Basic Information:

Course Title:	Data Structures & Algorithms	**Code**	IT-367
Program:	BBIT, IT Major	**Credit Hours:**	Three (03)
Total Sessions:	30 Classes + Mid Term + Final Term	**Pre-Requisite:**	Object Oriented Programming

Course Description:

The purpose of this course is to provide the students with solid foundations in the basic concepts of programming: data structures and algorithms. Another objective of the course is to teach the students how to select and design data structures and algorithms that are appropriate for problems that they might encounter. This course is also about showing the correctness of algorithms and studying their computational complexities. It also offers the students a mixture of theoretical knowledge and practical experience.

Learning Outcomes:

After the completion of this course, it is expected that students who will involve themselves in the knowledge base working of the course will be capable to:

1. *define basic static and dynamic data structures and relevant standard algorithms for them.*
2. *demonstrate advantages and disadvantages of specific algorithms and data structures,*
3. *select basic data structures and algorithms for autonomous realization of simple programs*
4. *formulate new solutions for programing problems using learned algorithms and data structures,*

Teaching Learning Methodology:

The study of data structures and algorithms is carried out within an object-oriented framework. When implementations are considered, the C/C++ programming language is used.

The formal teaching component of this course consists of: active student participation in and contribution to all forms of teaching and learning i.e. lectures, discussions, research assignments and projects. Lectures will be thrice a week of 90 minutes each.

Group Configurations:

One of the objectives of this course is to encourage and facilitate team work. Class will have to make a group of four for projects and research assignments. It is recommended that student will form their own groups. As general guideline, your group should have members with diverse skill sets including people who are proficient or have aptitude for different subject areas.

All Groups are required to submit their team rosters in the form of a memo to me by the end of 10th week. The memo should include Student Names, and ID numbers of all members and it should also identify a designated group leader who will serve as primary point of contact for me to communicate with the group.

Weekly Term Plan

Wk	Topics
01.	*Arrays, Sparse Matrix*
02.	*Sorting Routines*
03.	*Searching Methods*
04.	*Stack and its Implementation*
05.	*Queue, Circular Queue*
06.	*Linked Stack n Queue*
07.	*Linear Linked List*
08.	*Double Ended Linked List*
09.	*Mid Term Examination*
10.	*Tree, Binary Search Trees*
11.	*Balance Trees*
12.	*Heap, Priority Queues*
13.	*Graph and its Representation*
14.	*Shortest Path and Flow Problems*
15.	*Tables and Hashing*
16.	*Final Term Examination*

Topics in Detail

Matrices
- *Introduction*
- *Addition, Subtraction & Multiplication of Matrices*

Sparse Matrix
- *Addition & Subtraction of Sparse Matrices*

Sorting Routines
- *Priority Sorting Techniques*
  - *Bubble Sort, Selection Sort, Heap Sort*
- *Divide & Conquer Techniques*
  - *Shell Sort, Merge Sort, Quick Sort*
- *Key Insertion Techniques*
  - *Insertion Sort, Tree Sort, Radix Sort*

Stack
- *Array Implementation of Stack*
- *Dynamic Implementation of Stack*
- *Arithmetic Expression Validation & Evaluation*

Queue
- *Static Queue, Circular Queue*
- *Dynamic Queue, Circular Queue*

Linked List
- *Linear Linked List; Sorted & Unsorted*
- *Double Ended Linked List*
- *Circular Linear Linked List*
- *Circular Double Ended List*
- *List of Lists*

Recursion
- *Introduction*
- *Rules of Recursion*
- *Types of Recursion*
- *Factorial, Fibonacci, GCD etc.*

Searching
- *Sequential Search and Binary Search*
- *Depth First Search and Breadth First Search*

Hashing
- *Hash Function*
- *Collison Resolution*
- *Linear Probing, Quadratic Probing*

Tree
- *Introduction*
- *Binary Tree*
- *Expression Tree*
- *Tree Traversal*
  - *In Order Traversal*
  - *Pre Order Traversal*
  - *Post Order Traversal*
  - *Level Order Traversal*
- *Binary Search Tree*
- *Linked Implementation of Binary Tree*
- *Array Implementation of Binary Tree*
- *Balance Trees*
  - *AVL Trees*
  - *Red Black Trees*
- *Multilevel Trees, Forests*

Heap
- *Introduction*
- *Binary Heap*
- *Skew Heap*
- *Array Implementation of Heap*
- *Dynamic Implementation of Heap*

Graph
- *Introduction*
  - *Isomorphism, Circuit, Loop, Tournament*
  - *Adjacency Matrix & List*
  - *Weighted Graph, Di Graph*
- *Minimum Spanning Tree*
  - *Kruskal's Algorithm*
  - *Prim's Algorithm*
- *Shortest Path Algorithms*
  - *Bellman-Ford Algorithm*
  - *Dijkstra's Algorithm*
- *Network Flow*
  - *Floyd Warshall's Algorithm*
  - *Ford Fulkerson Algorithm*

Text & Recommended Readings

A. *Data Structures and Algorithm Analysis in C++*
Mark Allen Wessis

B. *Data Structures using C++*
Sartaj Sahani

C. *Classic Data Structures in C++*
Timothy A. Budd

Tools

1. *Visual C/C++ for Programming*
2. *Microsoft Word for Documentation*

Headings	*Arial 11pt Bold*
Normal Text	*Times New Roman 10pt*
Header Footer	*Times New Roman 8pt*
Paragraph	*Single Line Spacing*
	First Line Indent 1.0 cm
Page Margins	*2 cm from each side*

Grading Policy:

Final Grade for this course will be the cumulated result of the following term work both Lectures and Lab Sessions with relevant participation according to the quoted percentage.

Sessional	**25%**		***Mid Term***	**35%**		***Final Term***	**40%**
Assignments	10 %		*Mid Term Exam*	25%		*Final Exam*	30%
Quizzes	10%		*Lab Work/ Lab Mid Exam*	10%		*Case Study/ Project/ Term Paper*	10%
Presentations	05%						

Remember subdivision of Mid Term and Final Term Examination should be done only in case of very essential and major Grading Instruments.

Dishonest Practices & Plagiarism

A student found responsible for dishonest practice/cheating (copying the work of others, use of unauthorized material in Grading Instruments etc.) in relation to any piece of Grading Instrument will face penalties like deduction of marks, grade 'F' in the course, or in extreme cases, suspension and rustication from IBIT. For details consult Plagiarism Policy of the PU at http://pu.edu.pk/dpcc/downloads/Plagiarism-Policy.pdf

Grading System:

Letter Grade	Grade Point	Num Equivalence
A	4.00	85 – 100 %
A-	3.70	80 – 84 %
B+	3.30	75 – 79%
B	3.00	70 – 74 %
B-	2.70	65 – 69 %
C+	2.30	61 – 64 %
C	2.00	58 – 60 %
C-	1.70	55 – 57 %
D	1.00	50 – 54 %
F	0.00	Below 50 %
I	Incomplete	*
W	Withdraw	*

Norms to Course:

- ✓ *Submission Date and Time for the term instruments is always* **Un-Extendable**.
- ✓ *Printed Documentation shall be in accordance to the given format and following are essential parts.*
  `Title Page, Acknowledgement, Dedication, Contents, Problem Description, Analysis & Design, Flow Chart, Call-Return Model, Glossary, Data Dictionary, Menu Hierarchy, Listing, Index, Evaluation Sheet`
- ✓ *7 Absentees in class will be result in forced withdrawal.* ***(PU Policy)***
- ✓ *Re-sit in Mid and Final Term will cause you a loss of 2 and 3 grade marks respectively.* ***(PU Policy)***
- ✓ *This is your responsibility to keep track of your position in class evaluation units.*
- ✓ *After the submission date, NO excuse will be entertained.*
- ✓ ***Keep a copy of all submitted Grading Instruments.***
- ✓ *Assignment is acceptable only in its Entirety.*
- ✓ *No make up for any assignment and quiz.*
- ✓ *Copied & Shared work will score Zero.*
- ✓ *Assignments are Individual.*

Good Luck