Introduction to Data Structures and Algorithms	Algorithm Complexity (Big O Notation); Basic Data Structures Overview	1	2	a1
2	Arrays and Linked Lists	Array Structure; Operations on Arrays; Singly, Doubly, and Circular Linked Lists	2	4	a1, a3
3	Stacks and Queues	Stack Operations; Applications in Health IT; Queue Operations; Circular Queues	2	4	a3
4	Recursion	Concept of Recursion; Examples in Data Processing; Tail Recursion; Efficiency Considerations	1	2	a3, b1
5	Trees	Binary Trees; Binary Search Trees; Tree Traversal Methods; Applications in Health Data	2	4	a3, a4
6	Hashing	Hash Functions; Hash Table Implementations; Collision Handling Techniques	1	2	a3, b1
7	Graphs	Graph Representations; Graph Traversal Algorithms; Applications in Health Networks	2	4	a4, b3
8	Midterm Exam	Covers Units 1-6	1	2	a1, a3,

No.	Units/Topics List	Sub Topics List	Number of Weeks	Contact Hours	Learning Outcomes (CILOs)
					a4, b1, b3
9	Sorting Algorithms	Selection Sort, Bubble Sort, Merge Sort, Quick Sort; Efficiency and Comparisons	1	2	a3, b1
10	Searching Algorithms	Linear Search; Binary Search; Search Efficiency and Use Cases in Health IT	1	2	b1
11	Advanced Data Structures	Heaps; AVL Trees; B-Trees; Application to Medical Record Management	1	2	a3, b4, c2
12	Final Exam	Covers Units 1-11	1	2	a3, a4, b1, b3
Number of Weeks /and Units Per Semester			16	32	

B. Practical Aspect (Lab(/Clinical) (if any):

No.	Tasks/ Experiments	Number of Weeks	Contact Hours	Learning Outcomes (CILOs)
1	Implementing Arrays and Linked Lists	1	2	a1, a3
2	Stack Operations in Healthcare Scenarios	1	2	a3
3	Queue Management for Health Data	1	2	a3
4	Recursive Functions and Applications	1	2	a3, b1
5	Binary Tree Implementation	2	4	a4
6	Hash Table Creation and Usage	1	2	b1
7	Graph Algorithms for Health Networks	2	4	b3
8	Midterm Practical Exam	1	2	a1, a3, a4, b1, b3
9	Sorting Algorithms in Practice	1	2	b1
10	Searching Algorithms for Health Data	1	2	b1
11	Advanced Structures - Heaps and Trees	1	2	b4

No.	Tasks/ Experiments	Number of Weeks	Contact Hours	Learning Outcomes (CILOs)
12	Project Demonstrations	1	2	c2
13	Final Practical Exam	1	2	a3, a4, b1, b3, c2
Number of Weeks /and Units Per Semester		15	30	

C. Tutorial Aspect (if any):

No.	Tutorial	Number of Weeks	Contact Hours	Learning Outcomes (CILOs)
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
11				
12				
Number of Weeks /and Units Per Semester				

VII. Assignments:

No.	Assignments	Week Due	Mark	Aligned CILOs (symbols)

No.	Assignments	Week Due	Mark	Aligned CILOs (symbols)
1	Exercises and Home Works, Problem Solving (I)	3	3	a1,a3, a4, b1, b3
2	Exercises and Home Works, Problem Solving (II)	9	3	a3,a4,b1,b3,c2
3	Technical Report and Presentation.	11	4	a1, ,a3,a4,b1,b3, ,c2
Total			10	

VIII. Schedule of Assessment Tasks for Students During the Semester:

No.	Assessment Method	Week Due	Mark	Proportion of Final Assessment	Aligned Course Learning Outcomes
1	Assignments	3,8,11	10	10 %	a1,a3, a4, b1, b3, c2
2	Quizzes 1 & 2	6,12	5	5 %	a1,a3, a4, b1, b3
3	Mid-Term Theoretical Exam	9	10	10 %	a1, a3, a4, b1, b3
4	Mid-Term Practical Exam	7	5	5 %	a1, a3, a4, b1, b3
5	Final Practical Exam including Project Presentation & Evaluation	15	10	10 %	a3, a4, b1, b3, c2
6	Final Theoretical Exam	16	60	60 %	a3, a4, b1, b3
Total			100	100%	

IX. Learning Resources:

- *Written in the following order:* Author, Year of publication, Title, Edition, Place of publication, Publisher.

1- Required Textbook(s) (maximum two):

1. Cormen, T. H., Leiserson, C. E., Rivest, R. L., & Stein, C. (2022). Introduction to Algorithms (4th

ed.). Cambridge, MA: The MIT Press.

2. Weiss, M. A. (2020). Data Structures and Algorithm Analysis in C++ (4th ed.). Boston, MA: Pearson.

2- Essential References:

1. Goodrich, M. T., Tamassia, R., & Goldwasser, M. H. (2021). Data Structures and Algorithms in Python (2nd ed.). Hoboken, NJ: Wiley.
2. Sedgewick, R., & Wayne, K. (2020). Algorithms (4th ed.). Upper Saddle River, NJ: Addison-Wesley.
3. Shaffer, C. A. (2018). A Practical Introduction to Data Structures and Algorithm Analysis (3rd ed.). Upper Saddle River, NJ: Pearson.

3- Electronic Materials and Web Sites etc.:

Websites:

1. Khan Academy. (2023). Data Structures. Available at: https://www.khanacademy.org/computing/computer-science/algorithms
2. GeeksforGeeks. (2023). Data Structures and Algorithms. Available at: https://www.geeksforgeeks.org/data-structures/

Journals:

1. Journal of the ACM - Focuses on algorithms, data structures, and complexity in computing.
2. IEEE Transactions on Computers - Contains research on data processing and computational theory in health and IT fields.

Other Web Sources:

1. Coursera - Data Structures *and Algorithms Specialization* by the University of California, San Diego and National Research University Higher School of Economics. Available at: https://www.coursera.org/specializations/data-structures-algorithms
2. MIT OpenCourseWare - Introduction to Algorithms (6.006). Available at: https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/

X. Course Policies: (Based on the Uniform Students' By law (2007)

1	**Class Attendance:** Class Attendance is mandatory. A student is considered absent and shall be banned from taking the final exam if his/her absence exceeds 25% of total classes.
2	**Tardiness:** A student will be considered late if he/she is not in class after 10 minutes of the start

	time of class.
3	**Exam Attendance/Punctuality:** No student shall be allowed to the exam hall after 30 minutes of the start time, and shall not leave the hall before half of the exam time has passed.
4	**Assignments & Projects:** Assignments and projects must be submitted on time. Students who delay their assignments or projects shall lose the mark allocated for the same.
5	**Cheating:** Cheating is an act of fraud that results in the cancelation of the student's exam or assignment. If it takes place in a final exam, the penalties stipulated for in the Uniform Students' Bylaw (2007) shall apply.
6	**Forgery and Impersonation:** Forgery/Impersonation is an act of fraud that results in the cancelation of the student's exam, assignment or project. If it takes place in a final exam, the penalties stipulated for in the Uniform Students' Bylaw (2007) shall apply.
7	**Other policies:** The University official regulations in force will be strictly observed and students shall comply with all rules and regulations of the examination set by the Department, Faculty and University Administration.

Republic of Yemen
Ministry of Higher Education & Scientific Research
University: 21 September University for Medical & Applied Sciences

الجمهورية اليمنية
وزارة التعليم العالي والبحث العلمي
جامعة: جامعة 21سبتمبر للعلوم الطبية والتطبيقية

Faculty of Medical Technology

Department of Medical Information Technology

Program of Medical Information Technology

Course Plan (Syllabus) of

Data structures and algorithms

Course Code. 07.01. **732**

I. Information about Faculty Member Responsible for the Course:								
Name of Faculty Member:		Office Hours						
Location& Telephone No.:								
E-mail:		SAT	SUN	MON	TUE	WED	THU	

2024

II. Course Identification and General Information:

1	Course Title:	Data structures and algorithms			
2	Course Code & Number:	07.01. 732			
3	**Credit Hours:**	Credit Hours	Theory Hours		Lab. Hours
			Lecture	Exercise	
		3	2	--	2
4	**Study Level/ Semester at which this Course is offered:**	3 Level / 2 Semester			
5	**Pre –Requisite (if any):**	Introduction to Information Technology, programming 1, programming 2			
6	**Co –Requisite (if any):**	Non			
7	**Program (s) in which the Course is Offered:**	Bachelor of Information Technology			
8	**Language of Teaching the Course:**	English/Arabic			
9	**Study System:**	Semester Based System			
10	**Mode of Delivery:**	Full Time			
11	**Location of Teaching the Course:**	Faculty of Medical Technology			
12	**Prepared by:**				
13	**Date of Approval:**				

III. Course Description:

Data structures and algorithms aims to provide students with foundational knowledge in data structures and algorithms, emphasizing their relevance and application within health information technology. It covers essential topics, including data organization, storage techniques, sorting, searching, and optimizing algorithms for health data processing. The course focuses on developing analytical and practical skills to design efficient, healthcare -focused solutions, enhancing students' ability to address complex challenges in medical

information technology.	

IV. Course Intended Learning Outcomes (CILOs) :

Upon successful completion of the Course, student will be able to:

	A. Knowledge and Understanding:
a1	Identify and explain fundamental data structures, algorithms, and mathematical concepts relevant to Health Information Technology.
a2	
a3	Apply appropriate data structures and algorithms to solve specific computing problems in healthcare settings.
a4	Analyze data organization and storage strategies to optimize healthcare information system efficiency.
	B. Cognitive/ Intellectual Skills:
b1	Evaluate and select suitable algorithms for addressing computational challenges in health data management.
b2	
b3	Formulate efficient data processing techniques to meet the needs of healthcare information systems.
b4	Assess the effectiveness of different algorithmic solutions in meeting healthcare-specific requirements.
	C. Practical and Professional Skills:
c1	
c2	Test algorithmic solutions and their performance within health information applications
c4	
	D. Transferable Skills:
d1	

d2	

V. Course Contents:

A. Theoretical Aspect:

No.	Units/Topics List	Sub Topics List	Number of Weeks	Contact Hours	Learning Outcomes (CILOs)
1	Introduction to Data Structures and Algorithms	Importance in Health IT; Algorithm Complexity (Big O Notation); Basic Data Structures Overview	1	2	a1
2	Arrays and Linked Lists	Array Structure; Operations on Arrays; Singly, Doubly, and Circular Linked Lists	2	4	a1, a3
3	Stacks and Queues	Stack Operations; Applications in Health IT; Queue Operations; Circular Queues	2	4	a3
4	Recursion	Concept of Recursion; Examples in Data Processing; Tail Recursion; Efficiency Considerations	1	2	a3, b1
5	Trees	Binary Trees; Binary Search Trees; Tree Traversal Methods; Applications in Health Data	2	4	a3, a4
6	Hashing	Hash Functions; Hash Table Implementations; Collision Handling Techniques	1	2	a3, b1
7	Graphs	Graph Representations; Graph Traversal Algorithms; Applications in Health Networks	2	4	a4, b3
8	Midterm Exam	Covers Units 1-6	1	2	a1, a3, a4, b1, b3
9	Sorting Algorithms	Selection Sort, Bubble Sort, Merge Sort, Quick Sort; Efficiency and	1	2	a3, b1

		Comparisons			
10	Searching Algorithms	Linear Search; Binary Search; Search Efficiency and Use Cases in Health IT	1	2	b1
11	Advanced Data Structures	Heaps; AVL Trees; B-Trees; Application to Medical Record Management	1	2	a3, b4, c2
12	Final Exam	Covers Units 1-11	1	2	a3, a4, b1, b3
Number of Weeks /and Units Per Semester			**16**	**32**	

B. Case Studies and Practical Aspect:

No.	Tasks/ Experiments	Number of Weeks	Contact Hours	Learning Outcomes (CILOs)
1	Implementing Arrays and Linked Lists	1	2	a1, a3
2	Stack Operations in Healthcare Scenarios	1	2	a3
3	Queue Management for Health Data	1	2	a3
4	Recursive Functions and Applications	1	2	a3, b1
5	Binary Tree Implementation	2	4	a4
6	Hash Table Creation and Usage	1	2	b1
7	Graph Algorithms for Health Networks	2	4	b3
8	Midterm Practical Exam	1	2	a1, a3, a4, b1, b3
9	Sorting Algorithms in Practice	1	2	b1
10	Searching Algorithms for Health Data	1	2	b1
11	Advanced Structures - Heaps and Trees	1	2	b4
12	Project Demonstrations	1	2	c2
	Final Practical Exam	1	2	a3, a4, b1, b3
Number of Weeks /and Units Per Semester		**15**	**30**	

C. Tutorial Aspect:

No.	Tutorial	Number of Weeks	Contact Hours
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			
Number of Weeks /and Units Per Semester			

VI. Teaching Strategies of the Course:

Knowledge and Understanding Skills is developed through:

- Lectures
- Discussion
- Presentation
- Self-learning

Intellectual Skills are developed through:

- Lectures
- Tutorials
- Discussion
- Case studies (CBL)
- Self-Learning
- Problem Based Learning (PBL)

Practical and professional Skills are developed through:

- Tutorials
- Training
- Case studies (CBL)
- Problem Solving Learning (PSL)

- Problem Based Learning (PBL)

General/Transferrable Skills are developed through:

- Discussion
- Case studies (CBL)
- Self-Learning
- Presentation

VII. Assessment Methods of the Course:

- Written exam (mid and final terms and quizzes),
- Final practical exam

Assignments

VIII. Assignments:

No.	Assignments	Week Due	Mark
1	Exercises and Home Works, Problem Solving (I)	3	3
2	Exercises and Home Works, Problem Solving (II)	9	3
3	Technical Report and Presentation.	11	4
Total			10

IX. Schedule of Assessment Tasks for Students During the Semester:

No.	Assessment Method	Week Due	Mark	Proportion of Final Assessment
1	Assignments	3,8,11	10	10 %
2	Quizzes 1 & 2	6,12	5	5 %
3	Mid-Term Theoretical Exam	9	10	10 %
4	Mid-Term Practical Exam	7	5	5 %
5	Final Practical Exam including Project Presentation & Evaluation	15	10	10 %
6	Final Theoretical Exam	16	60	60 %
Total			100	100%

X. Learning Resources:

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XI. Course Policies: (Based on the Uniform Students' Bylaw (2007)

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	comply with all rules and regulations of the examination set by the Department, Faculty and University Administration.