DUBLIN INSTITUTE OF TECHNOLOGY

# DT211C BSc. (Honours) Degree in Computer Science (Infrastructure)

Year 3

# DT228 BSc. (Honours) Degree in Computer Science

Year 3

# DT282 BSc. (Honours) Degree in Computer Science (International)

Year 3

**SUMMER EXAMINATIONS 2017/2018**

## MOBILE ROBOTICS [CMPU3025]

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MR. ALAN FAHEY – DT211C
MR. PATRICK CLARKE – DT228/DT282

THURSDAY 10TH MAY      2.00 P.M. – 4.00 P.M.

TWO HOURS

INSTRUCTIONS TO CANDIDATES

ANSWER QUESTION 1 AND THREE OTHER QUESTIONS.

# Question 1.

1. What are the three D's when we consider using robots in environments? (5 marks)

2. Robots are in use in 8 major areas. Name any 5. (5 marks)

3. Explain the purpose of actuators. (5 marks)

4. What are electro-active polymers? (5 marks)

5. What is electric conductivity and give 4 examples of conductors? (5 marks)

6. What are the differences between Closed-Loop and Open-Loop controllers? (5 marks)

7. There are five major components of a mobile robot. What are these? (5 marks)

8. What is voltage? (5 marks)

# Question 2.

1. Describe what voltage is and give three ways in which it can be produced. (10 marks)

2. Considering Electrical Principals what are the following - an electrical source, a circuit and a load. (10marks)

# Question 3.

1. What are the characteristics of 'In Situ' sensor performance? (10marks)

2. Outline the Challenges for Localisation. (10marks)

# Question 4.

1. Explain what you know about Degrees of Freedom . (10marks)

2. Let us consider the following forward kinematic model for a differential drive robot:

$$\xi_1 = R(\varphi)^{-1}\xi_r \begin{bmatrix} (r\varphi_1)/2 + (r\varphi_2)/2 \\ 0 \\ (r\varphi_1)/2l + (r\varphi_2)/2l \end{bmatrix}$$

$$\text{where} \quad R(r\varphi)^{-1} = \begin{bmatrix} cos\varphi & -sin\varphi & 0 \\ sin\varphi & cos\varphi & 0 \\ 0 & 0 & 1 \end{bmatrix}$$

Suppose the robot is positioned such that $\varphi = \pi/2$ - i.e. 90 degrees, r = 2 and $l$ = 1; and the robot engages its wheels unevenly with $\varphi_1 = 3$ and $\varphi_2 = 6$. Compute the velocity of the robot in the global reference frame.

# Question 5.

1. When we wish to create a smooth path for a robot to navigate along, how do we do that? Illustrate with the help of a simple diagram. (10marks)

2. What are the most important issues in the concepts of locomotion? What are the advantages and disadvantages of legged motion? (10marks)