[CRT06]

UNIVERSITY OF BOLTON

CREATIVE TECHNOLOGIES

COMPUTING PATHWAY

SEMESTER TWO EXAMINATION 2018/2019

MATHEMATICS FOR COMPUTING

MODULE NO: SWE4002

Date: Friday 24th May 2019 **Time: 14:00 – 16:00**

INSTRUCTIONS TO CANDIDATES: **There are TEN questions.**

Answer ALL TEN questions.

All questions carry equal marks.

Marks for parts of questions are shown in brackets.

All rough work must be written in your answer book.

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1) For the purpose of error detection, numeric codes (such as ID numbers) often include a final 'check digit'.
   a) Suppose a numeric code consists of a string of 9 digits $x_1, x_2 ... x_9$, followed by a final check digit x_{10} defined to be the rightmost decimal digit of $x_1 + 2x_2 + 3x_3 + ... + 9x_9$.

   b) Verify that 2516238674 is a valid code. **(4 marks)**

   c) Let X be the set of all strings of 9 digits, let Y be the set of all digits, and let $f : X \to Y$ be the function that assigns the correct check digit to each string, for example f(251623867) = 4. State, giving reasons, whether f is one-to-one and whether f is onto. **(3 marks)**

   d) If an error is made in keying in a code, will the check digit always detect it? Explain, with reference to your answer to b). **(3 marks)**

2) Use the axioms of Boolean algebra to prove the complement law 0' =1. **(10 Marks)**

3) Simplify the following Boolean expressions
   a. $x'y + x(x + y')$ **(3 marks)**
   b. $(x + xy)'y$ **(3 marks)**
   c. $xz' + x'y + (yz)'$ **(4 marks)**

4) Find a recursive and a non-recursive definition for the sequence: 3, 4, 13, 14, 23, 24, … **(10 marks)**

5) The first term of a certain sequence is 1, and each subsequent term is obtained by tripling the previous term and adding 2 to the result. Write down a recursive definition of the sequence. **(10 marks)**

6) The telephone numbers in a certain area consist of 8 digits. The first digit of a telephone number is not permitted to be 0 or 1.
   a. How many such telephone numbers are there altogether? **(3 marks)**
   b. How many of the telephone numbers do not contain any zeros **(3 marks)**
   c. How many of the telephone numbers contain at least one zero? **(4 marks)**

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7) The Information Systems department at a university has 20 members of staff. The department has been asked to choose six of its members to serve on a faculty committee.
   a) In how many ways can the members who are to serve on the committee be chosen? **(5 marks)**

   b) If seven of the 20 members of the department are female, how many six-member committees can be formed in which exactly two of the members are female? **(5 marks)**

8) For each of the following draw a graph whose vertices have the following degrees, or explain why no such graph exists:

   a) 2,3,3,4,5 **(2 marks)**
   b) 2,3,3,3,3 **(2 marks)**
   c) 1,2,3,2,1 **(2 marks)**
   d) 1,1,1,1,1,3 **(2 marks)**
   e) 1,3,1,5,2,3 **(2 marks)**

9) A tree has eight vertices of degree 1, three vertices of degree 2, and two vertices of degree 3. The other vertices all have degree 4. How many vertices must there be altogether? **(10 marks)**

10) Construct an expression tree for each of the following expressions:
   a) $a + ((b – c) \times d)$ **(3 marks)**
   b) $((a \times b)/(c \times d)) – (e/f)$ **(3 marks)**
   c) $(a – (b + (c + d))) – ((e \times f) \times g)$ **(4 marks)**

END OF QUESTIONS