

SULTAN QABOOS UNIVERSITY COLLEGE OF SCIENCE DEPARTMENT OF COMPUTER SCIENCE BACHELOR OF SCIENCE IN ARTIFICIAL INTELLIGENCE COURSE OUTLINE

I COURSE INFORMATION						
Course Code	COMP5605					
	Mahila Dahatiaa Draarammin	Mobile Robotics Programming				
COURSE ITTLE	Mobile Robotics Programming	g				
UMAN QUALIFICATION	7					
FRAMEWORK (OQF) LEVEL	2	3				
CREDIT HOURS	3					
CONTACT HOURS	4					
PRE-REQUISITES	COMP3600					
CO-REQUISITES						
EQUIVALENT COURSES						
INCOMPATIBLE COURSES						
	□ University Requirement		□ Universit	y Elective		
	□College Requirement		□ College Elective			
	Department Requirement		□ Department Elective			
COURSE CATEGORY	□ Major Requirement		🗆 Major Ele	ective		
	Specialization Requirement		□ Specializ	ation Elective		
	□ Other (specify):					
	College: Science		Department: Computer			
COURSE OWNER			Science			
	Center:		Unit:			
Delivery Mode	\boxtimes Face to Face	🗆 Blei	nded	□ Online		
			⊠ Lecture/Lab			
	Lecture/Seminar		□ Lecture/Studio			
	□ Locture/Tutorial		□ Lecture/L	.ab/Tutorial or		
			Seminar			
COURSE I YPE	□Tutorial		□ Laborator	y (Practical)		
	□ Field or Work Placement		□ Studio			
	□Seminar		□ Internship			
	□ Workshop					

	Thesis O		□ Other (spe	□ Other (specify):		
LANGUAGE OF INSTRUCTION	English					
COURSE DESCRIPTION	This course provides the basic concepts and algorithms required to develop mobile robots that move in effective, safe, and predictable ways in complex environments. The course covers the basics of mobile robot controls, kinematic theory, navigation, localization, planning, and mapping					
	□ Augmente	d Reality		□ Flipped C	lassroom	
	□ Blended I	earning		□ Problem-H	Based Learn	ning
TEACHING AND LEARNING	□ Discovery	-Based Le	earning	⊠ Project-Ba	ased Learni	ng
SIRALEGIES	□ Student-L	ed Learnir	ıg	⊠ Team-Bas	ed Learnin	g
	□ Work-Bas	ed Learnin	ng	□ Other (spe	ecify):	
	⊠In-term ex	amination	(s) (25 %)	🗆 Quizzes (%)	□Other
ASSESSMENT COMPONENT	□ Homewor	k assignm	ents (%)	🛛 Project (25%)	(specify
AND WEIGHT	\boxtimes Final examination (40 %)			□ Practical/ %)	Lab (10): (%)
Textbooks And Educational Material	 Elements of Robotics, Mordechai Ben-Ari, Francesco Mondada, Springer Open (https://link.springer.com/book/10.1007/978-3-319- 62533-1) Introduction to Autonomous Mobile Robots, Roland Siegwart and Illah R. Nourbakhsh, The MIT Press, 2011 (2004 pdf) PROBABILISTIC ROBOTICS, Sebastian THRUN, EARLY DRAFT—NOT FOR DISTRIBUTION Sebastian Thrun, Dieter Fox, Wolfram Burgard, 1999-2000 ROS Robot Programming. From the basic concept to practical programming and robot application A Handbook Written by TurtleBot3 Developers YoonSeok Pyo I HanCheol Cho I RyuWoon Jung I TaeHoon Lim. Copyright © 2017 ROBOTIS Co., Ltd. 					
GRADING METHOD	□ A-F Scale		□ Pass	s/Not Pass	\Box Other ((specify):
GRADING METHOD DESCRIP	TION					
	RangeLetter GradeDescription				on	
	90 - 100	Α	Exceptional	performance:	All course	_
A-F GRADING SCALE:	86 – 89.9	A-	objectives achieved and met in a consistently outstanding manner.			stently
	81-85.9	B+	Very Good P	erformance. '	The majori	ty of the
	77 - 80.9	В	course objectives achieved (majority being at			eing at
	73 – 76.9	B-				0

			least two-thirds) and met in a consistently
			thorough manner.
	68 – 72.9	C+	Satisfactory Performance: At least most of
	64 – 67.9	С	course objectives have been achieved and met
	60 - 63.9	C-	satisfactorily.
	55 - 59.9	D+	Minimally Acceptable Performance: The
	50 - 54.9	D	course objectives met at a minimally acceptable
			level.
	0-49.9	F	Unacceptable performance: The course
			objectives not met at a minimally acceptable
			level.
PASS/NOT PASS:			·
OTHER:			

II. SEMESTER INFORMATION				
SEMESTER/YEAR	Spring	SECTION(S)	10	
DAY AND TIME		VENUE(S)	SCI/0022	
COURSE COORDINATOR	Dr. Hamza ZIDOUM	COURSE TEAM		
COORDINATOR OFFICE	0020	OFFICE HOURS	SUN-TUE: 10-11 (on appointment) https://meet.google. com/aod-ymhj-oev	
COORDINATOR EXTENSION	1484	COORDINATOR	zidoum@	
		Email		

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.	Demonstrate an understanding of a trajectory planning method, and some classical control design approaches	1,2	A , B	1, 2
2.	Design and implement intelligent solutions for mobile robots	1, 2, 6	A, B, F	1, 2, 6
3.	Implement localization and map building for mobile robotics	2	В	2
4.	Implement path planning for mobile robotics	2	В	2

5. Demo reinfo	nstrate proficiency in applying preement learning algorithms for	1, 2		A, B	1, 2
intelli	gent control strategies				
W. Com			- 0		
IV. COUR	SE LEARNING OUTCOMES (CLOS) AND ASSI	ESSMENT	f CRI	TERIA AND MET	HODS (FOR EACH
CLO1: D	emonstrate an understanding of a trajecto	rv planı	ning ı	method, and son	ne classical control
design ap	proaches	- J F	8	,	
ASSESSMI	- ent Criteria (to achieve this objectiv	E, THE		ASSESSMENT	T METHODS
STUDENT	MUST)				
A)	Describe control design approaches P, PD, a PID controllers	and	М	lidterm, Final	
B)	Program and use robotic microcontroller	boards			
	equipped with sensors and actuators.				
C)	Describe the mathematics of robotic motion	•			
D)	Program simple robotic behaviour based on	sensor			
	input and involving feedback loops				
CLO2: D	esign and implement intelligent algorithms	s for mo	bile r	obots	
ASSESSMI	ENT CRITERIA (TO ACHIEVE THIS OBJECTIV	E, THE		ASSESSMENT	T METHODS
STUDENT	MUST)				
A)	Integrate data from multiple sensors such a	s lidar,		Final, Project	
	cameras, IMUs (Inertial Measurement Unit	s), and			
	robot's surroundings	g of the			
B)	Use techniques like SLAM (Simult	aneous			
D)	Localization and Mapping) to create and	undate			
	maps of the robot's environment in real-time	е е			
C)	Employ computer vision and machine le	earning			
	algorithms to detect and recognize of	bjects,			
	obstacles, and landmarks in the environmen	t			
CLO3: In	nplement localization and map building fo	r mobile	e rob	otics	
ASSESSMI	ENT CRITERIA (TO ACHIEVE THIS OBJECTIV	E, THE		ASSESSMENT	T METHODS
STUDENT	MUST)				
A)	Utilize techniques like particle filters, k	Kalman		Midterm, Fina	ll Project
	filters, or Monte Carlo localization to estim	ate the			
	robot's pose (position and orientation) with	hin the			
D)	environment.	lonned			
Б)	bevelop algorithms to track and follow p	in the			
	environment or unforeseen disturbances	in the			
	environment of unforeseen disturbances.				

C)	Design a Bayes filter to estimate the state of the	
	robot and the environment.	
D)	Design strategies for coordinating multiple robots	
	to accomplish complex tasks collaboratively	
	normal month and contracts.	
ASSESSMI	ENT CRITERIA (TO ACHIEVE THIS OBJECTIVE, THE	ASSESSMENT METHODS
STUDENT	MUST)	
A)	Generate collision-free paths from the robot's	Final, Project
	current position to its goal using algorithms like	
	A*, and Dijkstra's algorithm	
B)	Incorporate reactive behaviors to handle	
	immediate obstacles or unexpected events,	
	ensuring safe navigation in dynamic environments	
C)	Conduct simulations and real-world experiments to	
	test the planning algorithms and evaluate the	
	robot's performance under various conditions.	

CLO5: Demonstrate proficiency in applying reinforcement learning algorithms for intelligent control strategies

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ENT CRITERIA (TO ACHIEVE THIS OBJECTIVE, THE	
MUST)	
Discuss the core principles and concepts of	
reinforcement learning	
Adapt reinforcement learning techniques	
specifically to mobile robotics contexts	
considering challenges such as sensor noise,	
actuator constraints, and dynamic environments	
Implementing a variety of reinforcement learning	
algorithms relevant to mobile robotics	
	EXAMPLE A CRITERIA (TO ACHIEVE THIS OBJECTIVE, THE MUST) Discuss the core principles and concepts of reinforcement learning Adapt reinforcement learning techniques specifically to mobile robotics contexts considering challenges such as sensor noise, actuator constraints, and dynamic environments Implementing a variety of reinforcement learning algorithms relevant to mobile robotics

V. COURSE CONTENT AND SCHEDULE				
WEEK	LECTURES #	TOPICS/ SUBJECTS	READINGS /	R EMARKS (e.g.,
			CHAPTERS	ASSESSMENTS)
1		Introduction, Defining Robotics	1	Midterm, Hwk, Final
2		Sensors	2	Midterm, Hwk, Project,
				Final
3		Reactive Behavior	3	Midterm, Hwk, Project,

			Final
4	Finite State Machines	4	Midterm, Hwk, Project,
			Final
5	Finite State Machines	4	Midterm, Hwk, Project,
			Final
6	Feature Extraction	4	Midterm, Hwk, Project,
			Final
7	Robotic Motion and Odometry	5	Project, Final
8	Control	6	Project, Final
9	Local Navigation: Obstacle	7	Project, Final
	Avoidance		
10	Localization	8	Project, Final
11	Mapping	9	Project, Final
12	Mapping-Based Navigation	10	Project, Final
13	Neural Networks	13	Project, Final
14	Image Processing	12	Project, Final
15	Revision and Presentations		

VI. ADDITIONAL INFORMATION (e.g., RUBRICS, etc.)

Assessment Plan:				
	Date Out	Due Date	Weight	
Lab tests			10%	
Midterm Exam 1		Week8	25%	
Project Part1	-	W9	10%	
Project Part2	-	W13	15%	
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 cond	uct.
ACADEMIC	The University expects the students to approach their academic endeavors with
INTEGRITY	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	To ensure the provision of a sound and fair assessment and grading, please
GRADING	review the Undergraduate Academic Regulations.
GRADE APPEAL	Students who wish to appeal their grades should review the Undergraduate
	Academic Regulations.
CLASSROOM	Students are expected to dress professionally during class time as required by the
POLICIES	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	Students are required to meet the course objectives by submitting coursework no
WORK	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	All quizzes, tests, clinical evaluations, and exams must be completed by the date
EVALUATIONS	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.
OTHER	

Course Outline Appendix

1. PROGRAM LEARNING OUTCOMES

- 1. Analyze a complex computing problem and to apply principles of computing and other relevant disciplines to identify solutions.
- 2. Design, implement, and evaluate a computing-based solution to meet a given set of computing requirements in the context of the Artificial Intelligence discipline.
- 3. Communicate effectively in a variety of professional contexts.
- 4. Recognize professional responsibilities and make informed judgments in computing and Artificial Intelligence practice based on legal and ethical principles.
- 5. Function effectively as a member or leader of a team engaged in activities appropriate to the Artificial Intelligence discipline.
- 6. Apply computer science theory, software development and Artificial Intelligence 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	1. Applies concepts, theories, and investigative methods to synthesize and interpret information

	1
experience that enables him/her to perform all	to evaluate conclusions.
tasks related to the specialization and other	2. Applies appropriate research methods and
related fields.	techniques and employs digital knowledge
	3. Evaluates and critiques information independently
	4. Uses cognitive and technical skills to analyze
	complex issues and develop appropriate
	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	1. Explains, presents, and adapts information to suit the recipients.
others to achieve the desired results	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	1. Performs advanced professional activities independently.
responsibility for decisions.	2. Demonstrates leadership skills.
	3. Takes professional responsibility.
	4. Assumes full accountability for the tasks and their
	output.
E. Responsibility and Commitment: The	1. Manages time and other resources assigned to
graduate appreciates the importance of	accomplishing tasks effectively and responsibly.
available resources and deals with them	2. Demonstrates effective practices when working in
effectively and is committed to the ethics of	teams.
the profession and society.	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	1. Demonstrates the ability to independently manage
graduate has a passion for development and	learning tasks, with an awareness of how to
innovation in the field of specialization.	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