1. Factual information			
Module title	COMPUTER SCIENCE 330 – Mobile Robotics Programming		
Module tutor	Dr. Alexander Astaras	**Level**	4
Module type	Taught: Lecture/guided discussion	**Credit value**	15
Mode of delivery	100% face-to-face		
Notional learning hours	150		

2. Rationale for the module and its links with other modules

Autonomously navigating mobile robots face the challenge of acquiring data from their surroundings, selecting their own navigation waypoints and dynamically altering their course of action to account for obstacles, power supply restrictions and unexpected events. In this course theoretical instruction is combined with experiential learning and challenge driven software development. Students participating in this course are challenged individually and in teams to build the hardware chassis and software control algorithms for mobile robots. An introduction to robotics fundamentals is followed by guided programming for automation (C, RobotC); basic electronics circuit design and troubleshooting; microcontroller programming; sensor data acquisition algorithms; actuator control; robotic navigation and obstacle avoidance; basic sensor data fusion; and concludes with a final robotic design challenge which integrates all aforementioned knowledge and skills.

3. Aims of the module

Students will be guided through lectures, experiential learning (design challenges) and a course project to jointly design software and mechanical hardware (robotics chassis); to build, program and troubleshoot mobile robots with a variety of roaming behaviours; to design for unforeseen real-world circumstances in mobile robotics, producing robust code that anticipates and exploits them; to program a microcontroller board to automatically sample and control a variety of sensors and actuators; to build and debug software to intelligently control mobile robotic systems; to design experiments which prove, characterize, extract and optimize performance parameters from each of their robot prototypes.

4. Pre-requisite modules or specified entry requirements

CS106

5. Is the module compensatable?

N/A

6. Are there any PSRB requirements regarding the module?

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N/A

7. Intended learning outcomes		
A. Knowledge and understanding	**Programme Learning Outcome(s) this maps against**	**Learning and teaching strategy**
At the end of the module, learners will be expected to: A1: Comprehend the function and differences among actuators, analogue and digital sensors. A2: Demonstrate understanding of the basic principles of mobile robotics algorithms. A3: Demonstrate an understanding and working knowledge of microcontroller level programming. A4: Understand the principles of sensor data fusion and be capable of coding simple fusion algorithms. A5: Be familiar with and possess comfortable working knowledge of iterative design, team and challenge-based development techniques for robotic design.		• Lectures will be used to introduce the topics and methods of approaching particular areas/subjects • Students will be required to engage in self-directed/self-motivated learning activities, such as supplementary reading of extra material solution of practice problems from the textbook and reference sources, in order to enhance their understanding of the topics discussed in classes • Summative Assessment will be used to test the ability of students to fulfil the expected learning outcomes • Formative Assessment will be used to assist the student in gauging their mastery of the concepts at regular interval during the module

B. Cognitive skills	Programme Learning Outcome(s) this maps against	Learning and teaching strategy
At the end of the module learners will be expected to: *B1: Be able to develop efficient algorithms for simple computational, navigation and manipulation tasks related to mobile robotics.* *B2: Be able to compare and quantitatively evaluate the effectiveness of robotic algorithms.* *B3: Demonstrate understanding and working knowledge of sensors and actuators.* *B4: Be familiar with sensor data fusion algorithms within the context of mobile robotics.*		• Lectures will be used to introduce the topics and methods of approaching particular areas/subjects. • Students will be required to engage in self-directed/self-motivated learning activities, such as supplementary reading of extra material solution of practice problems from the textbook and reference sources, in order to enhance their understanding of the topics discussed in class. • Summative Assessment will be used to test the ability of students to fulfil the expected learning outcomes. • Formative Assessment will be used to assist the student in gauging their mastery of the concepts at regular interval during the module.

C. Practical and professional skills	Programme Learning Outcome(s) this maps against	Learning and teaching strategy
At the end of the module, learners will be expected to: C1: Be able to develop efficient algorithms for simple robotic computational, navigation and manipulation tasks. C2: Be able to program and use robotic microcontroller boards in tandem with attached		• Lectures will be used to introduce the topics and methods of approaching particular areas/subjects • Students will be required to engage in self-directed/self-motivated learning activities, such as supplementary reading of extra material solution of practice problems from the textbook and reference sources, in order to enhance their understanding of the topics discussed in classes • Summative Assessment will be used to test the ability of students to fulfil the expected learning outcomes

C. Practical and professional skills	Programme Learning Outcome(s) this maps against	Learning and teaching strategy
sensors and actuators. C3: Apply their troubleshooting and debugging experience to design, optimize and maintain robotic software and hardware.		• Formative Assessment will be used to assist the student in gauging their mastery of the concepts at regular interval during the module

D Key transferable skills	Programme Learning Outcome(s) this maps against	Learning and teaching strategy
At the end of the module, learners will be expected to: D1: Demonstrate understanding of basic ideas about algorithm design and application. D2: Be able to develop efficient algorithms for simple computational tasks in the context of mobile robotics. D3: Be able to program simple robotic behaviour based on sensor input and involving feedback loops.		• Lectures will be used to introduce the topics and methods of approaching particular areas/subjects • Students will be required to engage in self-directed/self-motivated learning activities, such as supplementary reading of extra material solution of practice problems from the textbook and reference sources, in order to enhance their understanding of the topics discussed in class. • Summative Assessment will be used to test the ability of students to fulfil the expected learning outcomes • Formative Assessment will be used to assist the student in gauging their mastery of the concepts at regular interval during the module

8. Indicative content.

- Microcontroller programming using C
- Sensors and actuators
- Circuit troubleshooting
- Robotic shell design using
- Higher level programming for robotic control
- Mobile robotic algorithm design using RobotC
- Sensor data fusion
- Debugging and troubleshooting techniques
- Experimental characterization of robotic designs

9. Assessment strategy, assessment methods, their relative weightings and mapping to module learning outcomes

Assessment Strategy:

Assessment Task	Weighting	Week submitted	Grading (Pass / Fail / %)	Module Learning Outcome(s) the assessment task maps to
Midterm Examination: In-class (laboratory), closed book. Material covered approximately up to the middle of term.	30%	Due at approximately the middle of the term		A1, A2, A4, A5, B1, B2, B3, B4, C1, C3, D1, D2, D3
Course Project: A choice of individual project challenges, involving the implementation of data structures and employing the object oriented programming methodology.	20%	Due at approximately the third quarter of the term		A1, A2, A3, B1, B2, D1, D2, D3
Final Examination: In-class (laboratory), closed book. A cumulative course examination covering all class material.	50%	Finals Period		A1, A2, A4, B1, B3, C1, C2, C3, D1, D2, D3

Grade Description	UK points	US Letter Grade	US points
Excellent	70-75	A	4.0
Very Good (high)	65-69	A-	3.67
Very Good (low)	60-64	B+	3.33
Good (high)	55-59	B	3.0
Good (low)	50-54	B-	2.67
Satisfactory (high)	45-49	C+	2.33
Satisfactory (low)	40-44	C	2.0
Fail	0-39	F	0

10. Teaching staff associated with the module
Name and contact details
Dr. Alexander Astaras, Faculty office 017, Niarchos Technology Centre, Bissell Library. Phone number: 2310-398-384, email: astaras@act.edu

11. Key reading list				
Author	**Year**	**Title**	**Publisher**	**Location**
Alexander Astaras	2020	Course Lecture Slides	N/A	ACT Moodle server
Oomlout Inc.	2014	ARDX Experimenter's guide	Oomlout	Online

12. Other indicative text (e.g. websites)
Additional course material in the form of handouts in PDF and links to external resources are uploaded on the course MOODLE webpage: http://moodle.act.edu (ACT teaching support material distribution server)

13. List of amendments since last (re)validation		
Area amended	**Details**	**Date Central Quality informed**