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KIRIRI WOMENS' UNIVERSITY OF SCIENCE AND TECHNOLOGY
UNIVERSITY EXAMINATION, 2022/2023 ACADEMIC YEAR
FIRST YEAR, FIRST SEMESTER EXAMINATION
FOR THE DEGREE OF BACHELOR OF SCIENCE
(MATHEMATICS AND COMPUTER SCIENCE)

Date: 19th April, 2022
Time: 11.30am – 1.30pm

KMA 201 - CALCULUS 11

INSTRUCTIONS TO CANDIDATES

ANSWER QUESTION ONE (COMPULSORY) AND ANY OTHER TWO QUESTIONS

QUESTION ONE (30 MARKS)

- a) Find the critical points of $f(x) = x^3 - 6x^2 + 4$ (2 Marks)
Hence identify the intervals on which f is increasing and decreasing (2 Marks)
- b) Find the curve whose slope at the point (x, y) is $f'(x) = 3x^2$ if the curve is required to pass through the point $(1, -1)$. (3 Marks)
- c) Evaluate the following integrals:
- i) $\int \sin^3 x \cos^2 x dx$ (3 Marks)
- ii) $\int x^2 (1 + 4x^3)^3 dx$ (3 Marks)
- iii) $\int x^2 e^{2x^3 - 4} dx$ (3 Marks)
- iv) $\int \frac{1}{x (\ln x)^3} dx$ (3 Marks)
- d) Find the average value of $f(x) = 3x^2 + x - 2$ on the interval $[-1, 4]$ (3 Marks)
- e) Use partial fractions to evaluate $\int \frac{dx}{x^3 - 2x^2 + x}$ (5 Marks)
- f) The velocity of a moving point is given by the equation $v = (3t^2 + 2t + 1)m/s$. Find the path covered by the point after the first 10 seconds from the start. (3 Marks)

QUESTION TWO (20 MARKS)

- a) Determine the value of x whose existence is guaranteed by Rolle's theorem for the function $f(x) = x^2 - 2x - 8$ on the interval $[-2,4]$. (6 Marks)
- b) Sketch the graph of the function $y = x^3 - 6x^2 + 9x - 3$ (6 Marks)
- c) Evaluate the integrals:
- i) $\int (3x + 2) (3x^2 + 4x)^4 dx$ (4 Marks)
- ii) $\int e^x \cos 3x dx$ (4 Marks)

QUESTION THREE (20 MARKS)

- a) Write $\frac{x^2 - 5x + 9}{x^2 - 5x + 6}$ into partial fractions hence evaluate $\int \frac{x^2 - 5x + 9}{x^2 - 5x + 6} dx$ (10 Marks)
- b) Find the volume generated by rotating the area bounded by $y = 3 + x^2$ and the line $y = 4$ about the x -axis. (6 Marks)
- Evaluate $\int \frac{\cos 3x}{\sin^2 3x} dx$ (4 Marks)

QUESTION FOUR (20 MARKS)

- a) Find the integral of the following using trigonometric substitution
- i) $\int \frac{dx}{x^2 \sqrt{x^2 + 1}}$ (5 Marks)
- ii) $\int_{-6}^{-3} \frac{\sqrt{x^2 - 9}}{x} dx$ (5 Marks)
- b) Two bodies started moving at the same time from the same along a straight line. The first body moves with velocity $v = (3t^2 - 6t)m/s$, the second with the velocity $v = (10t + 20)m/s$. At what instant and at what distance from the initial point will they meet. (5 Marks)
- c) Find the volume of the solid generated by rotating about the x -axis the area under the curve $y = \frac{3}{4}x$, from $x=0$ to $x=4$. (5 Marks)

QUESTION FIVE (20 MARKS)

- a) The mean daily temperature in degrees celcius in Nairobi,, t months after July 15 is closely approximated by $T = 61 + 18 \cos \frac{\pi t}{6} = f(t)$.
Find the average temperature between September 15 ($t=2$) and December 15 ($t=5$). (6 Marks)
- b) Show that $\int_0^2 x^2 e^{2x} dx = \frac{1}{4}(3e^4 - 1)$ (8 Marks)
- c) The parabola $y = 2 - x^2$ and the line $y = -x$ enclose an area. Use integration methods to find the size of the area enclosed. (6 Marks)