

**COURSE SYLLABUS**  
(Training level: Undergraduate)

**Vietnamese Course Title:** Cấu trúc dữ liệu và thuật toán

**English Course Title:** Data Structure and Algorithm

**Course Code:** DAS231

**Major:** Information Technology

**Training program:** Information Technology

**Version:** 2021

**1. General information**

- Number of credits: 3 (Theory: 2; Practice: 1).

- Type of knowledge:

General Education		Base core courses		Major core courses		Concentration courses		Others
Required <input type="checkbox"/>	Optional <input type="checkbox"/>	Required x	Optional <input type="checkbox"/>	Required <input type="checkbox"/>	Optional <input type="checkbox"/>	Required <input type="checkbox"/>	Optional <input type="checkbox"/>	

- Required course: None

- Pre-requisite: Introduction to Computer Science

- Co-requisite: None

**2. Time Allocated**

Total: 60 periods	Theory: 30 periods
	Group Discussion/Presentation: 0
	Assignments/Essays/Practices: 28 periods.
	Tests: 2 + Theory: Number of Tests: 0    Periods: 0 + Practice: Number of Tests: 2.    Periods: 2
	Self-study: 105 periods Other activities: 0

**3. Departments in Charge:** Computer Science and Technology Department.

**4. Lecturer's Information**

No.	Lecturer name	Phone number	Email	Note
1	MSc. Ha Thi Thanh	0982266009	<a href="mailto:htthanh@ictu.edu.vn">htthanh@ictu.edu.vn</a>	Leader
2	MSc. Duong Thi Quy	0947015947	<a href="mailto:dtquy@ictu.edu.vn">dtquy@ictu.edu.vn</a>	Member
3	MSc. Nguyen Thi Oanh	0981368808	<a href="mailto:ntoanh@ictu.edu.vn">ntoanh@ictu.edu.vn</a>	Member
4	MSc. Dinh Khanh Linh	0977102556	<a href="mailto:dklinh@ictu.edu.vn">dklinh@ictu.edu.vn</a>	Member

**5. Facility Requirements:** The classroom is equipped with a projector and a whiteboard

**6. Course Description:** The course provides students with knowledge about various data structures, along with their representation of data and implementation methods, such as list, stack, queue, tree, binary search tree, graph, table, and dictionary. Additionally, the course provides some fundamental algorithms such as searching and sorting, as well as algorithms for each data model. Through this, students are able to analyze and select appropriate representation data and algorithms for specific problems. Moreover, this course also improves programming and algorithmic skills for students.

### 7. Objectives

Objectives	Description	PLOs	Proficiency level
G1	Using data structure to represent data models.	1.3.3	3
	Using flexibly of programming languages to implement problems	1.4.3	3
G2	Applying data structures and algorithms to solve problems.	2.2.1	3
	Applying optional data structures and algorithms to solve applied problems	2.2.2	3

### 8. Learning Outcomes

Objectives	CLOs	Description of CLOs	PLOs	Proficiency level
G1	G1.1	Applying data structure and algorithms for list, stack, and queue.	1.3.3	3
	G1.2	Applying data structures and algorithms for tree model.	1.3.3	3
	G1.3	Applying data structures and algorithms for Graph model	1.3.3	3
	G1.4	Applying data structures and algorithms for Set, Hash, Dictionary	1.3.3	3
	G1.5	Utilizing programming languages to implement data structures and algorithms	1.4.3	3
G2	G2.1	Using optional data representation methods to solve problems.	2.2.1	3

Objectives	CLOs	Description of CLOs	PLOs	Proficiency level
	G2.2	Choosing optional algorithms for specific problems.	2.2.2	3

### 9. Scientific ethics

Actively participate in theoretical classes and completing assignments given by lectures; Fully participate in practical sessions; Complete regular tests; All acts of cheating in learning will be handled according to regulations.

### 10. Detailed Contents

Period	Contents	References	CLOs	Proficiency Level	Teaching Methodology	Assessment Methodology
1-3	<b>Chapter 1: Course introduction</b>					
	<b>A/ Classroom learning content:</b> 1. From problems to programs 2. Basic concepts 2.1. Definition of data model 2.2. Abstraction 2.3. Abstract data type 2.4. Data 2.5. Representation of data in computer 2.6. Data types 2.7. Data structures 2.8. Algorithms 2.9. The relationship between data structures and algorithms 3. Algorithm analysis 4. The language of interpretive representation.	[1] [2]	G1.1 G1.2 G1.3 G1.4	2 2 2 2	Presentation; Identify the problem and solve it Text book, slides, exercises and sample practical examples	Evaluate by comments
	<b>B/ Self-study:</b> Study just learned materials, do writing exercises and redo practical examples and do assignment	[1]	G1.1 G1.2 G1.3 G1.4	2 2 2 2	Study just learned materials, do writing exercises and redo practical examples and do assignment	Evaluate by comments/ Combining attendance evaluation
4-6	<b>A/ Classroom learning content:</b> 5. Recursion and recursive algorithms 6. Sorting algorithms 6.1 Statement of the sorting problem 6.2 Basic sorting algorithms 7. Search algorithms 7.1 Linear search. 7.2 Binary search	[1] [2] [3] [4] [5] [6]	G1.1 G1.2 G1.3 G1.4	2 2 2 2	Presentation; Identify the problem and solve it Text book, slides, exercises and sample practical examples	Evaluate by comments

Period	Contents	References	CLOs	Proficiency Level	Teaching Methodology	Assessment Methodology
7-11	Practice: Guiding Exercises/Assignment	[1]	G1.1 G1.2 G1.3 G1.4	2 2 2 2	Guiding Exercises/Assignment Text book, slides, exercises and sample practical examples	Evaluate by comments
12-14	<b>Chapter 2: List</b>					
	<b>A/ Classroom learning content:</b> 1. Definition of list 2. List operations 3. Implement a list using an array structure - Implement operations on lists using array structures	[1] [2]	G1.1	3	Presentation; Identify the problem and solve it Text book, slides, exercises and sample practical examples	Evaluate by comments
	<b>B/ Self study:</b> Exercises	[1]	G1.1	3	Study just learned materials, do writing exercises and redo practical examples and do assignment	Evaluate by comments/ Combining attendance evaluation
15-17	<b>Chapter 2 (Continue):</b> <b>A/ Classroom learning content:</b> 4. Implement the list using the pointer 4.1 Linked list 4.2 Types of linked lists 4.3 Implement operations on singly linked lists <b>B/ Self study</b> 4.4 Double linked list and circular linked list	[1] [2]	G1.1	3	Presentation; Identify the problem and solve it Text book, slides, exercises and sample practical examples  Study just learned materials, do writing exercises and redo practical	Evaluate by comments/ Combining attendance evaluation

Period	Contents	References	CLOs	Proficiency Level	Teaching Methodology	Assessment Methodology
					examples and do assignment	
18-22	<b>Practice:</b> Guiding Exercises/Assignment about list	[1] [2]	G1.1 G2.1	3 3	Guiding Exercises/Assignment Text book, slides, exercises and sample practical examples	Evaluate by comments
23-25	<b>Chapter 2: (continue)</b> <b>A/ Classroom learning content:</b>  5. Stack 5.1 Stack definition and its operations 5.2. Representation of Stack - Implement stack using array structure and operations. - Implement the stack with pointer and operations 5.3 Applications of Stack 6. Queue 6.1 Queuing definition and operations 6.2 Queue representation with array and pointers 6.3 Application of Queue	[1] [2] [3] [4]	G1.1	3	Presentation; Identify the problem and solve it Text book, slides, exercises and sample practical examples	Evaluate by comments
	<b>B/ Self study:</b> Implement operations of Queue with array and pointer.	[1]	G1.1	3	Presentation; Identify the problem and solve it Text book, slides, exercises and sample practical examples	Evaluate by comments/ Combining attendance evaluation
26-29	<b>Practice:</b> Guiding Exercises/Assignment about stack and queue	[1]	G1.1 G1.5 G2.1 G2.2	3 3 3 3	Guiding Exercises/Assignment Text book, slides, exercises and sample practical examples	Evaluate by comments

Period	Contents	References	CLOs	Proficiency level	Teaching Methodology	Assessment Methodology
30	<b>Progress test 1</b>		G1.1 G1.5 G2.1	3 3 3	Practical test	Evaluate by score
31-33	<b>Chapter 3: Tree</b>					
	<b>A/ Classroom learning content:</b>  1 General Tree 1.1 Tree Definitions and Properties 1.2 The Tree Abstract Data Type 1.2 Tree Traversal Algorithms 1.3 Representation of tree and implementation operators.	[1] [2] [3]	G1.2	3	Presentation; Identify the problem and solve it Text book, slides, exercises and sample practical examples	Evaluate by comments
	<b>B/ Self study:</b> Implement operations of tree	[1]	G1.2	3	Study just learned materials, do writing exercises and redo practical examples and do assignment	Evaluate by comments/ Combining attendance evaluation
34-36	<b>Chapter 3: (Continue)</b>					
	<b>A/ Classroom learning content:</b>  2 Binary Trees 2.1 The Binary Tree Abstract Data Type 2.2 Properties of Binary Trees 2.3 Implementing Trees 2.4 Tree Traversal Algorithms	[1] [2] [3]	G1.2	3	Presentation; Identify the problem and solve it Text book, slides, exercises and sample practical examples	Evaluate by comments
	<b>B/ Self study:</b> Assignment about binary tree	[1]	G1.2	3	Study just learned materials, do writing exercises and redo practical examples and do assignment	Evaluate by comments/ Combining attendance evaluation

Period	Contents	References	CLOs	Proficiency level	Teaching Methodology	Assessment Methodology
37-41	<b>Practice:</b> Guiding Exercises/Assignment about tree	[1]	G1.2 G1.5 G2.1 G2.2	3 3 3 3	Guiding Exercises/Assignment Text book, slides, exercises and sample practical examples	Evaluate by comments
42-44	<b>Chapter 3 (tiếp)</b> <b>A/ Classroom learning content:</b> 3. Binary Search Tree 3.1 Definition of binary search tree 3.2 Searching Within a Binary Search Tree 3.3 Insertions and Deletions	[1] [2] [3]	G1.2	3	Presentation; Identify the problem and solve it Text book, slides, exercises and sample practical examples	Evaluate by comments
	<b>B/ Self study:</b> Assignments about binary search tree	[1]	G1.2	3	Study just learned materials, do writing exercises and redo practical examples and do assignment	Evaluate by comments/ Combining attendance evaluation
45-49	<b>Practice:</b> Guiding Exercises/Assignment about binary and binary search tree	[1]	G1.2 G1.5 G2.1 G2.2	3 3 3 3	Guiding Exercises/Assignment Text book, slides, exercises and sample practical examples	Evaluate by comments
50-52	<b>Chapter 4. Graph</b>					
	<b>A/ Classroom learning content:</b> 1 Graphs 2 Data Structures for Graphs 2.1 Edge List Structure 2.2 Adjacency List Structure 2.3 Adjacency Matrix Structure 3 Graph Traversals 3.1 Depth-First Search	[1] [2] [3] [4] [5] [6]	G1.3	3	Presentation; Identify the problem and solve it Text book, slides, exercises and sample	Evaluate by comments

Period	Contents	References	CLOs	Proficiency level	Teaching Methodology	Assessment Methodology
	3.2 Breadth-First Search				practical examples	
	<b>B/ Self study:</b> Assignments about graph	[1]	G1.3	3	Study just learned materials, do writing exercises and redo practical examples and do assignment	Evaluate by comments/ Combining attendance evaluation
	<b>Chapter 5. Set, Table, Dictionary</b>					
	<b>A Classroom learning content:</b> 1. Set 1.1 Concepts and operations 1.2 Methods of representing set 2. Table 2.1 Basic concepts and operations 2.2 Table representation methods 3. Dictionary 3.1 Dictionary concepts and operations on dictionary 3.2 Methods of representation of Dictionary	[1] [2]	G1.4	3	Presentation; Identify the problem and solve it Text book, slides, exercises and sample practical examples	Evaluate by comments
53-55	<b>B/ Self study:</b> Assignments about set/table/dictionary	[1]	G1.4	3	Study just learned materials, do writing exercises and redo practical examples and do assignment	Evaluate by comments/ Combining attendance evaluation
56-59	<b>Practice:</b> Guiding Exercises/Assignment about Graph	[1]	G1.3 G1.4 G1.5 G2.1 G2.2	3 3 3 3 3	Guiding Exercises/Assignment Text book, slides, exercises and sample practical examples	Evaluate by comments
60	<b>Progress test 2</b>		G1.2 G1.3	3 3	Practice test	Evaluate scores



Period	Contents	References	CLOs	Proficiency level	Teaching Methodology	Assessment Methodology
			G1.4 G1.5 G2.1 G2.2	3 3 3 3		

## 11. Student Assessment: 10 score Scale.

### 11.1. Test plan:

No.	Content	Time (Period)	CLOs	Proficiency level	Assessment methods	Assessment tools	Weight %
<b>Attendance</b>							<b>10</b>
<b>Progress Test Score</b>							<b>30</b>
1	Chapter 1, 2	30	G1.1 G1.5 G2.1	3 3 3	Pratice	Assignments	15
2	Chapter 3, 4, 5	60	G1.2 G1.3 G1.4 G1.5 G2.1 G2.2	3 3 3 3 3 3	Practice	Assignments	15
<b>Final exam</b>							
	Chương 1, 2, 3, 4, 5		G1.1 G1.2 G1.3 G1.4 G1.5 G2.1 G2.2	3 3 3 3 3 3 3	Question answering	Assignments	60

CLOs	Contents				Test method		
	Period 1-11	Pretiod 12-30	Period 31-49	Period 50-60	Progress test 1 - Practice	Progress test 2 Practice	Final exam Question Answering
G1.1	X	X			X		X
G1.2	X		X	X		X	X
G1.3	X			X		X	X
G1.4	X			X		X	X
G1.5		X	X	X	X	X	X
G2.1		X	X	X	X	X	X
G2.2		X	X	X		X	X

## 11.2 Assessment Rubrics

### \* Rubric 1: Attendance

Criteria assessment	Weight (%)	Very good (8.5-10)	Good (7.0-8.4)	Average (5.5-6.9)	Below average (4.0-5.4)	Poor (0-3.9)
Full Participation in classes	70	Full class attendance	Absence from 1-9%	Absence from 10-15%	Absence from 16-20%	Absence from 20% (banned from exams)
Activeness in lessons, self-study	30	Participate in questions, discussions very ctively, Complete all the assignments	Participate in asking questions, discussion, doing exercises quite actively	Participate in asking questions, discussions, and doing exercises less actively	Participate in asking questions, discussions, doing exercises with teachers' help	Only take part in class, but not participate in asking questions, discussions, doing exercises in active ways

\* **Rubric 2: Periodic Test No.1** (Allotted time: 1 period; Form: Practic; Total of questions: 2; Score Scale: 10)

Evaluation criteria		Weight (%)	Quality Level Description				
Question	CLOs		Very Good	Good	Average	Below Average	Poor
			(8,5-10 point)	(7,0-8,4 point)	(5,5-6,9 point)	(4,0-5,4 point)	(0-3.9 point)
1	G1.1	20	Optimization Data structure and Algorithm	Solve the problem but the data structure and algorithm are not optimal	Understand the idea of algorithmic data, but can't specify it	Knowing about data data and algorithms do not understand the nature	Don't understand Algorithms, Data Structures
2	G1.5 G2.1	80	The program runs without errors, the algorithm is optimal.	The program runs correctly, understands the algorithm, the algorithm is not optimal	The program has errors, understands the idea of algorithm	Understanding the idea of algorithm, can't not implement it	Don't remember the step of algorithm, can't implement program.

**\* Rubric 3: Periodic Test 2** (Allotted time: 1 period; Form: Practice; Total of questions: 2; Score Scale: 10)

Evaluation criteria		Weight (%)	Quality Level Description				
Question	CLOs		Very Good	Good	Average	Below Average	Poor
			(8,5-10 point)	(7,0-8,4 point)	(5,5-6,9 point)	(4,0-5,4 point)	(0-3.9 point)
1	G1.2 G1.5 G2.1 G2.2	40	Optimization Data structure and Algorithm	Solve the problem but the data structure and algorithm are not optimal	Understand the idea of algorithmic data, but can't specify it	Knowing about data data and algorithms do not understand	Don't understand Algorithms, Data Structures
2	G1.3 G1.5 G2.1 G2.2	40	The program runs without errors, the algorithm is optimal.	The program runs correctly, understands the algorithm, the algorithm is not optimal	The program has errors, understands the idea of algorithm	Understanding the idea of algorithm, can't not implement it	Don't remember the step of algorithm, can't implement program.
3	G1.4 G2.1	20	Optimization Data structure and Algorithm	The program runs correctly, understands the algorithm, the algorithm and data	The program has errors, understands the idea	Understanding the idea of algorithm, can't not	Don't remember the step of algorithm, can't

Evaluation criteria		Weight (%)	Quality Level Description				
Question	CLOs		Very Good	Good	Average	Below Average	Poor
			(8,5-10 point)	(7,0-8,4 point)	(5,5-6,9 point)	(4,0-5,4 point)	(0-3.9 point)
				storage are not optimal	of algorithm	implement it	implement program

**\*\* Rubric 4:** Final Examination (*Allotted time: 1 period; Form: Question Answering; Total of questions: 3; Score Scale: 10*)

Evaluation criteria		Weight (%)	Quality Level Description				
Question	CLOs		Very Good	Good	Average	Below Average	Poor
			(8,5-10 point)	(7,0-8,4 point)	(5,5-6,9 point)	(4,0-5,4 point)	(0-3.9 point)
1	G1.1 G1.2	30	Answering correctly, clearly, and addressing 90-100% of the given requirements	Answering clearly, and addressing 70-90% of the given requirements	The answer is quite clear, and addresses 50-70% of the given requirements	The answer is unclear. It addresses 40-50% of the given requirements	The answer is unclear. It addresses less than 40% of the given requirements
2	G1.5 G2.1 G2.2	50	Answering correctly, clearly, and addressing 90-100% of the given requirements	Answering clearly, and addressing 70-90% of the given requirements	The answer is quite clear, and addresses 50-70% of the given requirements	The answer is unclear. It addresses 40-50% of the given requirements	The answer is unclear. It addresses less than 40% of the given requirements
3	G1.4 G1.3	20	Answering correctly, clearly, and addressing 90-100% of the given requirements	Answering clearly, and addressing 70-90% of the given requirements	The answer is quite clear, and addresses 50-70% of the given requirements	The answer is unclear. It addresses 40-50% of the given requirements	The answer is unclear. It addresses less than 40% of the given requirements

## 12. Reading List

### A. Main Syllabus

[1] Slide Data structure and Algorithm, Computer science and Technology department, ICTU.

[2] Data structure and Algorithm, Software engineer department, ICTU, 2016.

[3] Do Xuan Loi, 1995, Data Structures and Algorithms, Science and Technology Publishing House.

[4] Dinh Manh Tuong, 2003, Data Structures & Algorithms, Science and Technology Publishing House

### ***B. References***

[5] Aho, A. V., J. E. Hopcroft, J. D. Ullman, 1983, Data Structure and Algorithms, Addison–Wesley.

[6] N. Wirth, 1983, Data structure + Algorithm= Program

### ***C. Software***

DEV C/C++

**13. First approval date:** August 30<sup>th</sup>, 2021

**14. Competent Authority Approval:** University of Information and Communication Technology

**Vice Rector**



**PhD. Do Dinh Cuong**

**Dean**



**PhD. Nguyen Hai Minh**

**Head of Department**



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