2023
TP-153

Course Specification
(Bachelor)

Course Title:	**Quantum Computing**
Course Code:	**CEN 1417**
Program:	**Bachelor in Computer Engineering**
Department:	**Computer Engineering**
College:	**Faculty of Computers and Information Technology**
Institution:	**University of Tabuk**
Version:	**1.0**
Last Revision Date:	**27 July 2022**

Table of Contents

A. General information about the course:

1. Course Identification

1. Credit hours: (3)					
2. Course type					
A.	☐University	☒ College	☐Department	☐Track	☐Others
B.	☐Required		☒ Elective		
3. Level/year at which this course is offered: (10/5)					
4. Course general Description:					
The course covers the fundamental concepts of complex numbers, complex vector spaces, leap from classical to quantum, and quantum Theory. Moreover, the course introduces some quantum algorithms such as Deutsch, and Grover's Search.					
5. Pre-requirements for this course (if any)**:**					
CSC 1202					
6. Co-requisites for this course (if any)**:**					
N/A					
7. Course Main Objective(s):					
In this course, students will learn how to use complex numbers and its geometry. Understand complex vector space. Students will have the ability to evaluate quantum architecture and design basic quantum algorithms.					

2. Teaching mode (mark all that apply)

No	Mode of Instruction	Contact Hours	Percentage
1	Traditional classroom	**45**	**100%**
2	E-learning	-	-
3	Hybrid • 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	**Recognize complex numbers.**	**K1**	**Lectures, textbooks, provided handouts, references.**	**Exams, quizzes, assignments, and the project.**
1.2	**Recognize complex vector spaces.**	**K1**		
1.3	**Define the leap from classical to quantum.**	**K3**		
1.4	**Specify and describe Quantum Theory.**	**K2**		
1.5	**Demonstrate and identify basic quantum algorithms.**	**K1**		
2.0	**Skills**			
2.1	**Design a basic quantum system using complex numbers.**	**S1, S3**	**Lectures, textbooks, provided handouts, references.**	**Exams, quizzes, assignments, and the project.**
2.2	**Develop a complex vector space.**	**S1, S3**		
2.3	**Evaluate basic quantum algorithms.**	**S1, S3**		
3.0	**Values, autonomy, and responsibility**			
3.1	**The ability to work in groups.**	**V2**	**Lectures, textbooks, provided handouts, references.**	**Exams, quizzes, assignments, and the project.**
3.2	**The ability to work professionally and effectively.**	**V1, V2**		

C. Course Content

No	List of Topics	Contact Hours
1.	Introduction	3
2.	Complex Numbers (part 1)	3
3.	Complex Numbers (part 2)	3
4.	Complex Vector Spaces (part 1)	3
5.	Complex Vector Spaces (part 2)	3
6.	Leap from Classical to Quantum (part 1)	3
7.	Leap from Classical to Quantum (part 2)	3
8.	Basic Quantum Theory (part 1)	3
9.	Basic Quantum Theory (part 2)	3
10.	Quantum Architecture (part 1)	3
11.	Quantum Architecture (part 2)	3
12.	Deutsch's Algorithm (part 1)	3
13.	Deutsch's Algorithm (part 2)	3
14.	Grover's Search Algorithm (part 1)	3
15.	Grover's Search Algorithm (part 2)	3
Total		45

D. Students Assessment Activities

No	Assessment Activities *	Assessment timing (in week no)	Percentage of Total Assessment Score
1.	Two Assignments	5,14	10%
2.	Two Quizzes	4,9	10%
3.	Two Midterm Exam	7,12	20%
4.	Project	15	20%
5.	Final Exam	16	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

Essential References	Yanofsky, Noson S., and Mirco A. Mannucci. *Quantum computing for computer scientists*. Cambridge University Press, 2008.
Supportive References	Provided Handouts
Electronic Materials	-

Other Learning Materials	-

2. Required Facilities and equipment

Items	Resources
facilities (Classrooms, laboratories, exhibition rooms, simulation rooms, etc.)	**Classroom**
Technology equipment (projector, smart board, software)	**Data show**
Other equipment (depending on the nature of the specialty)	**Students should have laptops**

F. Assessment of Course Quality

Assessment Areas/Issues	Assessor	Assessment Methods
Effectiveness of Teaching	Faculty, Program Leaders, and Advisory Board	Both Direct and Indirect
	Students	Indirect
Effectiveness of Students Assessment	Faculty, Program Leaders, Advisory Board, and Independent Opinion	Both Direct and Indirect
Quality of Learning Resources	Faculty, Students, and Advisory Board	Indirect
The Extent to which CLOs have been Achieved	Faculty, Program Leaders, Advisory Board, and Independent Opinion	Direct (as in section B) and Indirect/Surveys
	Students	Indirect
Other	-	-

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

G. Specification Approval

COUNCIL /COMMITTEE	
REFERENCE NO.	
DATE	