Course Specification

(Postgraduate)

Course Title:	**Advanced Analysis & Design of Algorithms**
Course Code:	CS CY60103
Program:	M.Sc. in Cybersecurity
Department:	**Department of Computer Science**
College:	**Faculty of Computing and Information**
Institution:	Al-baha University
Version:	**1**
Last Revision Date:	12 December 2023

Table of Contents

A. General information about the course:

1. Course Identification:

1. Credit hours: (3)				
2. Course type				
A.	☐University	☐College	☐Department	☐Track
B.	☒ Required		☐Elective	
3. Level/year at which this course is offered: (1/1)				
4. Course general Description:				
Algorithm design and analysis is a fundamental and important part of computer science. This course introduces students to advanced techniques for the design and analysis of algorithms and explores a variety of applications. The topics and applications be covered include hashing, bloom filters, scheduling, network design, online load balancing, algorithms in machine learning, boosting (in the context of learning), Markov chains and the MCMC method, byzantine agreement, internet algorithms, and nearest neighbour algorithms. Various useful ideas, including randomization, probabilistic analysis, amortized analysis, competitive analysis, eigenvalues, linear and semi-definite programming, high dimensional geometry, and random walks will be encountered. Additional topics include standard complexity classes, time and space tradeoffs in algorithms, using recurrence relations to analyze recursive algorithms, non-computable functions, the halting problem, and the implications of non-computability.				
5. Pre-requirements for this course (if any)**:**				
None				
6. Pre-requirements for this course (if any)**:**				
This course assumes a basic understanding of computer science concepts. Students should have a good understanding of fundamental algorithms and data structures covered in a typical undergraduate-level algorithms and data structures course.				
7. Course Main Objective(s):				
The students completed this course will be able to: **Write a suitable analysis method for any given algorithm** **Outline algorithms for variations of problems studied in class** **Define formally an algorithmic problem** **Design algorithms to solve computational problems in a correct and efficient way.** **Classify computational problems according to complexity.** **Analyze the complexity of algorithms**				

2. Teaching Mode: (mark all that apply)

No	Mode of Instruction	Contact Hours	Percentage
1	Traditional classroom	26	80%
2	E-learning	7	20%
3	Hybrid ☐ Traditional classroom ☐ E-learning		
4	Distance learning		

3. Contact Hours: (based on the academic semester)

No	Activity	Contact Hours
1.	**Lectures**	33
2.	**Laboratory/Studio**	-
3.	**Field**	-
4.	**Tutorial**	-
5.	**Others (specify)……**	-
	Total	33

B. Course Learning Outcomes (CLOs), Teaching Strategies and Assessment Methods:

Code	Course Learning Outcomes	Code of PLOs aligned with program	Teaching Strategies	Assessment Methods
1.0	**Knowledge and understanding**			
1.1	**Write a suitable analysis method for any given algorithm**	**K1**	**- Lectures** **- Assignments**	**- Homework** **-Midterm-exams** **- project** **- Final Exam**
1.2	**Outline algorithms for variations of problems studied in class**	**K2**	**- Lectures** **- Assignments**	**- Homework** **-Midterm-exams** **- project** **- Final Exam**

Code	Course Learning Outcomes	Code of PLOs aligned with program	Teaching Strategies	Assessment Methods
1.3	Explain the P, NP, NP-complete and NP-hard sets of problems.	K3	- Lectures - Assignments	- Homework -Midterm-exams - project - Final Exam
2.0	**Skills**			
2.1	Design algorithms to solve computational problems in a correct and efficient way.	S1	- Lectures - Assignments	-Homework -Midterm-exams - project - Final Exam
2.2	Classify computational problems according to complexity.	S2	- Lectures - Assignments	-Homework -Midterm-exams - project - Final Exam
2.3	Analyze the complexity and hardness of algorithms	S3	- Lectures - Assignments	-Homework -Midterm-exams - project - Final Exam
3.0	**Values, autonomy, and responsibility**			
3.1	Communicate effectively through oral presentations, computer presentations and written reports.	V1	-Small groups Project -Oral presentation	Course project presentation and report
3.2	Teamwork through groups	V2	Small groups Project -Oral presentation	Course project presentation and report

C. Course Content:

No	List of Topics	Contact Hours
1.	Function Growth and Complexity	3
2.	Algorithm Analysis	3
3.	Divide and Conquer Algorithms	3
4.	Dynamic Programming Algorithms (Part 1)	3
5.	Dynamic Programming Algorithms (Part 2)	3
6.	Graph Algorithms	3
7.	Greedy Algorithms	3
8.	Sorting Algorithms	3
9.	Approximation	3
10.	Computational Complexity and Complexity Classes (P, NP, NP-Complete NP-Hard)	3
11.	Selected applications to sets, graphs, arithmetic, and geometry	3
Total		33

D. Students Assessment Activities:

No	Assessment Activities *	Assessment timing (in week no)	Percentage of Total Assessment Score
1.	Assignments	Every two weeks	10%
2.	Midterm Exam	Within the 6th Week	20%
3.	Project	Week 11	20%
4.	Final Exam	Week 13	50%

*Assessment Activities (i.e., Written test, oral test, oral presentation, group project, essay, etc.)

E. Learning Resources and Facilities:

1. References and Learning Resources:

Essential References	Bradley Green, Programming Problems: Advanced Algorithms . February 27, 2013 ISBN-10: 1484964098, ISBN-13: 978-1484964095

	- Kindle Edition, Peter Brass, Advanced Data Structures 1st Edition, ISBN-13: 978-0521880374, ISBN-10: 052188037
Supportive References	• Communications of ACM (Association for Computer Machinery) - http://cacm.acm.org/ Journal of the ACM - http://jacm.acm.org/
Electronic Materials	• Access to the Saudi Digital Library (SDL). • Using the learning management system of the university – Rafid System (https://lms.bu.edu.sa/). • IEEE/ACM Transactions on Networking https://ieeexplore.ieee.org/xpl/RecentIssue.jsp?punumber=90
Other Learning Materials	

2. Educational and Research Facilities and Equipment Required:

Items	Resources
facilities (Classrooms, laboratories, exhibition rooms, simulation rooms, etc.)	• A classroom or lecture hall with whiteboard for 25 students. A laboratory with 25 computers.
Technology equipment (Projector, smart board, software)	All students shall have • A laptop or access to a desktop computer with access to a programming development tool • High speed Internet connection • Power outlets for student's laptop plug-in Relevant programming software for use of students.
Other equipment (Depending on the nature of the specialty)	• The laboratory should have computers with programming development tools.

F. Assessment of Course Quality:

Assessment Areas/Issues	Assessor	Assessment Methods
Effectiveness of teaching	Students - Program Leaders	Indirect
Effectiveness of students assessment	Program Leaders	Indirect
Quality of learning resources	**Students**	**Indirect**
The extent to which CLOs have been achieved	Peer reviewers	Direct
Reviewing course effectiveness and planning for improvement.	Program Leaders - Faculty	Direct

Assessor (Students, Faculty, Program Leaders, Peer Reviewer, Others (specify)
Assessment Methods (Direct, Indirect)

G. Specification Approval Data:

COUNCIL /COMMITTEE	
REFERENCE NO.	
DATE	