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KIRIRI WOMEN'S UNIVERSITY OF SCIENCE AND TECHNOLOGY UNIVERSITY EXAMINATIONS, 2024/2025 ACADEMIC YEAR FIRST YEAR, SECOND SEMESTER EXAMINATION FOR THE DEGREE OF BACHELOR SCIENCE IN COMPUTER SCIENCE (SPECIAL EXAMINATION)

KMA 201 INTEGRAL CALCULUS

DATE: 13TH AUGUST, 2024 TIME: 2:30 PM - 4:30 PM

<u>INSTRUCTIONS TO CANDIDATES</u> ANSWER QUESTION ONE (COMPULSORY) AND ANYOTHER TWO QUESTIONS

QUESTION ONE: (30 MARKS)

a. Evaluate the following integrals;

i.	$\int \frac{3x^2 + 2x}{(x^3 + x^2 + 4)^{10}} dx$	(2 Marks)
ii.	$\int x(x+1)^2 dx$	(2 Marks)
iii.	$\int \sin^3 x \cos x dx$	(2 Marks)
iv.	$\int x \tan x^2 dx$	(2 Marks)
v.	$\int x \cos x dx$	(2 Marks)
vi.	$\int \frac{2x+4}{x^2+4x+2} dx$	(2 Marks)

b. Determine the volume of the object generated when the area between $y = x^2$ and y = x is rotated around the *x*-axis. (3 Marks)

c. The velocity of a moving point is given by the equation $v = (2t^3 + 4t + 2)m/s$. Find the path covered by the point after 5 seconds. (3 Marks)

d. Evaluate the following definite integrals

i.
$$\int_0^{\frac{\pi}{4}} \sec^2 x \tan^2 x \, dx \tag{3 Marks}$$

ii.
$$\int_0^1 2 e^{4x^3 + 3} x^2 dx$$
 (3 Marks)

e. Determine the length of the arc represented by the equation $x = \frac{2}{3}(y-1)^{\frac{3}{2}}$ on the interval (1, 4). (3 Marks) f. Show that $\int \tan x = \ln|\sec x| + c$. (3 Marks)

QUESTION TWO: (20 MARKS)

a.	Evaluate the following integrals:				
	i. $\int x(2x+1)^4 dx$	(3 Marks			
	ii. $\int \ln x dx$	(4 Marks)			
	iii. $\int x \sin x$	(4 Marks)			
	iv. $\int x e^{x^2} dx$	(3 Marks)			
	v. $\int \cos^4 x \sin^5 x dx$	(3 Marks)			

b. Suppose a population of fruit flies increases at a rate of $g(t) = 2e^{0.02t}$ per day. If the initial population of fruit flies is 100 flies, how many flies are in the population after 10 days?

(3 Marks)

QUESTION THREE: (20 MARKS)

- a. Given the function $f(x) = \frac{x^3 + 2x}{x+3}$. i) Express f(x) as $p(x) + \frac{q(x)}{r(x)}$. ii) Evaluate $\int \frac{x^3 + 2x}{x+3} dx$. (3 Marks)
- b. If the motor on a motorboat is started at t = 0 and the boat consumes gasoline at the rate of $5t t^2$ gal/hr, how much gasoline is used in the first 2 hours? (4 Marks)
- c. The parabolas $y = x^2$ and $y = \sqrt{x}$ enclose an area. Use integration methods to find the size of the area enclosed. (5 Marks)
- d. During a 9 hour work day, the production rate at time t hours was $r(t) = 5 + \sqrt{t}$ cars per hour. Find the average hourly production rate. (5 marks)

QUESTION FOUR: (20 MARKS)

a. Evaluate the following integrals:

i.
$$\int \frac{\sin^2 t}{1 - \cos t} dt$$
 (4 Marks)

ii.
$$\int \frac{x \, dx}{\sqrt{x-1}}$$
 (4 Marks)

b. Evaluate the following definite integrals:

i.
$$\int_{0}^{3} e^{2x} dx$$
 (4 Marks)

ii.
$$\int_0^{\frac{\pi}{2}} \frac{\cos x}{1+\sin x} dx$$
 (4 Marks)

c. Find $\int_0^6 y dx$ using Simpsons Rule given the following data (4 Marks)

х	0	1	2	3	4	5	6
у	4	10	12	16	6	2	1

QUESTION FIVE: (20 MARKS)

a. Find the integral of the following using trigonometric substitution:

i.
$$\int \frac{x^2 dx}{\sqrt{9-x^2}}$$
 (5 Marks)
ii.
$$\int \frac{\sqrt{x^2+1}}{x} dx$$
 (5 Marks)

- b. Use the slicing method to find the volume of the solid of revolution bounded by the graphs of $f(x) = \sqrt{4-x}$, x = 0 and x = 4, and rotated about the x-axis. (5 Marks)
- c. Find the area of the region bounded by the parabolas $y = x^2 7x + 9$ and $y = -x^2 + 3x + 1$. (5 Marks)