University of Petra			University of Petra (30 Year Anniversary) جامعة البترا - ثلاثون عاما
Faculty of Information Technology **Department of Computer Science**		جامعة البترا	كلية تكنولوجيا المعلومات قسم علم الحاسوب

Course Syllabus

Year: 2025-2026   **Semester: (1)**

Course No.	Course Title	Prerequisite	Co-requisite	Credit Hours Lectures /Lab.	Equivalent hours in NQF	Course level according to NQF
601326	Advanced Algorithms	601221	-	3:3:0 Lab	70	7

Instructor Name	E-mail	Office No.	Office ext.
Dr. Eman Alduweib	eman.alduweib@uop.edu.jo		

Coordinator's Name:	Dr. Eman Alduweib

Short Course Description	This course continues to introduce the concepts of designing and analyzing algorithms. Topics covered: further discussion and analysis of computational complexities of algorithms, further algorithms analysis & design techniques including divide and conquer greedy methods; searching and sorting; combinatorial algorithms; Branch and Bound such as 0/1 Knapsack Problem - Traveling Salesman Problem (TSP) - Job Scheduling Problem; Greedy Programming such as Prim's Algorithm - Dijkstra's Algorithm; and Dynamic Programming such as Binomial Coefficient – Warshall's and Floyd's algorithms.

Course Objectives

- Review and teach students the elementary data structures for implementing dynamic sets and the analyses of operations performed on them .
- Teach students Understanding the correctness of algorithms using inductive proofs
- Teach students the major graph algorithms techniques for solving algorithms using different techniques including brute force, divide-and-conquer: Decrease-and-conquer
- Implement mathematical analysis to analyze the time complexity of algorithms using different techniques .
- Practice OOP to implement the different algorithms through the course.

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Course Intended Learning Outcomes (ILOs) and their Alignment with Program ILOs, Teaching and Learning Methods, and Assessment Methods:

Upon successful completion of this course, students are expected to achieve the following learning outcomes:

Course ILOs	Program ILOs	Teaching and Learning Method	Assessment Method
Knowledge (K)			
K1. Understand the principles of Algorithm's' design and analysis by introducing different possible mathematical models in order to solve a problem	7.1	Interactive Lectures	Quizzes
K2. Understand how to use different data structures within an algorithm to solve a problem	7.2	Interactive Lectures	Midterm exam
Intellectual Skills (I)			
I1. Ability to find best and most efficient solutions that meet desired needs	2.3	Interactive Lectures	Midterm exam
I2. Compare between algorithms to identify their tradeoffs.	CS-6.2	Interactive Lectures	Final exam
Practical skills (P)			
P1. Implementing the different algorithms and Programs using HLL.	2.2	Interactive Lectures	Project
Competencies (C)*			
C1. Knowledge integration	C7	Interactive Lectures	Midterm exam
C2: Solution development.	C2	Interactive Lectures	Quizzes
C3: Technical proficiency.	CS-C6	Interactive Lectures	Quizzes

Course Schedule:

Week	Topic Details	Course ILO Number	Reference
1,2	**Introduction** : Steps of problem-solving Graphs introduction Graph Representation (Adjcency List and Adjcency matrix) **Mathematical Background:** Arithmatic Review (series, sequancess, and series)	K1, K2	Ch. 1 , Ch. 2 Text Book – Lecture Notes

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	Proof by induction			
3	**Fundamentals of the Analysis of Algorithm Efficiency** Introduction to algorithem design and anylsis Growth of Functions Asymptotic Notations Complexity (Worst, Best, and Average Cases)	I1		Ch. 3 Text Book – Lecture Notes
4	**Sequential Method** Insertion Sort and Insertion Sort algorithm analysis Selection Sort	K1, K2, P1		Ch. 5 Text Book – Lecture Notes
5,6	**Recursive Algorithms** Designing Recursion solution Example recursive algorithms like Towers of Hanoi, Fibbonacci **Solving Recurrences** Backward substitution Master theorem	I1		Ch. 3 Text Book – Lecture Notes
7	**Brute Force** Brute Force concept in algorithm design Pros and cons Example algorithms like Simple password cracking and sequential search	K1, K2, P1		Ch. 5 Text Book – Lecture Notes
8	**Divide-and-Conquer** Quick Sort and Quick sort algorithm analysis	K1, K2, P1		Ch. 5 Text Book – Lecture Notes
	MID Exam			
9	**Decrease-and-Conquer**: Graph Review Heap sort and Heap sort algorithm analysis Breadth-First Search Algorithm	I1		Ch. 6 Text Book Lectur– Notes
10	**Greedy Technique** General Greedy Method Prim's Algorithm Kruskal's Algorithm Huffman Algorithm	I1		Ch. 9 Text Book – Notes
11	**Dynamic Programming**: Dynamic Programming (DP) Definition General DP Method DP vs Greedy Method Fractional Knapsack problem	K1, K2		Ch. 8 Text Book – Notes

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	All pairs shortest path Floyd's algorithm		
12,13	**Branch and Bound** NP-hard problems introduction Branch and Bound Definition 0/1 Knapsack Problem Traveling Salesman Problem (TSP)	K1, K2	Ch. 9 + Ch.7 Text Boo ks – Not es
14	**Project Discussion**		
15	**Final Exam**		

Assessment Methods and Grading System:

Assessment method	Grade	Comments
MID Exam	30	Topics of the first 7-8 weeks
Quizzes	20	4 quizzes (5 marks each)
Project	10	Implementing studied algorithms using a programming language(Java/Python) with presentation
Final Exam	40	All topics
Total	100	

Learning References:

1- Textbook(s): • **Introduction to Algorithms. 4th edition** Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest and Clifford Stein Publisher: The MIT Press Copyright: 2022 • **An Introduction to Design and Analysis of Algorithms: International Edition, 3rd edition** Anany V. Levitin, Villanova University Publisher: Pearson Higher Education Copyright: 2011
2- References: • **Computer Algorithms: Introduction to Design and Analysis. 3rd edition** Sara Baase and Allen Van Gelder Publisher: Pearson Copyright: 1999
3- Other Resources: << computer resources, lecture rooms needed for the course>>

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Course Policies[1]

- <u>Attendance Policy:</u> University regulations apply to attendance.

- <u>Academic Honesty:</u> Academic dishonesty is an unacceptable mode of conduct, and will not be tolerated in any form at University of Petra. All persons involved in academic dishonesty and plagiarism in any form will be disciplined in accordance with University rules and regulations.

Approved by	Name	Date	Signature
Coordinator of Curriculum Committee			
Faculty Dean/ Head of Department			

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[1] Additional information may be added in this section according to the nature of the course.