هيئة تقويم التعليم والتدريب
Education & Training Evaluation Commission

اعتماد NCAAA T4 2020

Course Specifications

Course Title:	**Algorithms and Data Structures 2**
Course Code:	**CPCS324**
Program:	**Bachelor of Science in Computer Sciences**
Department:	**Computer Sciences**
College:	**Faculty of Computing and Information Technology**
Institution:	**Northern Border University, Rafha**

Table of Contents

A. Course Identification **3**

1. Credit hours: 3
2. Course type 3
3. Level/year at which this course is offered: 3
4. Pre-requisites for this course (if any): 3
5. Co-requisites for this course (if any): 3
6. Mode of Instruction (mark all that apply) 3
7. Contact Hours (based on academic semester) 3

B. Course Objectives and Learning Outcomes **3**

1. Course Description 3
2. Course Main Objective 3
3. Course Learning Outcomes 4

C. Course Content **4**

D. Teaching and Assessment **5**

1. Alignment of Course Learning Outcomes with Teaching Strategies and Assessment Methods 5
2. Assessment Tasks for Students 5

E. Student Academic Counseling and Support **6**

F. Learning Resources and Facilities **6**

1.Learning Resources 6
2. Facilities Required 6

G. Course Quality Evaluation **7**

H. Specification Approval Data **7**

A. Course Identification

1. Credit hours: 3 **3**
2. **Course type** **a.** University ☐ College ☐ Department ☒ Others ☐ **b.** Required ☒ Elective ☐
3. Level/year at which this course is offered: **Level 9 / Year 3**
4. **Pre-requisites for this course (**if any**):** **CPCS223 – Analysis and Design of Algorithms**
5. **Co-requisites for this course (**if any**):** **Nil**

6. Mode of Instruction (mark all that apply)

No	Mode of Instruction	Contact Hours	Percentage
1	**Traditional classroom**	60	100%
2	**Blended**		
3	**E-learning**		
4	**Distance learning**		
5	**Other**		

7. **Contact Hours (**based on academic semester**)**

No	Activity	Contact Hours
1	**Lecture**	45
2	**Laboratory/Studio**	15
3	**Tutorial**	
4	**Others** (specify)	
	Total	60

B. Course Objectives and Learning Outcomes

1. Course Description

This course is considered as the second part of a two-course sequence on algorithmic solution design and advanced data structures. This course provides advanced algorithms from different application areas to illustrate the techniques used to construct specific strategies for solving problems, and to study the performance of these algorithms. Topics include space and time tradeoffs, dynamic programming, greedy technique, iterative improvement, and limitation of algorithm power.

2. Course Main Objective

Students will study the main algorithm design techniques and approaches applicable to optimization problems.

3. Course Learning Outcomes

CLOs		Aligned PLOs
1	**Knowledge and Understanding:**	
1.1	Recognize the Input Enhancement and Pre-structuring techniques	K1
1.2	Describe Dynamic Programming (DP) and Greedy techniques	K2
2	**Skills:**	
2.1	Apply and analyze DP, Greedy, and Iterative improvement techniques for a variety of different problems.	S2, S3
2.2	Classify a stated impact of computing related to data structures and algorithms as a local or global impact on individuals, organizations, and society.	S1
2.3	Identify the limitations of algorithm power and discuss the open question whether P=NP.	S5
3	**Values:**	
3.1	Use the studied techniques to resolve real complex problems related to computer science.	V3

C. Course Content

No	List of Topics	Contact Hours
1	Space and Time Trade-Offs: Revision Pre-requisite, Calculate the time complexity, O-notation, Θ-notation, Ω-notation; Different operations on graph (DFS, BFS).	3
2	Space and Time Trade-Offs: Horspool's algorithm; Boyer-Moore Algorithm; Exercises.	3
3	Space and Time Trade-Offs: Hashing; Open Hashing (Separate Chaining); Closed Hashing (Open Addressing); B-Trees; Exercises.	3
4	Dynamic Programming: Three basic examples of DP algorithms; Warshall's Algorithm	3
5	Dynamic Programming: Floyd's Algorithm for the All-Pairs Shortest-Paths Problem.	3
6	Dynamic Programming: Optimal Binary Search Trees.	3
7	Greedy Technique: Prim's Algorithm; Kruskal's Algorithm.	3
8	Greedy Technique: Dijkstra's Algorithm	3
9	Greedy Technique: Huffman Trees and Codes.	3
10	Iterative Improvement: The Maximum-Flow Problem	3
11	Iterative Improvement: Maximum Matching in Bipartite Graphs.	3
12	Limitations of Algorithm Power: Trivial Lower Bounds; Information-Theoretic Arguments; Adversary Arguments.	3
13	Limitations of Algorithm Power: Decision Trees for Sorting; Decision Trees for Searching a Sorted Array	3
14	Limitations of Algorithm Power: P and NP Problems; NP-Complete Problems;	3
15	Limitations of Algorithm Power: N-Queens Problem; Hamiltonian Circuit Problem; Subset-Sum	3
Laboratory Works		
1	Study and Implementation of Horspool's algorithm.	1.5
2	Study and Implementation of Boyer-Moor algorithm.	١,٥

3	Study and Implementation of hash table.	١,٥
4	Study and Implementation of Floyd's and Warshall's algorithm.	2
5	Study and Implementation of Optimal Binary Search Tree	١,٥
6	Study and Implementation of Kruskal's algorithm.	١,٥
7	Study and Implementation of Dijkstra's algorithm.	١,٥
8	Study and Implementation of Huffman code algorithm.	١,٥
9	Analysis of some P, NP and NP-complete Problems	1.5
10	Lab Evaluation	١
Total		60

D. Teaching and Assessment

1. Alignment of Course Learning Outcomes with Teaching Strategies and Assessment Methods

Code	Course Learning Outcomes	Teaching Strategies	Assessment Methods
1.0	**Knowledge and understanding**		
1.1	Recognize the Input Enhancement and Pre-structuring techniques	- Traditional and interactive Lectures - Discussion-Based - KWLH technique	Writing – Oral
1.2	Describe Dynamic Programming (DP) and Greedy techniques	-Traditional and interactive Lectures - Discussion-Based - KWLH technique	Writing – Oral
2.0	**Skills**		
2.1	Apply and analyze DP, Greedy, and Iterative improvement techniques for a variety of different problems.	- Problem solving - Lab-based learning -Model-based learning	Writing – Oral – Performance– Observation
2.2	Classify a stated impact of computing related to data structures and algorithms as a local or global impact on individuals, organizations, and society.	-Storytelling -Generative learning	
2.3	Identify the limitations of algorithm power and discuss the open question whether P=NP.	-Academic debate -Generative learning	
3.0	**Values**		
3.1	Use the studied techniques to resolve real complex problems related to computer science.	- Collaborative learning - Brain storming - Case studies	Performance– Observation

2. Assessment Tasks for Students

#	Assessment task*	Week Due	Percentage of Total Assessment Score
1	Quiz-1	2	٢,٥
2	Quiz-2	8	٢,٥
3	Assignment-1	٤	٥
4	Assignment-2	10	٥
5	Oral questions	1 – 11	٥
6	Lab tasks	1 – 10	١٦

#	Assessment task*	Week Due	Percentage of Total Assessment Score
7	Midterm exam	6	٢٠
8	Lab exam	12	٤
٩	Final exam	13	٤٠

***Assessment task** (i.e., written test, oral test, oral presentation, group project, essay, etc.)

E. Student Academic Counseling and Support

Arrangements for availability of faculty and teaching staff for individual student consultations and academic advice:
Every instructor has an announced office hours schedule. All students are encouraged to visit the concerned teacher according to the schedule. Students can also use Email address or Blackboard System to seek help or book an appointment.

F. Learning Resources and Facilities

1.Learning Resources

Required Textbooks	1. Steven S. Skiena," The Algorithm Design Manual", 3rd edition, 2020, Springer. 2. Anany Levitin. Introduction to the Design and Analysis of Algorithms. 3rd edition, 2012, Pearson Education.
Essential References Materials	
Electronic Materials	1. Blackboard System: https://lms.nbu.edu.sa/ 2. Northern Border University Electronic Library: https://www.nbu.edu.sa/AR/Deanships/Library_Issues 3. Saudi Digital Library (SDL): https://portal.sdl.edu.sa/english/
Other Learning Materials	Nil

2. Facilities Required

Item	Resources
Accommodation (Classrooms, laboratories, demonstration rooms/labs, etc.)	• Classroom • Labs
Technology Resources (AV, data show, Smart Board, software, etc.)	• Data Show (Projectors) in Classroom and laboratory. • Desktop computers • OS: Windows 10 • Software: NetBeans or Eclipse
Other Resources (Specify, e.g. if specific laboratory equipment is required, list requirements or attach a list)	• Nil

G. Course Quality Evaluation

Evaluation Areas/Issues	Evaluators	Evaluation Methods
Effectiveness of teaching and assessment.	Students	Indirect
Quality of learning resources	Students	Indirect
Extent of achievement of course learning outcomes	Faculty	Direct

Evaluation areas (e.g., Effectiveness of teaching and assessment, Extent of achievement of course learning outcomes, Quality of learning resources, etc.)
Evaluators (Students, Faculty, Program Leaders, Peer Reviewer, Others (specify)
Assessment Methods (Direct, Indirect)

H. Specification Approval Data

Council / Committee	Computer Sciences Department Council
Reference No.	10
Date	24/02/2022