

## Calculus 2 final exam

BSc. MATERIALS AND METALLURGICAL ENGINEERING (Jomo Kenyatta University of Agriculture and Technology)



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## JOMO KENYATTA UNIVERSITY

OF

# AGRICULTURE AND TECHNOLOGY UNIVERSITY EXAMINATIONS 2023/2024

SECOND YEAR SECOND SEMESTER EXAMINATION FOR BACHELOR OF SCIENCE IN ENGINEERING (MINING, GEGIS, GIS, TIE, CIVIL, EEE, EEC AND ABE).

#### SMA 2173: CALCULUS II

DATE: APRIL 2024

TIME: 2 HOURS

INSTRUCTIONS: Attempt question one and any other two questions.

### **QUESTION ONE (30 MARKS)**

(a) Briefly explain the following terms

(i) Parametric differentiation

[1 mark]

(ii) Implicit differentiation

[1 mark]

Hence determine  $\frac{dy}{dx}$  for the equations  $x = te^t$  and y = 4 + lnt

[3 marks]

(b) Determine the equation of normal at (3, -1) given that

 $-x^2y^2 + 2x^3 = 4x - y + 32$ 

[5 marks]

(c) State the assymptotes for the curve  $y = \frac{2x^3}{x^2-1}$ 

[3 marks]

(d) Show that  $\frac{d}{dx} \left( \cosh^{-1}(e^x) \right) = \frac{e^x}{\sqrt{e^{2x} - 1}}$ 

[3 marks]

(e) Evaluate the following integrals using an appropriate technique

(i)  $\int \sin^{-1}(x)dx$ 

[3 marks]

(ii)  $\int \cos(4x)\cos(2x)dx$ 

[3 marks]

(iii)  $\int e^{\sin x} \cos x dx$ 

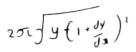
[2 marks]

(iv)  $\int \frac{x}{\sqrt{x+1}} dx$ 

[3 marks]

(f) Use Simpson's rule with n=4 subintervals to approximate the integral  $\int_{-2}^{2} 3^{x} dx$  to three decimal places. [3 marks]

## **QUESTION TWO (20 MARKS)**



- (a) Determine the surface area of the solid obtained by rotating  $y = \sqrt{16 - x^2}$ ,  $-4 \le x \le 4$  about the x-axis. [6 marks]
- (b) Evaluate the following integrals
  - (i)  $\frac{dx}{\sqrt{x^2+2x+10}}$

[5 marks]

(ii)  $\int tan^3xsec^3xdx$ 

[5 marks]

(c) Use trapezoidal rule with seven ordinates to estimate  $\int \sqrt{2^x + 1} dx$ to four decimal place.

[4 marks]

## QUESTION THREE (20 MARKS)

(a) Determine the area between the curves  $x = y^2 - 4y$  and y = x

[4 marks]

(b) Sketch the graph of  $f(x) = \frac{3x}{x^2-1}$ 

[5 marks]

- (c) Determine the volume of the solid obtained by rotating the region  $y = x^2$  between x = 1 and x = 3 about the x-axis. [5 marks]
- (d) Evaluate  $\int \frac{\sin(x)dx}{1+\cos(x)}$  using an appropriate method.

[6 marks]

[2 marks]

### **QUESTION FOUR (20 MARKS)**

(a) Find the length of  $f(x) = \frac{x^3}{6} + \frac{1}{2x}$  between x = 1 and x = 2.

1= J1 (dy)2 [9 marks]

- (b) Show that  $\int \frac{x^2 - 29x + 5}{(x - 4)^2 (x^2 + 3)} dx = \ln|x - 4| + \frac{5}{x - 4} - \frac{1}{2} \ln|x^2 + 3| + \frac{2}{\sqrt{3}} tan^{-1} \left(\frac{x}{\sqrt{3}}\right) + \frac{1}{2} tan^$ [9 marks]
- (c) Evaluate by separation of variables sin(x)sin(y)dx + cos(x)cos(y)dy = 0