Course Specification

(Postgraduate Programs)

Course Title:	**Advanced Algorithms**
Course Code:	**MSCS 611**
Program:	**Master Programme in Computer Science**
Department:	**Computer Science**
College:	**Computer Science and Information Technology**
Institution:	**King Faisal University**
Version:	*Course Specification Version Number*
Last Revision Date:	*Pick Revision Date.*

Table of Contents

A. General information about the course:

1. Course Identification:

1. Credit hours: 3 (3-0-6)				
2. Course type				
A.	☐University	☒ College	☐Department	☐Track
B.	☒ Required		☐ Elective	
3. Level/year at which this course is offered: : Level 2 , 3 or 4				

4. Course General Description:

This course introduces students to advanced Algorithms Analysis and Design Techniques. Topics covered in this course include: Underlying mathematical theory, Induction and recursion techniques, Asymptotic notations, Divide and conquer technique, Randomized algorithms, Parallel and heuristic algorithms, Brute force approach, Dynamic algorithms, Greedy algorithms, Importance of algorithms in graph theory, Optimization algorithms using graphs and trees, Minimal spanning tree algorithms, Variants of shortest path problem, Matrix operations, Algorithms for solving systems of linear equations, Linear programming algorithms, Numerical approximations, String matching, Pattern matching, Automata theory in algorithms designing, Computational geometry, NP completeness, NP completeness proofs and reducibility, Approximation algorithms.

5. Pre-requirements for this course (if any):

NA

6. Pre-requirements for this course (if any):

NA

7. Course Main Objective(s):

This course introduces students to advanced Algorithms Analysis and Design Techniques, which are useful for the students to efficiently model and solve different computer science problems.

2. Teaching Mode: (mark all that apply)

No	Mode of Instruction	Contact Hours	Percentage
1	Traditional classroom		
2	E-learning		
3	Hybrid	45	100%

No	Mode of Instruction	Contact Hours	Percentage
	• Traditional classroom • E-learning		
4	Distance learning		

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

No	Activity	Contact Hours
1.	**Lectures**	45
2.	**Laboratory/Studio**	-
3.	**Field**	-
4.	**Tutorial**	-
5.	**Others (specify)……**	-
	Total	45

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	Develop mathematical models and algorithms of computational problems.	K1	Lectures - Problem solving	- Quizzes - Exams - Assignments
1.2	Prove correctness and evaluate efficiency of algorithms	K2	- Lectures - Problem solving -	- Quizzes - Exams - Assignments
2.0	**Skills**			
2.1	Analyze and compare the complexities of different algorithms..	S1	- Lectures -Problem Solving	- Quizzes - Exams - Assignments
2.2	Analyze variants of traditional algorithms	S3	- Lectures - Problem solving	- Quizzes - Exams - Assignments
…				
3.0	**Values, autonomy, and responsibility**			

Code	Course Learning Outcomes	Code of PLOs aligned with program	Teaching Strategies	Assessment Methods
3.1	Solve scientific and engineering problems efficiently	V1	- Lectures - Case studies -Research assignment	- Quizzes - Exams - Assignments
...				

C. Course Content:

No	List of Topics	Contact Hours
1.	Introduction to Algorithms: Proof by Induction, Asymptotic Notation, Analysis of Algorithms, Asymptotic Performance, Selection Sort	3
2.	Sorting algorithms- Merge Sort, Recurrence Method, Substitution Method and Master Theorem	3
3	Sorting Algorithms- Heaps, Heaps Operations, Heap Sort algorithm and analysis	3
4	Queues- Priority Queues , Quicksort, Analyzing Quick Sort, Sorting in Linear Time	3
5	Dynamic sets, Binary Search Trees, Red-Black Trees Linked Lists	3
6	Dynamic Programming, LCS Problem, 0-1 Knapsack Problem	3
7	Representations of graphs, Adjacency Matrix, Adjacency Lists, Breadth-first search, Depth-first search	3
8	Minimum Spanning Trees, Prim's Algorithm	3
9	Single-Source Shortest Paths, Bellman-Ford Algorithm, Dijkstra's Algorithm, All pairs Shortest Paths	6
10	Solving systems of linear equations, Inverting matrices, Symmetric positive-definite matrices and least-squares approximation	6
11	Polynomial time, Polynomial-time verification, NP-completeness and reducibility, NP-completeness proofs	6
12	The vertex-cover problem , The traveling-salesman problem ,The set-covering problem, Randomization and linear programming	
Total		45

D. Students Assessment Activities:

No	Assessment Activities *	Assessment timing (in week no)	Percentage of Total Assessment Score
1.	Assignments	Continuous	10%
2.	Quiz	Continuous	10%
3.	Mid Term	8^{th}- 9^{th}	25%
4	Capstone Project	15^{th}	15%
5	Final Exam	16^{th}- 17^{th}	40%

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

E. Learning Resources and Facilities:

1. References and Learning Resources:

Required Textbook	Introduction to Algorithms by Thomas H. Corman, Charles E. Leiserson, Ronald L. Rivest and Clifford Stein, 3rd Edition, MIT Press, 2009. ISBN: 0262033844.
Essential References	Algorithms by S. Dasgupta, C. H. Papadimitriou and U. V. Vazirani, McGraw-Hill, 2006. ISBN: 0073523402.
Supportive References	
Electronic Materials	https://visualgo.net/en/sorting
Other Learning Materials	

2. Educational and Research Facilities and Equipment Required:

Items	Resources
facilities (Classrooms, laboratories, exhibition rooms, simulation rooms, etc.)	Sufficient seats (typically 20) as per student registration required in the lecture
Technology equipment (Projector, smart board, software)	Sufficient computer terminals with required setup having the necessary software installed and configured for the students to complete assignments and projects. Data show is needed to demonstrate in the class
Other equipment (Depending on the nature of the specialty)	Not Required

F. Assessment of Course Quality:

Assessment Areas/Issues	Assessor	Assessment Methods
Effectiveness of teaching	Students	Indirect Assessment through Teaching Evaluation
Effectiveness of students' assessment	Faculty	Indirect assessment through Course Evaluation Survey
Quality of learning resources	Students	Indirect Assessment through Learning Resources Survey
The extent to which CLOs have been achieved	**Faculty**	Direct assessment through Rubrics analyses
Other		

Assessor (Students, Faculty, Program Leaders, Peer Reviewer, Others (specify)

Assessment Methods (Direct, Indirect)

G. Specification Approval Data:

COUNCIL /COMMITTEE	
REFERENCE NO.	
DATE	