



THE MOMBASA POLYTECHNIC UNIVERSITY COLLEGE

(A Constituent College of JKUAT)

Faculty of Engineering and Technology

DEPARTMENT OF BUILDING AND CIVIL ENGINEERING

**DIPLOMA IN BUILDING & CIVIL ENGINEERING
DIPLOMA IN CIVIL ENGINEERING**

AMA 2208: CALCULUS I

END OF SEMESTER EXAMINATION

SERIES: DECEMBER 2011

TIME: 2 HOURS

Instructions to Candidates:

You should have the following for this examination

- *Answer booklet*
- *Mathematical tables/Scientific Calculator*

This paper consists of **FIVE** questions in two sections **A & B**

Answer question **ONE (COMPULSORY)** and any other **TWO** questions.

Maximum marks for each part of a question are clearly shown

This paper consists of **THREE** printed pages

SECTION A (COMPULSORY)

Question 1

a) Find the first derivatives for the following

(i) $y = \sqrt{x^2 + 1}$

(ii) $y = \frac{4-x}{1+\frac{1}{x}}$

(iii) $y = \cot^{-1} \frac{1}{x^2}$

(iv) $y = t^2 - \sin t \quad x = t + \cos 2t$

(16 marks)

b) From first principles, find the derivative of $y = \frac{1}{x^2 + 1}$
 $y^3 + 3xy + x^2 = 10$

(6 marks)

c) A function is given as: ; Find the equation for the following:

- (i) The tangent at point (-1, 5)
(ii) The normal to the tangent

(8 marks)

SECTION B (Answer any TWO questions from this section)

Question 2

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

(i) $y = \cos^3 t, \quad x = \sin t$

(ii) $y = \arctan x^4$

(iii) $y = \frac{e^x \sin x}{x \ln x}$

(12 marks)

- b) Find $\frac{d^2y}{dt^2}$ given $y = e^{-t} \ln t$ (8 marks)

Question 3

- a) Using logarithmic method find $\frac{dy}{dx}$ for:
- (i) $y = \frac{x^3 e^{x^2}}{\sqrt{\frac{1}{x} - x^3}}$ (8 marks)
- (ii) $y = \theta - \cos 2\theta$ $x = \sin 2\theta$ (12 marks)
- b) Find the angle of intersection between the functions. $2x^2 - x = 8$ and $2x^2 + y^2 = 10$ (8 marks)

Question 4

- a) Find the radius of curvature of $y^3 = 4x$ at $\left(\frac{1}{4}, 1\right)$ (10 marks)
- b) Determine at the point $t = 0$ the following:
- (i) Tangent
- (ii) Normal to the tangent in (i) above, where the function is defined as $y = 4e^{2t}$, $x = \frac{2}{e^t}$ (10 marks)

Question 5

- a) A function is of the form $y = x^3 + \frac{432}{x}$. Determine:
- (i) Critical values
- (ii) The nature of the critical values (8 marks)
- b) The distance s for a moving object is related to time t by an expression of the form:
- $$s = \frac{t^3}{6} + \frac{t^2}{4}$$
- (3 marks)

Find its acceleration

- c) A rectangular tank of height 2m is to be fabricated. The capacity of the tank is 10m^3 .
- (i) Determine the dimensions of the base if the material to be used is to be of minimum surface area.
 - (ii) Show that dimensions for the tank in c(i) are for the minimum surface area (9 marks)