Course Outline

Course Title	Data Structures and Algorithms
Course Code	CC-213
Course Webpage	
Course Email	swjaffry@pucit.edu.pk
Instructor	Prof. Dr. Syed Waqar ul Qounain
Teacher Assistant(s) (T.A)	**For Morning Section (BITF22 Old Campus)** TA-1 NAME-ROLL NO TA-2 NAME-ROLL NO TA-3 NAME-ROLL NO TA-4 NAME-ROLL NO

Credit Hours	3
	         Theory/week:
	        Weight 3 Cr. hrs.
	            Lectures: 2
	             Duration 1.5 hrs.

Prerequisite Course	CC-211 Object Oriented Programming
Prerequisite Skill/Knowledge/Understanding	o Excellent concept of object manipulation. o Expertise in design, implementation, testing, and strong debugging of object-oriented programs. o Good concepts of Types. o Well versed with Streams and Templates. o Strong concept with the notion of Abstraction, Information hiding, and Aggregation
Follow Up	CC-311 Operating Systems; EI-326 Artificial Intelligence
Program Name	BS Information Technology
Aims and Objectives	o *"An apprentice carpenter may want only hammer and saw, but a master craftsman employs many precision tools. Computer programming likewise requires sophisticated tools to cope with complexity of real applications and only practice with these tools will build skill in their use. (Robert L. Kruse Data Structure and Program Design)".* o This subject deals to make students convenient in building a memory and time efficient data structures for the implementation of small to medium-scale (data intensive) computer systems and a view of large scale systems. In short Students learn to write code in optimized way.
Syllabus	**Algorithm Specification:** Properties of Algorithm, examples, performance, analysis, measurement, and Big Oh notation. **Introduction to ADTs:** Array and Polynomial as an ADT, Sparse Matrices, and Representation of Arrays. **The Stack ADT:** Linked list and array implementations, Expressions, Postfix Notation, and Infix to postfix conversion. **The Queue ADT**: Linked and array implementations of circular and double ended queue. **Recursion:** Recursive Definition and Processes, Writing Recursive Programs. Self-Referencing Classes and Dynamic Memory Allocation. **Linked List:** Singly Linked Lists,

	Circular Lists, Linked Stacks and Queues (Double Ended List), Doubly Linked Lists. **Trees:** Introduction to Trees, Logical construction and Traversing of Binary Trees, Implementation of Binary Trees (Insertion and Traversing), Searching and deletion in Binary Trees, Binary Search Tree, Introduction to Balanced and AVL Trees. **Heaps:** Heaps and Heaps as Priority Queues, Double Ended Priority Queue. **Searching:** Linear Search, Binary Search, and Types of Indexing. Hashing: Hash Functions: Division; Overflow Handling: Chaining; **Introduction to advanced topics:** B-Trees, Generalized List, etc. **Sorting:** Selection, Insertion, Merge, Quick, Bubble, Heap, Shell, Radix, and Bucket sorts. **Graphs:** Graph terminology, Adjacency List and Adjacency Matrix and Adjacency list representation of Graph; **Elementary Graph Operations:** Breadth First Search and Depth First Search, Spanning Trees (BFSST, DFSST), topological order, shortest path.
Text Book(s)	A. Mark Allen Weiss, "Data Structure and Algorithms Analysis in C++", 4th Ed., Pearson Education, 2014, ISBN 978-0-13-284737-7 B. Adam B. Drozdek "Data Structure and Algorithm in C++" ISBN 0-534-37668-1 C. D. Malhotra and N. Malhotra. "Data Structures and Program Design Using C++." ISBN: 978-1-68392- 370-1 D. Ellis Horowitz, Sartaj Sahni, and D. Mehta "Data Structures and Algorithm Analysis in C++", 4th Ed., Computer Science Press, 1995. ISBN 81-7808-792-8
Reference Material	R1. Varsha H. Patil. "Data Structures Using C++", Thomson Learning, 2nd Ed., 2001, ISBN-13: 978-0-19-806623-1 R2. D. Samanta. "Classic Data Structures", Prentice Hall, 2001 R3. Mark Allen Weiss, "Data Structure and Algorithms in C++", 2nd Ed., Pearson Education, ISBN 81-7758-943-1 R4. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, and Clifford Stein, "Introduction to Algorithms", 2nd Ed, MIT Press, 2001, ISBN 0-07-013151-1

Assessment Criteria	Sessional 25%		Mid 35%	Final 40%
	Quizzes, Assignment, Tests	10	Written Exam 35	Written Exam 40
	Term Paper/Presentations	5		
	Project	10		
	Total	25	35	40
		100		

○ Sessional Marks will be available on CMS.

Lecture Breakdown

Week	Lecture	Topic	Source
1	1	**Introduction 01:** Course Introduction	C-(1.3,1.4,1.5)
	2	**Introduction 02:** Data Structures and Algorithm	B-(1.9), R1-(1.3, 1.4)
2	3	**Algorithm Specification 01:** Definition: Properties and Examples	A-(1.5), R4-(1.1), R1-(1.5)
	4	**Algorithm Specification 02:** Performance Analysis and Measurement, (Big Oh Notation)	A-(2.3,2.4), R3-(1.2), R1-(1.10), C-(1.6,1.8), B-(2.2 ~ 2.5)

			Quiz No.1
3	5	**Abstract Datatypes 01:** Array and Polynomial as ADT	R1-Chap No.2
	6	**Abstract Datatypes 02:** 2D and nD Arrays, Memory Representation of Arrays, Sparse Matrices	R3-(3.2,3.2.1,3.2.7) R2-Chap No.2 R1-(2.11)
4	7	**Stack ADT 01:** Linked list and Array Implementation	A-(3.6.1, 3.6.2) C-(7.1 ~ 7.5)
	8	**Stack ADT 02:** Application of Stack, Expressions, Postfix Notation, and Infix to postfix conversion	A-(3.6.3) C-(7.6) **Quiz No.2** **Assignment No.1**
5	9	**Queue ADT 01**: Linked and array implementation of Circular Queue	A-(3.7) C-Chap No.5
	10	**Queue ADT 02:** Linked and Array Implementation of Circular Queue	R1-(5.4) C-(5.5.1)
6	11	**Recursion 01: Recursive Definition** and Processes, Writing Recursive Programs	B-Chap No.5 R1-(4.2,4.3,4.4)
	12	**Recursion 02:** Examples of Recursion	B-Chap No.5, R1-(4.6) **Quiz No.3**
7	13	**Linked List 01:** Self-Referenced Classes	A-(1.5), B-(1.4)
	14	**Linked List 02:** Singly Linked Lists	B-(3.1), R1 -(6.11, 6.12)
8	15	**Linked List 03:** Circular Lists, Linked Stacks and Queues(Double Ended List)	**B-**(3.2, 3.3), R1-(6.7, 6.8)
	16	**Linked List 04:** Doubly Linked Lists	R1-(6.9, 6.13, 6.15) C-(4.5, 4.6), R1-(6.3.1) **Quiz No.4** **Assignment No.2**
Mid Term Examination			
9	17	**Trees 01:** Introduction, Logical construction and Traversing of Binary Trees	A-(4.1) R1-(7.1,7.2)
	18	**Trees 02:** Implementation of Binary Trees (Insertion and Traversing) Searching and deletion in Binary Trees	A-(4.2, 4.6), R1-(7.3, 7.7), C-(8.3)
10	19	**Trees 03:** Binary Search Tree	A-(4.3) R1-(7.10) **Quiz No.5**
	20	**Trees 04:** Height Balance Trees	B-(6.7)
11	21	**Trees 05:** AVL Tree	A-(4.4) R1-(10.3.1,10.3.2) C-(8.5.1, 8.5.2)
	22	**Trees 06:** Heaps: Heaps and Heaps as Priority Queues, Double Ended Priority Queue	A-Chap No.6 R3-Chap No.6

12	23	**Searching and Hashing 01:** Linear Search, Binary Search and Types of Indexing	R1-(9.1,9.2)
	24	**Searching and Hashing 02:** Hashing, Hash Functions, Overflow Handling	A-(5.1~5.5) R1-(11.3,11.5) **Quiz No.6** **Assignment No.3**
13	25	**Sorting 01:** Divide and Conquer Algorithms, Sorting Techniques: Selection, Insertion, Merge	R1-(9.3) A-(7.1 ~ 7.6)
	26	**Sorting 01:** Quick, Bubble, Heap, Shell, Radix and Bucket sorts	R1-(9.3) A-(7.1 ~ 7.6)
14	27	**Graphs 01:** Graph terminology Adjacency Matrix representation of Graph	R1-(8.1, 8.2, 8.3.1) C-(12.3.2)
	28	**Graphs 02:** Adjacency list representation of Graph	R1-(8.3.2,8.3.2,8.3.4) C-(12.3.2) **Quiz No.7**
15	29	**Graphs 03:** Breadth First Search (**BFS**) and Depth First Search(**DFS**)	R1-(8.4) C-(12.4)
	30	**Graphs 04:** Spanning Trees (**BFSST , DFSST**)	B-(8.5), R1-(8.5) C-(12.6)
16	31	**Graphs 05:** Shortest path	R1-(8.6), A-(9.3)
	32	**Introduction to Advanced Topics** Generalized List, Quad-Tree, B-Trees Tries etc.	R1-(13.3) **Quiz No.8** **Assignment No.4**
Final Term Examination			

Reference Books:

Following Books contains valuable resources for this subject and can be used for reference purpose

1. Robert Sedgewick, "Algorithms in C++", 3rd Ed., Addison Wesley Publishers, 1998. ISBN 0-201-35088-2
2. James Roberge,Stefan Brandle, and David Whittington, "A Laboratory Course in C++ Data Structures",2nd Ed, Jones and Bartlett Publishers, 2003, ISBN 0-7637-1976-5
3. Larry Nyhoff, "C++ An Introduction to Data Structures",
4. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, and Clifford Stein, "Introduction to Algorithms", 2nd Ed, MIT Press, 2001, ISBN 0-07-013151-1
5. Alfred A. Aho, John E. Hopcroft, and Jeffrey D. Ullman, "Data Structures and Algorithms", 2nd Ed, Addison Wesley Publishers, 1985, ISBN 0-201-00023-7

Web Sites:

1. Dictionary of Data Structure and Algorithms
   http://www.nist.gov/dads/

Additional Topics:

o Disjoint Set
o Graphs (Shortest Path and Connected Components), Bipartite Graph, Topological Sort
o Data Compression

- Pattern Matching
- Quad Trees, Red Black Trees, Splay Trees, Tries, Decision Trees
- Fibonacci Heap, Binomial Heap

Code of Conduct

- Quizzes will be unannounced you will have to be prepared for the Quizzes sequence that is included in outline.

- Things which surely lead to grade 'F'
  - Your neighbors are your enemies, so any sort of communication on assigned tasks will lead you to Grade 'F' in the current and in the previously submitted tasks.
  - Violation of coding convention.
  - Late Submissions.
  - Discussion or sniffing on neighbor's work in the laboratory/assigned tasks.

- Once the marks are published on Google docs for any graded task (sessional), you can question about any discrepancy about marks within next two working days.

- Mobile Phones must be switched off during the class and laboratory. No use of Internet during your laboratory time.

- T.A's are also your teachers!

- How to Approach Instructor/TA:
  - Observe the meeting hours!
  - Send an e-mail to Course E-mail
    - How to Send Email
      - Email Header/Subject
        - BSITF22
      - Email Body
        - Email Text must contain your roll-no and complete name