# Data structures and Algorithms (1)

## Course Definition

**I**nformation

**T**echnology

**E**ngineering

# 1. Basic Information:

| Course Name | Data structure and algorithms I |
| --- | --- |
| Course Code | BDA501 |
| Number of Presentational Sessions* | 10−16 |
| Number of Synchronous Sessions** | 10−16 |
| Number of Shorter Tests*** | 2 |
| Number of Exams*** | 0 |
| Theoretical Sessions Work Load (hrs.) | 36 |
| Practical Sessions Work Load (hrs.) | 48 |
| Credit Hours | 6 |

**\*Each presentational session comprises both recorded lecture (1.5 hrs.) and interactive learning content (1.5 hrs.).**

**\*\*Each synchronous session comprises the interactive lecture carried out in real time in a virtual class (1.5 hrs.).**

**\*\*\*Each shorter test is 0.5 hr. long. The final exam is 2 hrs. long.**

**N.B.**

**Generally, each chapter requires two presentational sessions: one for the recorded content and one for the interactive content (unless the chapter is too long, in which case it may require more sessions (. This note applies to synchronous sessions as well, where each chapter requires one synchronous session generally.**

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## 2. Prerequisites courses:

| Course | Code |
|---|---|
| Programming II | BPG402 |

## 3. Course Objectives:

This course exposes different data structure and algorithms. Topics include: Concept of an algorithm, abstract data structure, arrays, lists, stacks, queues, trees, hash tables, graphs, and its algorithms.

This course prepares students to apply the main concepts of data structure and algorithms (I) in solving informatic problem in the most appropriate way, and measuring the complexity in terms of execution time, number of executed operations and the memory allocation size. The ultimate goal of this course is to enable students to design and analyze algorithms as optimal as possible in different engineering domains.

## 4. Learning Outcomes (LO):

By the end of this course the learner is expected to:

- Study main data structures:
  - Arrays
  - Lists
  - Stacks
  - Queues
  - Overview of Trees
  - Overview of Hash tables
  - Overview of Graphs

- Study some algorithms concerning the above data structures:
  - Search algorithms
  - Sort algorithms
  - Recursive algorithms
  - Backtracking algorithms
- Study the complexity of algorithms in terms of:
  - Execution time
  - Number of executed operations
  - Memory size
- Have the necessary skills to design and implement algorithms in optimal way in different engineering domains.

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## 5. Assessment Results:

| Chapter Number | Chapter Title | General Objectives | Assessment Type | | | | |
|---|---|---|---|---|---|---|---|
| | | | Interactive Content & Recorded Sessions | Applied Activities (Synch. Sessions) | Final Exam*/ Shorter Tests** | Presentations and Interviews*** | Reports *** |
| CH1 | Main concepts of algo. | Comprehension –Analytical Thinking – Tools And Application Hands– On | √ | √ | √ | √ | √ |
| CH2 | Complexity of algos. | Comprehension –Analytical Thinking – Tools And Application Hands– On | √ | √ | √ | √ | √ |
| CH3 | Lists | Comprehension –Analytical Thinking – Tools And Application Hands– On | √ | √ | √ | √ | √ |
| CH4 | Stacks | Comprehension –Analytical Thinking – Tools And Application Hands– On | √ | √ | √ | √ | √ |
| CH5 | Queues | Comprehension –Analytical Thinking – Tools And Application | √ | √ | √ | √ | √ |

| | | Hands– On | | | | | |
|---|---|---|---|---|---|---|---|
| **CH6** | Trees | Comprehension –Analytical Thinking – Tools And Application Hands– On | √ | √ | √ | √ | √ |
| **CH7** | Hash tables | Comprehension –Analytical Thinking – Tools And Application Hands– On | √ | √ | √ | √ | √ |
| **CH8** | Graphs | Comprehension –Analytical Thinking – Tools And Application Hands– On | √ | √ | √ | √ | √ |
| **CH9** | Search and sort alogs. | Comprehension –Analytical Thinking – Tools And Application Hands– On | √ | √ | √ | √ | √ |
| **CH10** | Backtracking and recursive algos. | Comprehension –Analytical Thinking – Tools And Application Hands– On | √ | √ | √ | √ | √ |

\*The final exam is two hours long and is given at the end of the course.

\*\*Shorter tests are about 30 minutes long and are given after three or four lectures throughout the semester during synchronous sessions.

\*\*\*Presentations, interviews, and reports are submitted once after each three or four lectures throughout the semester during synchronous sessions.

## 6. Course Syllabus:

| Chapter | Subject | Content | Number of Learning Objects | Number of synchronous Learning Objects |
|---|---|---|---|---|
| CH1 | Main concepts of algos. | 1. Introduction<br>2. Main Concepts of Algos.<br>3. Exercises | 3 | 2 |
| CH2 | Complexity of algos. | 1. Introduction<br>2. Calculation of Algorithm Implementation time<br>3. Necessary Memory Volume<br>4. Exercises | 4 | 2 |
| CH3 | Lists | 1. Introduction<br>2. Linear Data Structure<br>3. Exercises | 3 | 2 |
| CH4 | Stacks | 1. Stack Definition<br>2. Operations on Stack<br>3. Stack Implementation<br>4. Stack Applications<br>5. Exercises | 5 | 2 |

| CH5 | Queues | 1. Queue Definition<br>2. Queue Applications<br>3. Procedures and Operations on Queue<br>4. Queue Representation<br>5. Special Queues<br>6. Exercises | 6 | 3 |
|---|---|---|---|---|
| CH6 | Overview of Trees | 1. Introduction<br>2. Tree Definition<br>3. Idioms Used in Tree Structure<br>4. Trees Applications<br>5. Binary Tree Representation<br>6. Tree Representation<br>7. Measurements and Operations on Trees<br>8. Exercises | 8 | 4 |
| CH7 | Overview of Hash tables | 1. Introduction (Basic Problem)<br>2. Suggested Solutions<br>3. Hash Table<br>4. Hash Tables Implementation<br>5. Exercises | 5 | 2 |
| CH8 | Overview of Graphs | 1. Introduction<br>2. Definitions and Legends<br>3. Graph Representation<br>4. Operation on Graph<br>5. Exercises | 5 | 2 |

| | | | | |
|---|---|---|---|---|
| **CH9** | Search and sort algos. | 1. Introduction<br>2. Search definition<br>3. Sort Definition<br>4. Sort Algorithms Classification and Comparison<br>5. Exercises | 5 | 2 |
| **CH10** | Recursive and backtracking algos. | 1. Introduction<br>2. Recursive Algorithm general plan<br>3. Recursive Procedure Implementation completion<br>4. Recursive Program Example<br>5. Backtracking Algorithms<br>6. Exercises | 6 | 3 |

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## 7. Practical Activity:

- **Tools and Labs:**

| Tool Name | Description |
|---|---|
| C++ | Programing language |

- **Practical Activities per Chapters:**

| Chapter | Activities Type | Remarks |
|---|---|---|
| **CH1** | ☑ Exercises<br>☑ Homework<br>☐ Webinars<br>☐ Project<br>☑ Experiment<br>☐ Other | |
| **CH2** | ☑ Exercises<br>☑ Homework<br>☐ Webinars<br>☐ Project<br>☑ Experiment<br>☐ Other | |

| CH3 | ☑ Exercises<br>☑ Homework<br>☐ Webinars<br>☐ Project<br>☑ Experiment<br>☐ Other | |
|---|---|---|
| CH4 | ☑ Exercises<br>☑ Homework<br>☑ Webinars<br>☐ Project<br>☑ Experiment<br>☐ Other | |
| CH5 | ☑ Exercises<br>☑ Homework<br>☐ Webinars<br>☑ Project<br>☑ Experiment<br>☐ Other | |
| CH6 | ☑ Exercises<br>☑ Homework<br>☐ Webinars<br>☐ Project<br>☑ Experiment<br>☐ Other | |

| CH7 | ☑ Exercises<br>☑ Homework<br>☑ Webinars<br>☐ Project<br>☑ Experiment<br>☐ Other | |
|---|---|---|
| CH8 | ☑ Exercises<br>☑ Homework<br>☐ Webinars<br>☐ Project<br>☑ Experiment<br>☐ Other | |
| CH9 | ☑ Exercises<br>☑ Homework<br>☐ Webinars<br>☐ Project<br>☑ Experiment<br>☐ Other | |
| CH10 | ☑ Exercises<br>☑ Homework<br>☑ Webinars<br>☐ Project<br>☑ Experiment<br>☐ Other | |

## 8. References:

- Algorithms and Data Structure (Dr. Rakan Razouk)
- Algorithms and Data Structure course (Dr. Nada Ghneim, Dr Ola Abu Amsha)