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 18th November 2019

**To be completed by 09:00 Monday 25th November 2019**

Student ID …………………………………..

Student Name ………………………………………………..

This problem set has 8 questions, for a total of 100 points.

**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 8 questions, for a total of 100 points.

Marks Awarded:

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| **Question** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **Total** |
| **Marks Available** | **10** | **8** | **16** | **10** | **15** | **12** | **16** | **13** | **100** |
| **Score** |  |  |  |  |  |  |  |  |  |

Question 1

Find the degree of every vertex of the following graphs. In each case state the sum of the degrees and how many of the vertices had an odd degree. [5 points each part]



*v*6

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| *v*1 | *v*5 |  |
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| *v*2 | *v*4 |  |
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|  | *v*3 |  |
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| *D*  *C*  *B*  *A*  *E* |  |
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Points awarded: \_\_\_\_\_\_\_\_\_ out of a possible 10.

Question 2

For each of the following degree sequences draw a graph that they represent, answer in the space provided. [4 points each part]

1. **(4, 4, 3, 2, 1)**

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1. **(4, 3, 3, 3, 1, 0)**

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Points awarded: \_\_\_\_\_\_\_\_\_ out of a possible 8.

Question 3

Construct an Adjacency Matric and an Incident Matrix for each of the following graphs, answer in the space provided. [16 points]



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| *v*1  *v*2  *v*3  *v*4  *v*5 | *e*6 |  |
|  | *e*5 |  |
| *e*1 |  |  |
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|  | *e*3 |  |
|  | *e*4 |  |
|  | *e*2 |  |
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| *D*  *C*  *B*  *A*  *E* |  |
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1. Are the graphs isomorphic?\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Points awarded: \_\_\_\_\_\_\_\_\_ out of a possible 16.

Question 4

Five friends; Alice, Bob, Clive, Dave and Eve, share five different flavoured ice creams, (one of each flavour); Raspberry, Strawberry, Toffee, Vanilla and Walnut, Alice likes Raspberry and Strawberry, Bob likes only Strawberry, Clive likes Toffee and Walnut, Dave likes all of then except for Walnut, Eve likes only Vanilla. Answer the following in the space provided.

1. Draw a bipartite graph to model the situation. [5 points]

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1. Is it possible for each person to get a flavour they like? If so state which flavour each person gets, if not explain why not. [5 points]

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

Question 5

Draw three distinct (non-isomorphic) connected simple graphs, each having six vertices, six straight edges and no crossing edges. Answer in the space provided. [5 points each graph]



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| *v*1  *v*2  *v*3  *v*4  *v*5  *v*6 |  |  |
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|  | *v*1  *v*2  *v*3  *v*4  *v*5  *v*6 |  |
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|  | *v*1  *v*2  *v*3  *v*4  *v*5  *v*6 |  |
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Points awarded: \_\_\_\_\_\_\_\_\_ out of a possible 15.

Question 6

*D*

*C*

*B*

*A*

*E*

*H*

*G*

*F*

For the graph opposite answer the following in the space provided. [6 points each part]

1. Does the graph have an Eulerian Cycle? If so draw it or state it, if not state why it is not possible.

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1. Does the graph have a Hamiltonian Cycle? If so draw it or state it, if not state why it is not possible.

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Points awarded: \_\_\_\_\_\_\_\_\_ out of a possible 12.

Question 7

Complete the game tree started below, the player using X goes first. Use +1 for a win for X, 0 for a draw and -1 for a loss to value each of the leaf nodes. [16 points]

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|  | **X** | **O** | **X** |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  | **X** |  | **O** |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
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What is the outcome after best play from both players?\_\_\_\_\_\_\_\_\_\_\_\_\_\_

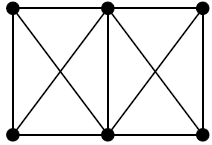
Points awarded: \_\_\_\_\_\_\_\_\_ out of a possible 16.

Question 8

*v*3

*v*2

*v*1

1. Show that the following graph is Planar by drawing it with straight lines for edges and without any crossing edges. [6 points]

*v*6

*v*4

*v*5

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1. For the graph you produce for part a, show that

faces + vertices = edges + 2 [3 points]

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1. A Planar graph has 10 vertices and . How many edges and faces does it have? [4 points]

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| **Edges =** | **Faces =** |

Points awarded: \_\_\_\_\_\_\_\_\_ out of a possible 13.