UNIVERSITY OF KENT

DIVISION OF COMPUTING, ENGINEERING
AND MATHEMATICAL SCIENCES

LEVEL 4 EXAMINATION

Foundations of Computing I

Monday, 24 May 2021

Paper Instructions
The paper contains FIVE questions. Answer FOUR questions. This examination is designed to take 2 hours but you can take longer if you wish. Please ensure that you submit your answer booklet within 24 hours of the exam release time.
Notes to Candidates
This is an open book examination to be completed and submitted within 24 hours.
As you will have access to resources to complete your assessment, any content you use from external source materials should be cited. Full academic referencing is <u>not</u> required.
You are reminded of your responsibility to act with honesty, integrity and fairness in completing assessment requirements for your course, and to demonstrate good academic practice when undertaking this assessment.
This is an individual piece of work and collusion with others is strictly prohibited.
Plagiarism detection software will be in use.
Breaches of academic integrity will be considered to be academic misconduct.
Where the University believes that academic misconduct has taken place the University will investigate the case and apply academic penalties as published in [Annex 10 of the Credit Framework](#).

1. (a) Solve the following:

    (i) $12x + 17 = 65$

    (ii) $\left.\begin{array}{l} 14x - 13y = 16 \\ 2x + 9y = 24 \end{array}\right\}$

    (iii) $5x^2 + 7x - 19 = 0$ [10 marks]

    (b) Find the sum to infinity for the series $18 + 12 + 8 + \cdots$ [4 marks]

    (c) Determine the values of a, b, c and d:

    $$(1 + 2x)^a = 1 + bx + 24x^c + dx^3 + 16x^4$$

    $$\boxed{\begin{array}{c} ax^2 + bx + c = 0 \\[2mm] x = \dfrac{-b \pm \sqrt{b^2 - 4ac}}{2a} \end{array}}$$

    [6 marks]

2. (a) Let L be the language $L = \{r^o 101^o r \mid r \in \{0,1\}^*\}$

    State which strings are in L:

    (i) 110111

    (ii) 101

    (iii) 0110110

    (iv) 111011

    (v) 1010110

    [5 marks]

    (b) Draw a Hasse diagram to represent the relation "exactly divides" on the natural numbers from 1 to 15 inclusive.   [6 marks]

(c) Enumerate the elements of the following sets:

    (i) $\{x | x = 4p \text{ where } p < 8 \text{ and } P \in \mathbb{N}\}$

    (ii) $\{x \in \mathbb{N}^+ | x = \frac{12}{p} \text{ where } p \in \mathbb{N}\}$

                                                        [9 marks]

3.   A series is defined by $S_n = \sum_{r=1}^{n}(4r - 2)$

    (a)   Find the first 4 terms of the series   [4 marks]

    (b)   Use the method of induction to prove that $S_n = 2n^2$ [14 marks]

    (c)   Find the sum of the first 20 terms of the series.   [2 marks]

4. The table summarises the percentage marks obtained by 200 students sitting an examination.

Marks	0 –	10 –	20 –	30 –	40 –	50 –	60 –	70 –	80 –	90 –
No. students	2	4	4	6	30	70	60	14	6	4

    (a)   Find the mean and standard deviation of the marks. State the assumption that you make.   [5 marks]

    (b)   Use the method of interpolation to determine the median for the data.   [7 marks]

    (c)   Two further sets of data have the following properties:

        Set 1: $\bar{x}_1 = 16, \sigma_1 = 3, n = 24$

        Set 2: $\bar{x}_2 = 13, \sigma_2 = 5, n = 20$

        (i)   find the combined mean for the data

        (ii)   find the scaling formula that maps Set 2 onto Set 1.   [8 marks]

$$\bar{x} = \frac{\sum fx}{\sum f}$$

$$\sigma = \sqrt{\frac{\sum fx^2}{\sum f} - \bar{x}^2}$$

$$Q_2 = lcb + \frac{(v - prev.cf)}{f} \times (ucb - lcb)$$

5. (a) Use BCD arithmetic to perform the calculation:

    14326 + 92378

    Show all your working.   [7 marks]

    (b) In a particular computer numbers are stored in IEEE standard 754 floating point format, with an 8-bit mantissa and a 4-bit exponent.

    (i) Show how 43.125 would be stored   [5 marks]

    (ii) What number is stored as 1 11001010 1011?   [8 marks]