COURSE DESCRIPTION FORM

INSTITUTION National University of Computer and Emerging Sciences (NUCES-FAST)

BS(CS)

PROGRAM (S) TO BE EVALUATED

A. Course Description

Course Code	CS2001
Course Title	Data Structures
Credit Hours	3+1
Prerequisites by Course(s) and Topics	Object-oriented Programming (CS217)
Assessment Instruments with Weights (homework, quizzes, midterms, final, programming assignments, lab work, etc.)	Midterm Exam 1: 15 (1 Hour written exam) Midterm Exam 2: 15 (1 Hour written exam) Project: 8 Quizzes: 12 (Quizzes and one hackathon) Final: 50 (3 Hours Written Exam)
Course Coordinator	Dr. Jawwad A Shamsi
URL (if any)	-
Current Catalog Description	-
Textbook (or **Laboratory Manual** for Laboratory Courses)	**Textbook:** Data Structures and Algorithms in C++ 4th Edition by Adam Drozdek **Reference books:** Data Structure and Algorithms Analysis in C++ Mark Allen

	Using C++ -- A Practical Implementation by Sachi Nandan Mohanty and Pabitra Kumar Tripathy
Reference Material	Data Structures Using C++ by VARSHA H. PATIL Oxford University Press Data Structures and Algorithm Analysis by Clifford A. Shaffer Open Data Structures in C++ Open Data Structures in Java
Course Goals	**A. Course Learning Outcomes (CLOs)** 1. *Use & explain* concepts related to basic and advanced data structures and describe their usage in terms of common algorithmic operations **[Bloom's Taxonomy Level:** 3**, Learning Domain:** Cognitive**]** 2. *Solve* recursive problems efficiently using Backtracking **[Bloom's Taxonomy Level:** 3**, Learning Domain:** Cognitive**]** 3. *Compare* different data structures in terms of their relative efficiency and *design* effective solutions and algorithms that make use of them. **[Bloom's Taxonomy Level:** 6**, Learning Domain:** Cognitive & Psychomotor**]** 4. *Transform* cycling-bearing graphs into acyclic tree structures for minimum cost traversal **[Bloom's Taxonomy Level:** 6**, Learning Domain:** Cognitive & Psychomotor**]**

B. Program Learning Outcomes		
1. Computing Knowledge	Apply knowledge of mathematics, natural sciences, computing fundamentals, and a computing specialization to the solution of complex computing problems.	CLO-1
2. Problem Analysis	Identify, formulate, research literature, and analyze complex computing problems, reaching substantiated conclusions using first principles of mathematics, natural sciences, and computing sciences.	CLO-2

	3.Design/Develop Solutions	Design solutions for complex computing problems and design systems, components, and processes that meet specified needs with appropriate consideration for public health and safety, cultural, societal, and environmental considerations.	CLO-3
	4. Investigation & Experimentation	Conduct investigation of complex computing problems using research based knowledge and research based methods	CLO-4

C. Relation between CLOs and PLOs
(CLO: Course Learning Outcome, PLOs: Program Learning Outcomes)

		PLOs											
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
CLOs	1	✔											
	2		✔										
	3			✔									
	4				✔								

Topics Covered in the Course, with Number of Lectures on Each Topic (assume 15-week instruction and one-hour lectures)

1. Topics to be covered:

List of Topics	No. of Weeks	Contact Hours	CLO
ADT, C++ Language Specification, Pointers revisited, Rule of Three, Dynamic Safe Arrays	**1**	**3**	**1**
Elementary Sorting Techniques	**1**	**3**	**1,3**

	List (Singly Linked List), List (Doubly Linked List), List (Circular Linked List)	**2**	**6**	**1, 3**	

	Recursion, it's types, issues and Backtracking (with examples)	1	3	2
	======= Mid-term 1 Exam ==========			
	Advanced Sorting Techniques and their issues, Linear, Binary & Interpolation Search	1	3	3
	Stack, Queue, their implementation strategies and applications(Simulation of recursion)	1	3	1, 3
	Binary trees and their properties (Full Binary Tree, Complete Binary Tree), Multi-way Trees/Tries Binary Search Trees, their operations and applications, skewness and issues	2	7	1, 2, 3
	Balance in Binary Search Trees, AVL Trees	1	3	2, 3
	========== Mid-term 2 Exam ==========			
	Priority Queues, Heaps as Priority Queues	1	3	1, 3
	Hashing, Hash Functions, Collision-resolution Techniques, Rehashing	1	3	1, 3
	Graphs and their representation and traversal, Shortest Path Problem,	1	3	4
	Minimum Spanning Trees, Graph Algorithms, Topological Sort	1	3	4
	========== Final Exam ==========			
	Total	**16**	**48**	

Laboratory Projects/Experiments Done in the Course

There will be weekly labs starting from the first week.
The following is a summary of the Lab exercises given to Students:

- Introduction to Data Structures and their implementation.
- Writing & using dynamic safe arrays
- Solving recursive problems using Backtracking in programs
- Implementation of Linked Lists
- Linked List based implementation of primitive Data Structures
- Implementing Sorting Algorithms
- Implementing Binary Trees and writing functions for their properties
- Implementing Binary Search Trees using Structures and Classes

	• Writing functions for tree traversal and maintaining balance • Implementing graphs and writing functions for their traversal
Programming Assignments Done in the Course	to Backtracking, Stacks & Queues, Binary Search Trees and traversal

Class Time Spent on (in credit hours)	**Theory**	**Problem Analysis**	**Solution Design**	**Social and Ethical Issues**
	15	15	13	0

Oral and Written Communications	Every student is required to submit at least __1__ written report of typically _6__ pages and to make _1__ oral presentations of typically __10__ minute's duration. Include only material that is graded for grammar, spelling, style, and so forth, as well as for technical content, completeness, and accuracy.

Instructor Name:

Instructor Signature: _____

Date: