## APM2616

May/June 2014

## COMPUTER ALGEBRA

Duration : 2 Hours

100 Marks

**EXAMINERS :**
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**SECOND ·** PROF R MARITZ

**Closed book examination.**

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This paper consists of 3 pages

Answer all the questions

## QUESTION 1

State the output that MuPAD would produce from the following inputs If the given statements would not produce output because of a coding error, say so

(a) int$(x, x = 0\ 1)$,

(b) solve$(x + y^2 = 0,\ x)$,

(c) $f\ = x- > x^2$,

$f(3)$,

(d) ? series

(e) normal $\left((x + y)^2 / (y + z)\right)$,

(f) sq: = proc (n Type PosInt)

begin

return $(n^2)$

end_proc,

sq$(-3)$,

(g) fe $= (a + x)^2$; '

coeff$(f, x, 1)$,

(h) diff$(x^3,\ x,\ y)$,

[TURN OVER]

(i) limit(sin $(x)$ /$x$, 0),

(j) subs($x^2 + x$, $x = 2$),

[20 marks]

## QUESTION 2

Given that the following have been defined in a MuPAD session

$n$ positive integer

$x$ array of $n$ identifiers

$g$ $n \times n$ matrix

write a MuPAD procedure called mygam that takes the above as input and outputs $n \times n \times n$ array defined by

$$C_{abc} = \frac{1}{2} \sum_{i=1}^{n} h_{ci} \left( \frac{\partial g_{ai}}{\partial x_b} + \frac{\partial g_{bi}}{2x_a} - \frac{\partial g_{ab}}{\partial x_i} \right)$$

where $h$ is the matrix inverse of $g$       [20 marks]

## QUESTION 3

(a) Write LaTeX code, in the form of a complete document, for the following

- The first term is

$$K_{abc} = \frac{1}{2} \sum_{i=1}^{n} h_{ci} \left( \frac{\partial g_{ai}}{\partial x_b} \right),$$

- where $h = g^{-1}$       (15 marks)

(b) How would you incorporate MuPAD code and output in a LaTeX document       (5 marks)
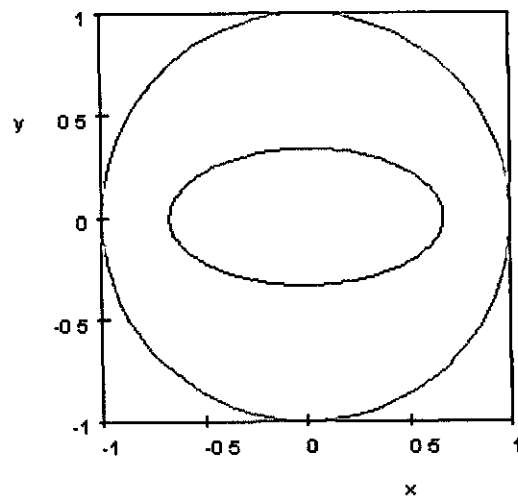
[20 marks]

## QUESTION 4

Write a MuPAD procedure, called mydiff($f, x$), that does not use the operator $D$ or diff. The input parameters are $f$, which is a polynomial in $x$, which is an identifier. The output should be the first derivative of $f$ with respect to $x$ [Note that degree(p,x) returns the highest power of $x$ in the polynomial $p$]

[20 marks]

[TURN OVER]

## QUESTION 5



Write MuPAD code to produce the diagram shown above  The same scale is used on the $x$- and $y$-axes, and the objects are drawn inside a box  The circle is uniformly colored red, and the ellipse is uniformly coloured blue with parametric definition

$$\left( \frac{2}{3} \cos(u), \quad \frac{1}{3} \sin(u) \right)$$

[20 marks]
**TOTAL: [100 marks]**

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