Mathematics for Software Development

BSc (Hons) Computer Games Programming

School of Engineering, Arts, Science and Technology

Answer all of the following questions, showing all of your working. Use extra sheets of paper if required (graph or squared paper may be used).

Hand out on Monday 4th November 2019

**To be completed by 09:00 Monday 18th November 2019**

Student ID …………………………………..

Student Name ………………………………………………..

**ASSESSMENT**

The majority of the summative assessment takes the form of regular problem sets assigned to students to be completed within a reasonable time frame, formative feedback will be available to them during tutorial sessions and workshops.

These problem sets will reinforce topics discussed in lectures and lead into a final exam of three hours, requiring students to answer a series of questions and provide their workings to demonstrate their understanding of the concepts underlying the questions being asked of them.

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| **Component Number** | **Form of assessment** | **Assessment size** | **Weighting (%)** | **Learning Outcomes assessed** |
| 1 | Problem Sets | 8 sets | 80% | 1, 2, 3 |
| 2 | Exam | 3 hours | 20% | 1, 2, 3 |

**ASSESSMENT CRITERIA**

1. Attempted to solve mathematical problems, making use of the correct underlying theories.
2. Submitted a series of solutions to assigned problem sets.
3. Produced solutions to problems, explaining their workings for each problem clearly and concisely.

This problem set has 9 questions, for a total of 100 points.

Marks Awarded:

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| **Question** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **Total** |
| **Marks Available** | **10** | **10** | **10** | **10** | **10** | **10** | **10** | **10** | **20** | **100** |
| **Score** |  |  |  |  |  |  |  |  |  |  |

Question 1

If , and **.** Answer the following in the space provided. Where it is not possible to answer the question, state Not Possible. [2 points each part]

1. State the order of and .

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1. Calculate .

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1. Calculate .

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1. Calculate .

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1. Calculate .

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Points awarded: \_\_\_\_\_\_\_\_\_ out of a possible 10.

Question 2

Consider the parallelogram ABCD drawn below. For the translation matrix answer the following showing all working.

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| 9 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
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| 4 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 3 |  | D |  |  | C |  |  |  |  |  |  |  |  |  |  |
| 2 | A |  |  | B |  |  |  |  |  |  |  |  |  |  |  |
| 1 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |

0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15

1. Represent each of the corners A, B, C and D by column vectors. [2 points]

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1. Translate the corners A, B, C and D to A´, B´, C´ and D´ respectively by using the matrix T. [4 points]

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1. Plot the new shape A´B´C´D´ on the grid above, label the corners.

[4 points]

Points awarded: \_\_\_\_\_\_\_\_\_ out of a possible 10.

Question 3

Consider the trapezium ABCD drawn below. Answer the following showing your working.

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| 4 |  |  |  | D | C |  |  |  |  |  |  |  |  |  |  |
| 3 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 2 |  |  | A |  |  | B |  |  |  |  |  |  |  |  |  |
| 1 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |

0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15

1. Represent each of the vertices A, B, C and D by column vectors. [2 points]

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1. Multiple each of the vectors representing the vertices A, B, C and D by the scale factor 2, to produce A´, B´, C´ and D´. [4 points]

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1. Plot the new shape A´B´C´D´ on the grid above, label the vertices.

[4 points]

Points awarded: \_\_\_\_\_\_\_\_\_ out of a possible 10.

Question 4

Consider the trapezium ABCD drawn below. For the reflection matrix answer the following showing working.

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| 4 |  |  |  |  |  | D | C |  |  |  |  |  |  |  |  |
| 3 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 2 |  |  |  |  | A |  |  | B |  |  |  |  |  |  |  |
| 1 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
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| -2 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| -3 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |

1. Represent each of the vertices A, B, C and D by column vectors. [2 points]

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1. Multiple each of the vectors representing the vertices A, B, C and D by the matric R, to produce A´, B´, C´ and D´ respectively. [4 points]

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1. Plot the new shape A´B´C´D´ on the grid above, label the vertices.

[4 points]

Points awarded: \_\_\_\_\_\_\_\_\_ out of a possible 10.

Question 5

Consider the trapezium ABCD drawn below. For the rotation matrix answer the following showing working.

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| 3 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 2 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 1 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 0 |  |  |  | D | C |  |  |  |  |  |  |  |  |  |  |
| -1 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| -2 |  |  | A |  |  | B |  |  |  |  |  |  |  |  |  |
| -3 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |

1. Represent each of the vertices A, B, C and D by column vectors. [2 points]

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1. Multiple each of the vectors representing the vertices A, B, C and D by the matric R, to produce A´, B´, C´ and D´ respectively. [4 points]

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1. Plot the new shape A´B´C´D´ on the grid above, label the vertices.

[4 points]

Points awarded: \_\_\_\_\_\_\_\_\_ out of a possible 10.

Question 6

Consider the trapezium ABCD drawn below. For the transformation matrix answer the following showing working.

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| 4 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 3 | E |  | D |  |  |  |  |  |  |  |  |  |  |  |  |
| 2 |  |  |  | C |  |  |  |  |  |  |  |  |  |  |  |
| 1 | A |  |  | B |  |  |  |  |  |  |  |  |  |  |  |

0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15

1. Represent each of the vertices A, B, C, D and E by column vectors. [2 points]

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1. Multiple each of the vectors representing the vertices A, B, C, D and E by the matric S, to produce A´, B´, C´, D´ and E´. [4 points]

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1. Plot the new shape A´B´C´D´ on the grid above, label the vertices.

[4 points]

Points awarded: \_\_\_\_\_\_\_\_\_ out of a possible 10.

Question 7

For answer the following in the space provided showing working.

1. [2 points]

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1. [3 points]

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1. Show that [5 points]

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Points awarded: \_\_\_\_\_\_\_\_\_ out of a possible 10.

Question 8

If **V**1 = **i** + 2**j** + 4**k** and **V**2 = 2**i** + **j** + 3**k** answer the following in the space provided showing working.

1. Calculate the vector product **V**1 X **V**2 [6 points]

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1. Show that the vector **V**1 X **V**2 is perpendicular to the vector **V**1 . [4 points]

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Points awarded: \_\_\_\_\_\_\_\_\_ out of a possible 10.

Question 9

Consider the square ABCD and the point P(5, 4) drawn below. To perform a rotation of 90o about the point P(5, 4), we translate the point to the origin, then perform the rotation and finally do the reverse translation. Answer the following showing working. [4 points each part]

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| 7 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 6 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 5 |  |  |  |  | P |  |  |  |  |  |  |  |  |  |  |
| 4 |  |  |  | C |  |  |  |  |  |  |  |  |  |  |  |
| 3 | D |  |  |  | B |  |  |  |  |  |  |  |  |  |  |
| 2 |  | A |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 1 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |

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1. Using the homogeneous coordinate system represent each corner by a column vector.

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1. Translate the points using the matrix .

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**Question continues P.T.O.**

1. Rotate the translated points through 90o using the matrix .

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1. Translate the rotated points back using the matrix and plot the new shape on the grid.

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**Question continues P.T.O.**

1. Replace with a single matrix.

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Points awarded: \_\_\_\_\_\_\_\_\_ out of a possible 20.