

**COLLEGE OF INFORMATION TECHNOLOGY**

**DEPARTMENT OF INFORMATION TECHNOLOGY**

**COURSE SYLLABUS/ SPECIFICATION**

**Course Code & Title:** ITCS 224 - Data Structures

**Weight: (3 - 0 - 3)**

**Prerequisite:** ITCS 201

**NQF Level Allocated:** Level 6

**NQF Notional Hours / Credits:** 120 notional hours/ 12 NQF credit

**Description:**

This course introduces different data structures such as: arrays, linked list, stacks, queues, hash tables, and graphs. It covers the design and analysis of different algorithms to manipulate these data structures, such as: create, traverse, delete data, and insert data. The students will implement the data structure algorithms and apply them using a programming language.

**Objective:**

1. To overview various types of data structures.

2. To explain the algorithms associated with each data structure and their implementations.

3. To provide an analysis of the efficiency of algorithms associated with each data structure in terms of both time and space.

4. To demonstrate the effective use of data structures in computational problem solving.

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| **SEMESTER:** |  | **ACADEMIC YEAR:** |
| **INSTRUCTOR:** | | |
| **OFFICE TEL:** | | |
| **EMAIL:** | | |

**Intended Learning Outcomes (ILOs):**

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| 1. **Knowledge and Understanding** | | **NQF Descriptor/ Level** |
| **A1** | **Concepts and Theories:** Demonstrate a broad knowledge of the concepts and theories of various data structures and their algorithms. | Knowledge: theoretical understanding  [Level 6] |
| **A2** | **Contemporary Trends, Problems and Research:** N/A | N/A |
| **A3** | **Professional Responsibility:** N/A | N/A |

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| 1. **Subject-specific Skills** | | **NQF Descriptor/ Level** |
| B1 | **Problem Solving:** Identify problems and choose the appropriate and efficient data structures to solve these problems. | Knowledge: Practical  Application  [Level 6]  Skills: Communication, ICT  & Numeracy  [Level 6] |
| **B2** | **Modeling and Design:** Formulate data model, and design software solution through the application of the appropriate data structures. | Knowledge: Practical  Application  [Level 6] |
| **B3** | **Application of Methods and Tools:** Use a programming language to implement various data structures and apply different methods of designing algorithms. | Knowledge: Practical  Application  [Level 6]  Skills: Communication, ICT  & Numeracy  [Level 6] |

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| 1. **Critical-Thinking Skills** | | **NQF Descriptor/ Level** |
| **C1** | **Analytic:** Evaluate and analyze the performances of algorithms associated with the various data structures. | Generic Problem Solving & Analytical skills [Level 6] |
| **C2** | **Synthetic:** N/A | N/A |
| **C3** | **Creative Thinking and innovation:** N/A | N/A |

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| 1. **General and Transferable Skills (other skills relevant to employability and personal development)** | | **NQF Descriptor/ Level** |
| **D1** | **Communication:** Express and communicate ideas in written and oral form. | Communication, ICT and  Numeracy Skills  [Level 6] |
| **D2** | **Teamwork and Leadership:** | N/A |
| **D3** | **Organizational and Developmental Skills:** Demonstrate ability to organize ideas and effectively allocate time in given assignment. | Competence: Autonomy,  Responsibility and Context  [Level 6] |
| **D4** | **Ethics and Social Responsibility:** | N/A |

**Course Structure (Outline)**

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| **Course Structures (Outline)** | | | | | | | | | | | | | | | |
| **Week** | |  | **Hours**  **.** | | |  | **ILOs** | | **Unit/Module or Topic Title** | | **Teaching Methods** | | **Assessment Method** | | |
| **Lec.** | | | **Labs** | |
| 1 | | 2 |  | |  | 2 | A1 | | Syllabus- Introduction | | Lecture | | - | | |
| 2-3 | | 4 |  | |  | 4 | A1, B1, B2, B3, C1 | | **Arrays:**  -Array creation and initialization.  -Insertion and deletion of an element.  -Multidimensional arrays and their representations.  -Performance Analysis. | | Lecture/ In- Class Supervised Work /  In-Lab Supervised Work | | In-Class Exercises/ In-Lab Exercises | | |
| 4 | | 2 |  | |  | 2 | B2, B3, C1, D1, D3 | | **Arrays:**  -Sequential and binary search operations.  -Selection and insertion sort operations. | | Lecture/ In-  Class Supervised Work /  In-Lab Supervised Work | | Assignment 1 | | |
| 5-6 | | 4 |  | |  | 4 | A1, B1, B2, B3, C1 | | **Stack:**  -Applications of stack.  -Push and pop operations.  -Performance Analysis. | | Lecture/ In-  Class Supervised Work /  In-Lab Supervised Work | | In-Class Exercises/  In-Lab Exercises/ Major Test | | |
| 7-8 | | 4 |  | |  | 4 | A1, B1, B2, B3, C1 | | **Queue:**  -Types of queues like circular one.  -Insertion and deletion operations on queues.  -Performance Analysis. | | Lecture/ In-  Class Supervised Work /  In-Lab Supervised Work | | In-Class Exercises/  In-Lab  Exercises | | |
| 9-10 | | 4 |  | |  | 4 | A1, B1, B2, B3, C1, D1, D3 | | **Linked list:**  **-** Linked list, doubly linked list and circular linked list.  **-**Insertion and deletion operations on linked list.  -Performance Analysis. | | Lecture/ In-  Class Supervised Work /  In-Lab Supervised Work | | Assignment 2/ In-Class Exercises/  In-Lab  Exercises | | |
| 11-12 | | 4 |  | |  | 4 | A1, B1, B2, B3, C1 | | **Hash Tables:**  -Hash function.  -Collision resolution.  -Performance Analysis. | | Lecture/ In- Class Supervised Work / In-Lab  Supervised  Work | | In-Class Exercises/ In-Lab Exercises | | |
| 13-14 | | 4 | | | 4 | | | | A1, B1, B2, B3, C1 | | **Trees:**  -Definitions and basic terminologies.  -In-order, pre-order and post- order traversal.  -Tree creation, insertion and deletion of a node.  -Performance Analysis. | | Lecture/ In- Class Supervised Work /  In-Lab Supervised Work | | In-Class Exercises/  In-Lab  Exercises |
| 15 | | 2 | | | 2 | | | | A1, B1, B2 | | **Graphs Concepts:**  -Undirected and directed graphs.  **-**Representing graphs. | | Lecture/ In-  Class Supervised Work | | Lab Test |
| 16 | | 2 | | | - | | | | A1, B1,  B2, C1 | | All Topics | |  | | Final Exam |

**Teaching Materials:**

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| **Textbook(s):** | 1. Goodrich M. T., Tamassia R. and Goldwasser M. H. (2014) *Data Structure and Algorithms in Java*, 6th Edition, Wiley. |
| **Handout(s):** | Available on Moodle i.e. <http://www.ahlia.edu.bh/moodle> |
| **Reference(s):** | 1. Weiss M. A. (2011) *Data Structures and Problem Solving using Java*, 4th Edition, Pearson Education.  2. Dale N., Joyce D. and Weems C. (2011) *Object Oriented and data structures using Java*, Third Edition, Jones & Bartlett Publishers. |

**ASSESSMENTS:**

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| **Type of**  **Assessment** | **Description** | **ILOs** | **Weighting** |
| In-Lab Exercises | They consist mainly of implementing different  data structures. | B3 | Formative |
| In-Class Exercises | They cover problem solving and analysis  questions and help students in differentiating between the various data structures. | B1, B2 | Formative |
| Assignments | Two assignments, each one covers a number of data structures used for solving a problem and will worth ten marks. The students have to analyze the performance of each data structure. | B1, B2, B3, C1, D1, D3 | 20 % |
| Major Test | One written test to be given to students. The major  test is a written, in-class 90 minutes test. It will cover topics studied in the first 10 weeks. The  majority of questions are problem solving and  analysis questions. | A1, B1, B2, C1 | 20 % |
| Lab Test | A practical comprehensive test of two hours. It  consists of questions to implement data structures appropriate to solve given problems. | B1, B3 | 20% |
| Final Exam | The final exam is a comprehensive, written exam and will be of two hours. It consists of problem solving and analysis questions. | A1, B1, B2, C1 | 40% |
| Overall |  |  | 100% |

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| **Admissions** | |
| **Minimum number of students** | **5** |
| **Maximum number of students** | **25** |

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