Ministry of Higher Education and Scientific research

Department of ...Software and Informatics….

College of …Engineering….

University of ....Salahaddin….

Subject: ....Data Structures and Algorithms...

Course Book ..(2nd Year\ Fall Course)..

Lecturer's name: ....Kanar Shukr Muhamad....

Academic Year: .... 2023/2024....

1. Course name	**Data Structures and Algorithms**
2. Lecturer in charge	**Kanar Shukr Muhamad**
3. Department/ College	**Software and Informatics Engineering- College of Engineering**
4. Contact	kanar.muhamad@su.edu.krd, kanarshukr@yahoo.com
5. Time (in hours) per week	**Theory: 2 Hours** **Practical: 2 Hours**
6. Office hours	**Office hours are stated in the time table**
7. Course code	**5111**
8. Teacher's academic profile	**Kanar Shukr Muhamad** **Lecturer at Software and Informatics Engineering Department** **College of Engineering – Salahaddine University** **Hawler – Kurdistan** **Current:** **Data Structures and Algorithms (2nd year),** **Past:** **Programming Algorithms (1st Year), Programming Principles (1st Year), Procedural Programming (1st year), Digital Design (1st year), Data Structures and Algorithms (2nd year), Object Oriented Programming (2nd year) , Numerical Analysis and Probability(2nd year), Engineering Analysis (3rd year) and Data Security (4th year).** **Education:** **BSc of Software Engineering – college of Engineering – Salahaddine University (2005)** **MSc of Software Engineering – college of Engineering – Salahaddine University (2009)** https://academics.su.edu.krd/kanar.muhamad/
9. Keywords	**Algorithm, ADT, Complexity, Sorting, Searching, Heap,….etc**

10. Course overview:

This course is a mandatory requirement for the BSc in Software Engineering. It provides an introduction to many of the basic data structures used in computer software, Analyze the algorithms that use them and to apply them by writing programs. (although a review of the necessary basic programming notions is included).

- You will understand
  - what the tools are for storing and processing common data types
  - which tools are appropriate for which
- So that you will be able to

- Justify your design decisions via formal reasoning
- Communicate ideas about programs clearly and precisely.

11. Course objective:

The students in this course will learn how to compute data structures are built. The course, intended to clarify the concepts used to build data inside computer and how different searching and sorting techniques are applied to it. Finally, the student will be introduced to different techniques of building algorithms.

12. Student's obligation

Students are obliged to attend within the time stated in the lecture schedule for lessons that are many examples of solution during the lecture for closer understanding of the subject and that's what does not exist in the form reproduced obtained lectures, also the students responsible to solving home works and assignments.

13. Forms of teaching

There are four hours of scheduled instruction per week. New material will be formally presented in lectures. Students are expected to read in advanced the relevant sections and chapters from the essential text(s). Parts of some topics will not be lectured at all – instead, students will be expected to read the corresponding material from the textbook. In such cases, lecture and lab time will be used for discussing the concepts, studying examples, and solving problems. Whiteboard and pen have been mostly used and frequently clear the subject step by step. Homework is normally given throughout the academic year.

14. Assessment scheme

For the award of credit points, it is necessary to pass the module exam. It contains:

- % 50 Work Load includes Theory and Practical:
  (Activities, quizzes, normal Exam,….)
- %30 Theory Final Exam
- %20 Practical Final Exam
- Student's attendance is required in a class

Note:

There will be randomly quizzes. Each quiz will be given at the beginning of the class period and covers materials covered in the previous lectures.

15. Student learning outcome:

At the end of this course, students will be able to:

1. Describe the data structures used in computer systems, how data is stored and retrieved in each structure (accessing protocols).
2. Write good algorithms with minimum cost analyze algorithms and compare them to choose the best one.
3. Know all sorting algorithms.
4. Understand the searching technique.

16. Course Reading List and References:

The following references are recommended:

1. Data Structures, Algorithms and Application in C++ by S. Sahni, any edition
2. Data Structure and Programming Design in C++ by Krurse and Ryba, Prentice Hall, any edition.
3. Algorithms and Data Structures by Kurt Mehlhorn and Peter Sanders, any edition.
4. Advanced Data Structures by Prof. Erik Demaine, Notes Collection.
5. Fundamentals of Data Structures by Ellis Horowitz and Sartaj Sahni
6. Notes on Data Structures and Programming Techniques by James

17. Topics	**Lecturer's Name**
Theory Topics	**Kanar Sh. Muhamad**
Week 1, 2: Course Overview: general overview of the course, C++ programming language concepts and learning operating-system structure and operations and more C++ concepts.	
Week 3: Structure Mapping Function, Asymptotic Complexity	
Week 4: Abstract data types starting with stack, stack algorithms, and stack applications.	
Week 5: Queue, queue algorithms, and queue applications.	
Week 6, 7, 8: Pointer and heap memory, starting with single linked list algorithms, and examples, double linked list algorithms, and examples.	
Week 9, 10: Tree Data structure terminology, and binary search tree operations, and algorithms.	
Week 11, 12, 13: Sort algorithm types and divide and conquer mechanism.	
Week 14: Search algorithm types.	
Week 15: Graph theory and Dijkstra algorithm.	

Practical Topics	Lecturer's Name
Week 1, 2, 3: Writing programs using C++ language	**Kanar Sh. Muhamad**
Week 4: C++ Implementation of a Stack data type.	
Week 5, 6: C++ Implementation of a Queue data type.	
Week 7, 8 and 9: C++ Implementation of single linked list, doubly linked list and their functions.	
Week 10, 11: Implementation of tree data type.	
Week 12, 13: Implementation of sorting algorithm types.	
Week 14: Implementation of binary search algorithm.	
Week 15: Review.	

18. Examinations:

Q1/ Fill in blanks with the correct answer.

1- New elements are added to the . . . . . . of the queue.

2- . . . . . . is data structure used in evaluating mathematical expressions with parentheses.

3- The equation . . . . returns number of the elements in the queue.

Q2/ Answer the following questions

4- Write the full condition(s) code of circular queue:

5- Determine step by step the overall asymptotic complexity (Big-O) of the following code statement by statement.

```
for(i=0;i<n;i++)
{
        cout<<"Hello";
        for(j=1;j<n;j++)
                cout<<"2nd class";
}
```

Q3/ Write a c++ function to insert an element at the end of the single linked list.

Q4/ Write an algorithm to add an element to queue.

19. Extra notes-

20. Peer review