Course E-Syllabus

1	**Course title**	Theory of Algorithms
2	**Course number**	1901341
3	**Credit hours**	3 Theory per Week
	Contact hours (theory, practical)	3 Theory per Week
4	**Prerequisites/corequisites**	Data Structures
5	**Program title**	B.Sc. in Computer Science
6	**Program code**	01
7	**Awarding institution**	The University of Jordan
8	**School**	King Abdullah II School of Information Technology
9	**Department**	Computer Science
10	**Level of course**	Third Year
11	**Year of study and semester (s)**	Fall Semester – 2022/2023
12	**Final Qualification**	B.Sc. in Computer Science
13	**Other departments involved in teaching the course**	Computer Information Systems; Information Technology; and Computer Engineering
14	**Language of Instruction**	English
15	**Teaching methodology**	☒Face to Face ☐Online ☐Blended
16	**Electronic platform(s)**	☒Moodle ☒Microsoft Teams ☐Skype ☐Zoom ☐Others……
17	**Date of production/revision**	October / 2022

18 Course Coordinator:

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19 Instructors:

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20 Course Description:

Definition of an Algorithm; Algorithm design and techniques, such as sequential versus divide-and-conquer; Algorithm analysis; Concept of basic operations; Concept of worst, best, and average-case analysis; Complexity analysis: big O, Omega and Theta notations; Recurrence equations and recursive algorithms; Searching and sorting algorithms; Concept of graphs; Graph algorithms.

21 Course aims and outcomes:

A- Aims:

a. To provide a thorough treatment of the concepts and design principles of contemporary Computer Algorithms.
b. To present the time and space complexity of algorithms.
c. To measure the efficiency of algorithms.
d. To design and analyze various sorting algorithms such as insertion, merge, quick, and heap sort.
e. To design and analyze various searching algorithms such as breadth-first and depth-first search.
f. To select the best algorithm for a certain problem.
g. To design different algorithmic approaches; such as sequential, divide-and-conquer, greedy, and dynamic programming.

B- Intended Learning Outcomes (ILOs):

A- Knowledge and Understanding:

A1) know and understand basic terms associated with algorithms; such as time and space complexities, Big O notation, Big Omega notation, Big Theta notation, etc.
A2) know and understand basic terms associated with graphs; such as directed and undirected graphs, path, cycle, strongly and weakly connected graphs, tree and forest, etc.
A3) know and understand sequential, divide-and-conquer, greedy and dynamic programming approaches.
A4) know the advantages and disadvantages of various sorting, searching, and minimum spanning tree algorithms.
A5) understand the structure of various sorting algorithms; such as insertion sort, merge sort, heap sort, quicksort, etc.
A6) understand the structure of various searching algorithms; such as breadth-first search, depth-first search, etc.
A7) understand the structure of various minimum spanning tree algorithms.
A8) know the applications of various sorting, searching, minimum spanning tree algorithms.

B- Cognitive and Intellectual Skills:

B1) analyze and evaluate various sorting algorithms
B2) analyze and evaluate various searching algorithms.
B3) analyze and evaluate various minimum spanning tree algorithms.

C- Subject Specific Skills:

C1) design various sorting algorithms using sequential and divide-and-conquer approaches.
C2) design various searching algorithms.
C3) design various minimum spanning tree algorithms using a greedy approach.

22. Topic Outline and Schedule:

Week	Lecture	Topic	Teaching Methods*/platform	Evaluation Methods**	References
1 – 3	1.1	**Overview:** Syllabus & Course Outlines. **Topic 1** **Introduction:** Definition of Algorithm; Characteristics & Components of Algorithm; Algorithms Examples & Calculating Effort; Algorithm's Efficiency. **Topic 2** **Getting Started:** Analyzing and Designing Algorithms; Insertion Sort (Sequential); Merge Sort (Divide and Conquer).	Synchronous lecturing	Questions in classes	Chapters 1+2
	1.2		Synchronous lecturing		
	1.3		Synchronous lecturing		
	2.1		Synchronous lecturing		
	2.2		Synchronous lecturing		
	2.3		Synchronous lecturing		
	3.1		Synchronous lecturing		
	3.2		Synchronous lecturing		
	3.3		Synchronous lecturing		
4 & 5	4.1	**Topic 3** **Growth of Functions:** Complexity (Worst-Case, Best-Case, and Average-Case); Practical vs. Impractical Complexities; Mathematical Functions' Properties (Polynomials, Exponents, Logarithms, Summation, and Factorials). **Topic 4** **Recurrences:** Recurrence Equations; Iteration Method.	Synchronous lecturing	**Quiz-1**: Topics 1, 2, 3 **Exams**	Chapter 3+4
	4.2		Synchronous lecturing		
	4.3		Synchronous lecturing		
	5.1		Synchronous lecturing		
	5.2		Synchronous lecturing		
	5.3		Synchronous lecturing		
6	6.1	**Topic 5** **Heap Sort:** Heap Property; Heapify Function; Build Heap Function; Heap Sort Function.	Synchronous lecturing	**Exams**	Chapter 6
	6.2		Synchronous lecturing		
	6.3		Synchronous lecturing		
7 & 8	7.1	**Topic 6** **Quicksort:** Advantages and Disadvantages; Quicksort Function; Partition Function; Choosing a Pivot; Run Time Complexity (Worst, Best, and Average Case).	Synchronous lecturing	**Quiz-2:** Topics 4, 5, 6 **Midterm:** Topics 1–6	Chapter 7
	7.2		Synchronous lecturing		
	7.3		Synchronous lecturing		
	8.1		Synchronous lecturing		
	8.2		Synchronous lecturing		
	8.3		Synchronous lecturing		
9	9.1	**Topic 7** **Graphs-I:** Graph Terminologies; Representations of graphs.	Synchronous lecturing	**Exams**	Chapter 22
	9.2		Synchronous lecturing		
	9.3		Synchronous lecturing		

10 – 12	10.1	**Topic 7** **Graphs-II + Graphs-III:** Breadth-First Search; Depth-First Search.	Synchronous lecturing	**Quiz-3 (Optional)**: Topic 7	Chapter 22
	10.2		Synchronous lecturing		
	10.3		Synchronous lecturing		
	11.1		Synchronous lecturing		
	11.2		Synchronous lecturing		
	11.3		Synchronous lecturing		
	12.1		Synchronous lecturing		
	12.2		Synchronous lecturing		
	12.3		Synchronous lecturing		
13 & 14	13.1	**Topic 8** **Greedy Algorithms:** General Greedy Method. **Topic 9** **Minimum Spanning Tree:** Kruskal's Algorithm	Synchronous lecturing	**Exams**	Chapters 16+23
	13.2		Synchronous lecturing		
	13.3		Synchronous lecturing		
	14.1		Synchronous lecturing		
	14.2		Synchronous lecturing		
	14.3		Synchronous lecturing		
15 & 16	15.1	**Topic 10** **Dynamic Programming (DP):** DP Definition; General DP Method; DP Approaches; DP vs. Greedy; Elements of DP; Examples of DP Problems; Multistage Graphs – Example. **Revision**	Synchronous lecturing	**Final Exam:** All Topics	Chapter 15
	15.2		Synchronous lecturing		
	15.3		Synchronous lecturing		
	16.1		Synchronous lecturing		
	16.2		Synchronous lecturing		
	16.3		Synchronous lecturing		

- Teaching methods include Synchronous lecturing/meeting.
- Evaluation methods include at least two of the following: Homework, Quiz, and Exam.

23 Evaluation Methods:

Opportunities to demonstrate achievement of the ILOs are provided through the following assessment methods and requirements:

Evaluation Activity	Mark	Topic(s)	Period (Week)	Platform
Quiz-1	10	1 – 3	4	Automated/paper
Quiz-2	10	4 – 6	7	Automated/paper
Midterm Exam	30	1 – 6	8	Automated
Quiz-3 (Optional)	10	7	12	Automated/paper
Final Exam	50	All Topics	16	Automated

Note: If three quizzes are taken, we drop the lowest quiz.

24 Course Requirements (e.g.: students should have a computer, internet connection, webcam, account on a specific software/platform, etc.):

Each student must have one computer connected to the internet, and an account on both Moodle and Microsoft Teams.

25 Course Policies:

Cheating	• Cheating or copying on exams or quizzes or Homework is illegal and unethical activity. • Standard University of Jordan's policy will be applied. • All graded assignments/quizzes/exams must be your work (your own words).
Attendance	• Excellent attendance is expected. • The University of Jordan policy requires the faculty member to assign a ZERO grade (F) if a student misses 10% of classes that are not excused. • If you miss a class, it is your responsibility to find out about any announcements or assignments you may have missed.
Workload	• The average work-load student should expect to spend 8 hours per week.
Participation	• Participation in and contribution to class discussions will affect your final grade positively. • Making any kind of disruption and (side talks) in the class will affect you negatively.
Concerns or Complaints	• Concerns or complaints should be expressed in the first instance to the module lecturer; if no resolution is forthcoming, then the issue should be brought to the attention of the module coordinator (for multiple sections) who will take the concerns to the module representative meeting. Thereafter, problems are dealt with by the Department Chair and if still unresolved the Dean and then ultimately the Vice President. For final complaints, there will be a committee to review grading the final exam.
Students with Disabilities	• Students with disabilities who need special accommodations for this class are encouraged to meet with the instructor and/or their academic advisor as soon as possible. To receive accommodations for academic work in this course, students must inform the course instructor and/or their academic advisor, preferably in a written format, about their needs no later than the **3rd** week of classes.
University Regulations	• For more details on University regulations please visit: http://www.ju.edu.jo/rules/index.htm

26 References:

A- Required book (s), assigned reading, and audio-visuals:

Title: *Introduction to Algorithms*
Author(s): *Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, & Clifford Stein*
Publisher: *The MIT Press*
Edition & Year: *Third Edition 2009*
Book Website: *http://mitpress.mit.edu/algorithms/*
http://highered.mcgraw-hill.com/sites/0070131511/student_view0/

B- Recommended books, materials, and media:

- *Jeffrey J. McConnell, "Analysis of Algorithms: An Active Learning Approach", Second Edition, Jones & Bartlett, 2008.*
- *Richard Neopolitan, "Foundations of Algorithms", Fifth Edition, Jones & Bartlett, 2015.*
- *Richard Johnsonbaugh and Marcus Schaefer, "Algorithms", Pearson/Prentice Hall, 2004.*
- *Sara Baase and Allen Van Gelder, "Computer Algorithms: Introduction to Design and Analysis", Third Edition, Addison-Wesley, 2000.*
- *Horowitz Ellis, Sahni Sartaj & Rajasekaran Sanguthevar, "Fundamentals of Computer Algorithms", 2008.*

27 Additional information:

Semester / Academic Year:	Fall 2022/2023
Course Website:	http://elearning.ju.edu.jo

Name of Course Coordinator: **Sherenaz Al-Haj Baddar** Signature:……..…… Date: **Oct., 2022**

Head of Curriculum Committee/Department: ---------- Signature: ----------

Head of Department: ---------- Signature: ----------

Head of Curriculum Committee/Faculty: ---------- Signature: ----------

Dean: ---------- Signature: ----------