# TECHNICAL UNIVERSITY OF MOMBASA

# Faculty of Engineering & Technology

DEPARTMENT OF BUILDING & CIVIL ENGINEERING

**DIPLOMA IN BUILDING & CIVIL ENGINEERING (DBC)**
**DIPLOMA IN ARCHITECTURE (DA)**

AMA 2113: ENGINEERING MATHEMATICS II

**END OF SEMESTER EXAMINATION**
**SERIES:** APRIL 2013
**TIME ALLOWED:** 2 HOURS

**Instructions to Candidates:**
You should have the following for this examination

- *Answer Booklet*
- *Scientific Calculator*

This paper consists of **FIVE** questions.
Answer any **THREE** questions
Maximum marks for each part of a question are as shown
This paper consists of **THREE** printed pages

**Question One**

**a)** Find first derivative for each of the following:

**(i)** $y = x^3 \sin x^4$

**(ii)** $y = \dfrac{e^3 \log_e 2x}{(x^2+1)\sin 4x}$

**(iii)** $y^2 = \tan^{-1}(x^2+1)$ **(14 marks)**

**b)** An oil container is to be made in the form of a right circular cylinder to carry 1m$^3$ of oil when full. Determine dimensions of the container if the surface area has to be a minimum. **(6 marks)**

**Question Two**

**a)** Find $\dfrac{dy}{dx}$ given

$$3xy^2 + \frac{1}{x} = y^3 \ln \cos x$$

**(5 marks)**

**b)** A function is defined as:

$x = \cos 2\theta$ $y = \sin 2\theta$

Find radius of curvature if $\theta = \dfrac{\pi}{4}$ **(7 marks)**

**c)** (i) Find the stationary points for the function:

$y = x^3 - 3x^2 - 4x + 12$

Given $y = 0$ when $x = 2$

(ii) Determine the nature for the stationary points in (i) above. **(8 marks)**

**Question Three**

**a)** Find $\dfrac{dy}{dx}$ for the following:

**(i)** $y = \tan^{-1} \cosh x$

(ii) $y = \dfrac{\left(x^2 - 2\right)\sec x}{\left(x+1\right)\ln x}$ (use logarithms) **(6 marks)**

**b)** (i) Sketch the curve for $y = 8x^3 - 24x + 16$ given y = when x = 1

(ii) Find and classify the stationary points for the function in b(i) **(14 marks)**

**Question Four**

**a)** Find $\dfrac{dy}{dx}$ at x = 1 for $xy + xy^2 = 10$ **(4 marks)**

**b)** An open rectangular tank measures 1.5m, xm and ym for the height base length and base width respectively. Find:

**(i)** Dimensions that make surface area a minimum

**(ii)** Prove that the surface area I b(i) is a minimum. **(8 marks)**

**c)** The distance xm is related to time taken t in seconds for a moving particle by an expression of the form: $x = 16t^3 - 32t^2 + 8t - 1$

Find:

(i) Velocity after 3 seconds

(ii) Time taken for the particle to come to rest

(iii) Time required for acceleration to be 16m/s$^2$

**(iv)** Distance covered when the particle comes to rest. **(8 marks)**

**Question Five**

a) Find first derivative for:

$$y^2 = arc\ \cos\left(x^2 + 4x\right)$$

**(4 marks)**

b) Use logarithms to find $\dfrac{dx}{dt}$ given:

$$x = \frac{\left(t^2 + 5\right)e^{t^2}}{\sin t}$$

**(4 marks)**

c) (i) A rectangular sheet of metal measures 20cm by 15cm. Squared pieces of the material are removed from each of the four corners and an open box is formed. Find maximum volume of the box.

(ii) Show that the volume of the box in c (i) above is a maximum. **(12 marks)**