**Course Specification**

(**CS 316 Algorithms**)

|  |  |
| --- | --- |
| *University:* | Helwan University |
| *Faculty:* | Faculty of Computers & Information |
| *Department:* | ***Computer science*** |

**1. Course Data**

|  |  |
| --- | --- |
| **Code:** | **CS 316** |
| **Course title:** | Algorithms |
| **Level:** | 2 |
| **Specialization:** | Computer Science |
| **Credit hours:** | 3 hours |
| **Number of learning units (hours):** | (3) theoretical 2) practical |

**2. Course Objective**

Algorithm concept: Analysis and complexity. Design methods, divide and conquer, binary search, merge sort, quick sort, selection, matrix multiplication, the greedy method. Dynamic programming: shortest paths, optimal search trees. Backtracking. NP-hard and NP-complete problems.

**3. Intended Learning Outcomes:**

**A- Knowledge and Understanding:**

A3. Describe and model Mathematical Problems.

A6. Describe the Modeling Problems.

A7. Define the basics of Computer Systems.

A8. Apply Programming to solve Problems.

A9. Apply the Problem Solving Techniques.

A10. Apply the basics of Discrete Mathematics.

* **Intellectual Skills**

B3. Develop Analytical Skills.

B6. Diagnose the potential and the limitations of Computers.

B7. Create computer algorithms to solve different problems.

B8. Gather and assess relevant information, using abstract ideas to

interpret it effectively.

B9. Design and implement Programming methods.

B15. Focus, gather information, integrate, and evaluate the data for Problem Solving.

B18. Classify different problems.

B21. Design and analyze Problems.

* **Professional and Practical Skills**

C5. Acquire information independently.

C16. Deploy the tools for software projects documentation.

**D- General and Transferable Skills**

D3. Use different Problem Solving techniques.

D5. Follow Creative Thinking.

D6. Use Modeling capability in software projects.

D11. Clarify Ideas formulation and presentation.

**4. Course contents**

|  |  |  |  |
| --- | --- | --- | --- |
| **Topic** | **No. of hours** | **Lecture** | **Tutorial/ Practical** |
| Review of elementary programming concepts and C programming language. | 3 | 1 | 1 |
| **Software engineering:**  Software validation, testing fundamentals, including test plan creation and test case generation. | 3 | 1 | 1 |
| Encapsulation and information hiding; separation of behavior and implementation; basic built-in data structures, one-, two-, and three-dimensional arrays. | 3 | 1 | 1 |
| **Fundamental data structures:**  Stacks; queues; linked lists; hash tables; trees; graphs. | 3 | 1 | 1 |
| **Recursion:**  The concept of recursion; recursive mathematical functions; simple recursive procedures; divide-and-conquer strategies; recursive backtracking; implementation of recursion; writing recursive algorithms in iterative fashion; when and when not to use recursion; | 6 | 2 | 2 |
| **Basic algorithmic analysis**:  Asymptotic analysis of upper and average complexity bounds; identifying differences among best, average, and worst case behaviors; big “O,” little “o,” omega, and theta notation; standard complexity classes; empirical measurements of performance; time and space tradeoffs in algorithms; using recurrence relations to analyze recursive algorithms | 6 | 2 | 2 |
| **Fundamental computing algorithms**:  O(N log N) sorting algorithms; hash tables, including collision-avoidance strategies; binary search trees; representations of graphs; depth- and breadth-first traversals | 6 | 2 | 2 |
| **Object-oriented programming:**  Object-oriented design; encapsulation and information hiding; classes; separation of behavior and implementation; class hierarchies; inheritance. | 6 | 2 | 2 |
| **Algorithmic strategies**:  Brute-force algorithms; greedy algorithms; divide-and-conquer; backtracking; branch-and-bound; heuristics; pattern matching and string/text algorithms. | 6 | 2 | 2 |

**Mapping contents to ILOs**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Topic | Intended Learning Outcomes (ILOs) | | | |
| Knowledge and understanding | Intellectual Skills | Professional and practical skills | General and Transferable skills |
| **Review of elementary programming concepts and C programming language.** | A3 | B3 | C16 | D5 |
| **Software engineering** | A3,A6 | B6 | C16 | D6 |
| **Encapsulation and information hiding** | A3 | B7,B3 | C16,C5 | D11 |
| **Fundamental data structures** | A3 | B3 |  | D3 |
| **Recursion** | A3 | B3 |  | D3 |
| **Basic algorithmic analysis** | A7,A6 | B3 |  | D6,D11 |
| **Fundamental computing algorithms** | A3,A10 | B3,B8,B9 |  | D5 |
| **Object-oriented programming** | A3,A8 | B3,B15,,B7 |  | D5 |
| **Algorithmic strategies** | A3,A9,A6 | B18,B7,B21 |  | D5 |

**5. Teaching and Learning Methods**

Class Lectures

Exercises

Lab. work.

**6. Teaching and Learning Methods for students with limited capability**

Using data show

e-learning management tools

**7. Students Evaluation**

**a) Used Methods**

Lab exam

Assignments

Lab work

Programming projects

**b) Time**

Assessment 1: Test 1 Week 4

Assessment 2: Test 2 Week 7

Assessment 3: Midterm Exam Week 10

Assessment 4: Practical Exam Week 14

Assessment 5: final written exam Week 16

**c) Grades Distribution**

Mid-Term Examination 20%

Final-term Examination 60%

Other types of assessment 20 %

Total 100%

Any formative only assessments

**List of Books and References**

**a) Notes**

Course Notes

- Handouts

**b) Mandatory Books**

**Title:** Introduction to Algorithms, Second Edition

**Author(s):** [Thomas H. HYPERLINK "http://mitpress.mit.edu/catalog/author/default.asp?aid=344"Cormen](http://mitpress.mit.edu/catalog/author/default.asp?aid=344), [Charles E. HYPERLINK "http://mitpress.mit.edu/catalog/author/default.asp?aid=345"Leiserson](http://mitpress.mit.edu/catalog/author/default.asp?aid=345), [Ronald L. HYPERLINK "http://mitpress.mit.edu/catalog/author/default.asp?aid=346"Rivest](http://mitpress.mit.edu/catalog/author/default.asp?aid=346) and [Clifford Stein](http://mitpress.mit.edu/catalog/author/default.asp?aid=13714)

**Publisher:** McGraw –Hill, 2004

**ISBN:** 978-0-262-03293-3

**c) Suggested Books**

**d) Other publications**

**Course Coordinator:**  **:** A. Prof. Dr. Mohamed Belal

**Chairman of the Department:** Prof. dr. Iraqy Khalifa