COURSE OUTLINE TEMPLATE

	**SULTAN QABOOS UNIVERSITY** **COLLEGE OF SCIENCE** **BACHELOR OF SCIENCE IN COMPUTER SCIENCE** **HIGH PERFORMANCE COMPUTING**

I. COURSE INFORMATION		
COURSE CODE	COMP5557	
COURSE TITLE	HIGH PERFORMANCE COMPUTING	
OMAN QUALIFICATION FRAMEWORK (OQF) LEVEL	**8**	
CREDIT HOURS	3	
CONTACT HOURS	3	
PRE-REQUISITES	COMP3502 and COMP4501	
CO-REQUISITES	NONE	
EQUIVALENT COURSES	NONE	
INCOMPATIBLE COURSES	NONE	
COURSE CATEGORY	Specialization Elective	
COURSE OWNER	College: Science	Department: Computer Science
DELIVERY MODE	Face to Face	
COURSE TYPE	Lecture	
LANGUAGE OF INSTRUCTION	English	
COURSE DESCRIPTION	This course exposes the student to the theory and practice of high performance computing with a focus on current systems, architectures, programming models, languages and software tools. Topics include contemporary architectures, interconnection topologies, shared memory and message-passing systems, multi-	

	threaded kernels, methods for data and workload partitioning and performance profiling.		
TEACHING AND LEARNING STRATEGIES	□ Augmented Reality	□ Flipped Classroom	
	□ Blended Learning	**X** Problem-Based Learning	
	□ Discovery-Based Learning	**X** Project-Based Learning	
	□ Student-Led Learning	**X** Team-Based Learning	
	X Work-Based Learning	□ Other (specify):	
ASSESSMENT COMPONENT AND WEIGHT	□ In-term examination(s) (20%)	□ Quizzes (%)	□ Other (specify): (%)
	□ Homework assignments (20%)	□ Project (20%)	
	□ Final examination (40%)	□ Practical/ Lab (%)	
TEXTBOOKS AND EDUCATIONAL MATERIAL	- Parallel Programming, Barry Wilkinson and Michael Allen, Prentice Hall. - Introduction to High Performance Computing for Scientists and Engineers, Georg Hager and Gerhard Wellein, CRC Press.		
GRADING METHOD	**X** A-F Scale	□ Pass/Not Pass	□ Other (specify):

GRADING METHOD DESCRIPTION			
A-F GRADING SCALE:	**Range**	**Letter Grade**	**Description**
	90 – 100	A	**Exceptional performance:** All course objectives achieved and met in a consistently outstanding manner.
	86 – 89.9	A-	
	81– 85.9	B+	**Very Good Performance:** The majority of the course objectives achieved (majority being at least two-thirds) and met in a consistently thorough manner.
	77 – 80.9	B	
	73 – 76.9	B-	
	68 – 72.9	C+	**Satisfactory Performance:** At least most of course objectives have been achieved and met satisfactorily.
	64 – 67.9	C	
	60 – 63.9	C-	
	55 – 59.9	D+	**Minimally Acceptable Performance:** The course objectives met at a minimally acceptable level.
	50 – 54.9	D	
	0 – 49.9	F	**Unacceptable performance:** The course objectives not met at a minimally acceptable level.

II. Semester Information			
Semester/Year	Spring 2021	**Section(s)**	1
Day and Time	Monday, Wednesday 12:00 – 13:20	**Venue(s)**	
Course Coordinator	Khaled Day	**Course Team**	
Coordinator Office	0007	**Office Hours**	Sun, Tue 11:00 – 12:00
Coordinator Extension	2231	**Coordinator Email**	kday@squ.edu.om

III. Alignment of Course Learning Outcomes (CLO), Program Learning Outcomes (PLO), Graduate Attributes (GA), and Oman Qualification Framework (OQF) Characteristics			
CLO	**PLO**	**SQU Graduate Attributes**	**OQF Characteristics**
1. Understand the concepts and terminology of high performance computing.	SO1	**A**	**1**
2. Describe different high performance computing architectures and models.	SO1	**A**	**1**
3. Design high performance computing solutions.	SO2, SO6	**B**	**2**
4. Analyze the complexity of high performance computing solutions.	SO2	**B**	**2**
5. Implement high performance computing solutions using appropriate tools.	SO2, SO6	**B**	**2**
6. Evaluate experimentally the performance of high performance computing solutions.	SO2	**B**	**2**
7. Learn how to use high performance computing tools and frameworks (eg. MPI, OpenMP, Pthreads, CUDA, Hadoop, Spark).	SO2	**D**	**4**

IV. Course Learning Outcomes (CLOs) and Assessment Criteria and Methods		
CLO1: Understand the concepts and terminology of high performance computing.		
Assessment Criteria		**Assessment Methods**
A)	Understand the different types of HPC systems.	Homework, Midterm Exam, Final Exam
B)	Understand the models of parallel computing.	Homework, Midterm Exam, Final Exam
C)	Understand the different divide-and-conquer strategies.	Homework, Midterm Exam, Final Exam
CLO2: Describe different high performance computing architectures and models.		
Assessment Criteria		**Assessment Methods**
A)	Describe the different types of HPC systems.	Homework, Midterm Exam, Final Exam
B)	Describe the models of parallel computing.	Homework, Midterm Exam, Final Exam
C)	Describe the different divide-and-conquer strategies.	Homework, Midterm Exam, Final Exam
CLO3: Design high performance computing solutions.		
Assessment Criteria		**Assessment Methods**
A)	Design HPC solutions for distributed memory systems.	Homework, Project, Midterm, Final
B)	Design HPC solutions for shared memory systems.	Homework, Project, Midterm, Final
CLO4: Analyze the complexity of high performance computing solutions.		
Assessment Criteria		**Assessment Methods**
A)	Analyze the complexity of HPC solutions for distributed memory systems.	Homework, Project, Midterm, Final
B)	Analyze the complexity of HPC solutions for shared memory systems.	Homework, Project, Midterm, Final
CLO5: Implement high performance computing solutions using appropriate tools.		
Assessment Criteria		**Assessment Methods**
A)	Implement HPC solutions using distributed memory HPC tools such as MPI.	Homework, Project, Midterm, Final
B)	Implement HPC solutions using shared memory HPC tools such as Pthreads, OpenMP and CUDA.	Homework, Project, Midterm, Final
CLO6: Evaluate experimentally the performance of high performance computing solutions.		
Assessment Criteria		**Assessment Methods**
A)	Evaluate experimentally the performance of HPC solutions for distributed memory systems.	Homework, Project
B)	Evaluate experimentally the performance of HPC solutions for shared memory systems.	Homework, Project

CLO7: Learn how to use high performance computing tools and frameworks (eg. MPI, OpenMP, Pthreads, CUDA, Hadoop, Spark).		
ASSESSMENT CRITERIA		**ASSESSMENT METHODS**
A)	Learn how to use tools and frameworks for distributed memory communication tools such as MPI.	Homework, Project
B)	Learn how to use tools and frameworks for shared memory communication tools such as Pthreads, OpenMP and CUDA.	Homework, Project

V. COURSE CONTENT AND SCHEDULE				
WEEK	**LECTURES #**	**TOPICS/ SUBJECTS**	**READINGS/ CHAPTERS**	**REMARKS (e.g., ASSESSMENTS)**
1	1 and 2	HPC Systems		HWK1, Midterm, Final
2	1 and 2	HPC Systems		HWK1, Midterm, Final
3	1 and 2	Models of Parallel Processing		HWK1, Midterm, Final
4	1 and 2	Models of Parallel Processing		HWK1, Midterm, Final
5	1 and 2	Partitioning and Divide-and-Conquer Strategies		HWK1, Midterm, Final
6	1 and 2	Partitioning and Divide-and-Conquer Strategies		HWK1, Midterm, Final
7	1 and 2	Distributed Memory HPC		HWK2, Midterm, Final
8	1 and 2	Distributed Memory HPC		HWK2, Midterm, Final
9	1 and 2	Revision for Midterm Exam and Midterm Exam		
10	1 and 2	Shared Memory HPC		HWK2, Final
11	1 and 2	Shared Memory HPC		HWK2, Final
12	1 and 2	HPC Applications		Final
13	1 and 2	HPC Applications		Final
14	1 and 2	Project Presentations		Project
15	1 and 2	Review		

VI. Additional Information (e.g., Rubrics, etc.)

Assessment Plan

	Date Out	Due Date	Weight
HW1	W3	W5	10%
Term Project Progress Report		W7	5%
Midterm Exam	W8		20%
HW2	W10	W12	10%
Term Project Final Report	W14		10%
Term Project Presentation	W15		5%
Final Exam			40%

Department's Late Submission Policy:

(a) 1-24 hours: 25% of the mark will be deducted.
(b) > 24 hours: Not accepted.

Department's Policy for Dealing with Cheating:

It is essential that each student solves all programming assignments, lab tests and exams individually unless instructed otherwise, e.g., for group projects. Copying, plagiarism, collusion, switching, and falsification are violations of the university academic regulations. Students involved in such acts will be severely penalized. The department has adopted a firm policy on this issue. A zero mark will be assigned the first time a student is caught involved in copying and his/her name will be added to a watch list maintained by the Head of Department. Further repeated involvements in copying will cause the student to get an F grade in that course. This is in line with the university academic regulations.

VII. STUDENTS RESPONSIBILITIES	
It is the student's responsibility to know and comply with all University Academic Regulations relevant to participation in this course. These regulations specifically include attendance requirements and student academic code of conduct.	
ACADEMIC INTEGRITY	The University expects the students to approach their academic endeavors with the highest academic integrity. Please refer to the **Undergraduate Academic Regulations**.
ADD AND DROP	Students who wish to drop or add the course should review the **Undergraduate Academic Regulations**.
ATTENDANCE	Sultan Qaboos University has a clear requirement for students to attend courses, detailed in the **Undergraduate Academic Regulations**.
ASSESSMENT AND GRADING	To ensure the provision of a sound and fair assessment and grading, please review the **Undergraduate Academic Regulations**.
GRADE APPEAL	Students who wish to appeal their grades should review the **Undergraduate Academic Regulations**.
CLASSROOM POLICIES	Students are expected to dress professionally during class time as required by the University. Use of phones or any other electronic devices in the classroom during class time is strictly prohibited. Unauthorized use may lead to faculty member confiscation of the device for the remainder of the class. Behavior that persistently or grossly interferes with classroom activities is considered disruptive behavior and may be subject to disciplinary action. A student responsible for disruptive behavior may be required to leave the class.
LATE AND MAKE-UP WORK	Students are required to meet the course objectives by submitting coursework no later than the assigned due date. Students may be allowed to submit late work if approved by the course coordinator. Assignments submitted after the due date may be penalized.
MISSED EVALUATIONS	All quizzes, tests, clinical evaluations, and exams must be completed by the date they are assigned. If a quiz, test, or exam is missed due to a documented emergency situation (e.g., medical emergency, death in the immediate family), it is the student's responsibility to contact the instructor.

Course Outline Appendix

1. PROGRAM LEARNING OUTCOMES

SO1. Analyze a complex computing problem and to apply principles of computing and other relevant disciplines to identify solutions.

SO2. Design, implement, and evaluate a computing-based solution to meet a given set of computing requirements in the context of the program's discipline.

SO3. Communicate effectively in a variety of professional contexts.

SO4. Recognize professional responsibilities and make informed judgments in computing practice based on legal and ethical principles.

SO5. Function effectively as a member or leader of a team engaged in activities appropriate to the program's discipline.

SO6. Apply computer science theory and software development fundamentals to produce computing-based solutions.

2. SQU Graduate Attributes and Competencies for Undergraduate Studies

GRADUATE ATTRIBUTES	GRADUATE COMPETENCIES FOR UNDERGRADUATE STUDIES
A. Cognitive Capabilities: The graduate has sufficient general and specialized theoretical knowledge that enables him/her to deal well with his/her specialty and other related fields.	1. Demonstrates familiarity and works with advanced specialized knowledge in the area of specialization.
	2. Demonstrates a general understanding of the relationship of advanced specialized knowledge with knowledge in other relevant professional fields and aspects.
	3. Demonstrates a comprehensive understanding of the theories, principles, and methods used in his/her specialty, and how to create and apply new knowledge.
	4. Demonstrates general knowledge of the legal environment and necessary relevant regulatory frameworks.
	5. Shows awareness of contemporary literature and research.

B. Skill and Professional Capability: The graduate has sufficient skill and practical experience that enables him/her to perform all tasks related to the specialization and other related fields.	1. Applies concepts, theories, and investigative methods to synthesize and interpret information to evaluate conclusions.
	2. Applies appropriate research methods and techniques and employs digital knowledge
	3. Evaluates and critiques information independently
	4. Uses cognitive and technical skills to analyze complex issues and develop appropriate solutions.
	5. Initiates new ideas or processes in the professional, educational or research context.
C. Effective Communication: The graduate has the ability to communicate effectively with others to achieve the desired results	1. Explains, presents, and adapts information to suit the recipients.
	2. Employs appropriate information and communication technology to collect and analyze information.
D. Autonomy and Leadership: The graduate has the ability to lead, make decisions and take responsibility for decisions.	1. Performs advanced professional activities independently.
	2. Demonstrates leadership skills.
	3. Takes professional responsibility.
	4. Assumes full accountability for the tasks and their output.
E. Responsibility and Commitment: The graduate appreciates the importance of available resources and deals with them effectively and is committed to the ethics of the profession and society.	1. Manages time and other resources assigned to accomplishing tasks effectively and responsibly.
	2. Demonstrates effective practices when working in teams.
	3. Demonstrates advanced levels of understanding of values and ethics relevant to the specialization, profession and local and international society and promotes them among others.
	4. Works within the professional, institutional, and specialization guiding frameworks and strategic plans.
	5. Interacts with community affairs positively and preserves national identity.

F. Development and Innovation: The graduate has a passion for development and innovation in the field of specialization.	1. Demonstrates the ability to independently manage learning tasks, with an awareness of how to develop and apply new knowledge.
	2. Utilizes specialized knowledge and skills for entrepreneurship.
	3. Utilizes creative and innovative skills in the field of specialization.

3. OQF Characteristics

1. Knowledge
2. Skills
3. Communication, Numeracy, and Information and Communication Technology Skills.
4. Autonomy and Responsibility
5. Employability and Values
6. Learning to learn