CM1015

BSc EXAMINATION

COMPUTER SCIENCE

Computational Mathematics

Release date: Monday 6 September 2021 at 12:00 midday British Summer Time

Submission date: Tuesday 7 September 2021 by 12:00 midday British Summer Time

Time allowed: 24 hours to submit

INSTRUCTIONS TO CANDIDATES:

Section A of this assessment consists of a set of **10** Multiple Choice Questions (MCQs) which you will take separately from this paper. You should attempt to answer **ALL** the questions in Section A. The maximum mark for Section A is **40**.

Section A will be completed online on the VLE. You may choose to access the MCQs at any time following the release of the paper, but once you have accessed the MCQs you must submit your answers before the deadline or within **4 hours** of starting whichever occurs first.

Section B of this assessment is an online assessment to be completed within the same 24-hour window as Section A. We anticipate that approximately **1 hour** is sufficient for you to answer Section B. Candidates must answer **TWO** out of the THREE questions in Section B. The maximum mark for Section B is **60**.

Calculators are not permitted in this examination. Credit will only be given if all workings are shown.

You should complete Section B of this paper and submit your answers as **one document**, if possible, in Microsoft Word or a PDF to the appropriate area on the VLE. You are permitted to upload 30 documents. However, we advise you to upload as few documents as possible. Each file uploaded must be accompanied by a coversheet containing your **candidate number**. In addition, your answers must have your candidate number written clearly at the top of the page before you upload your work. Do not write your name anywhere in your answers.

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SECTION B

Candidates should answer any **TWO** questions from Section B.

Question 2

(a) Show whether the following series are convergent or divergent. If the series is convergent determine the value of it. [6]

i. $s_n = \frac{6+7n^2}{5-3n^2}$

ii. $\sum_{n=1}^{\infty}(-1)^n \cos(\frac{1}{n})$

(b) Suppose that we have a die which is rolled and a coin which is tossed. What is the probability that the die shows an odd number and the coin shows a head. [6]

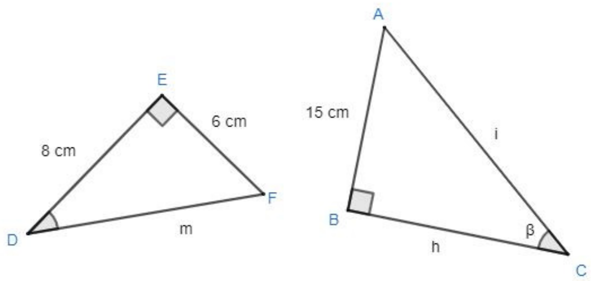
(c) Find the value of the following, put it in its simplest form. [6]

i. $\cos\frac{\pi}{12}$

ii. $\log_{x^2} x^3$

(d) Consider that the position of an object is given by the following equation : $s(t) = 2te^t$. Will this object stop moving ? If so, at which value of t the object will stop moving. [6]

(e) If the two triangles given below are similar. Find the length of the side i. [6]



Question 3

(a) Show your answer for the following : [6]

i. Find the sine and tangent of the angle θ in $[\pi, \frac{3\pi}{2}]$ for which we have $\cos\theta = -\frac{1}{3}$.

ii. Show whether $f(x) = \frac{x^2-x}{x^2-1}$ is a continuous function or not on all the real numbers $\Re$?

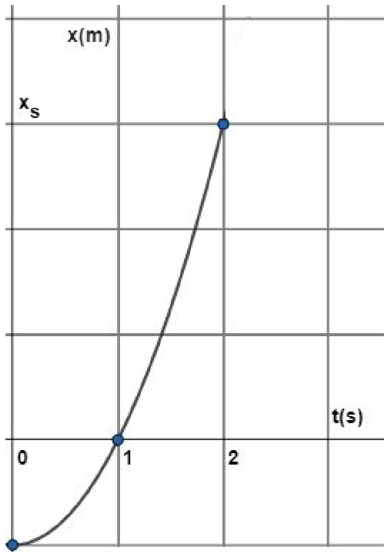
(b) You throw a fair six-sided die twice, each number has the same probability, then add the two numbers. What is the probability of getting a number divisible by five ? [6]

(c) i. Find the determinant of the matrix $A = \begin{pmatrix} 1 & -1 \\ 1 & 1 \end{pmatrix}$ and then find its inverse. [4]

ii. Solve the following system of equations using the inverse matrix. [4]
$3x + 8y = 5$
$4x + 11y = 7$

(d) How many functions $f : \{1, 2, ..., 8\} \to \{1, 2, ..., 8\}$ are bijective ? [4]

(e) From the following figure, the motion of a particle moving along an x axis with a constant acceleration. The figure's vertical scaling is set by $x_s = 6m$. What is the magnitude ? [6]



Question 4

(a) Point P moves along the x-axis in such a way that its position at time t/s is given by
$x = 2t^3 - 15t^2 + 24t$ ft [9]

i. Find the velocity and acceleration of P at time t

ii. In which direction and how fast is P moving at $t = 2s$? Is it speeding up or slowing down at that time ?

iii. When is P instantaneously at rest ? When is its speed instantaneously not changing ?

(b) You want to invite your friends to have a party. You have 15 friends but you have only 7 chairs in your garden. [6]

i. How many different ways do you have for which 7 friends to invite ?

ii. What if you decided not only which friends to invite but also where to seat them along your table ? How many different ways do you have ?

(c) Solve the equation $3\log(x+5) = 2\log(7-x)$. [3]

(d) Find the derivatives of the following : [6]

i. $y = e^{x^3 - 3x^2}$

ii. $y = 10^{5x}$

(e) Find the critical points (maximum and minimum values) of the function $f(x) = x^2 e^{-x}$. Sketch the graph. [6]

END OF PAPER

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