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

KMA 2104: INTEGRAL CALCULUS

DATE: 13TH DECEMBER. 2024
TIME: 8:30AM-10:30PM

INSTRUCTIONS TO CANDIDATES
ANSWER QUESTION ONE (COMPULSORY) AND ANY OTHER TWO QUESTIONS

QUESTION ONE: COMPULSORY (30 MARKS)

a) Evaluate the following integrals:

i) $\int x^2\sqrt{x^3+5}\,dx$ **(4 Marks)**

ii) $\int_1^4 (5x - 2\sqrt{x} + \frac{32}{X^3})\,\text{dx}$ **(4 Marks)**

iii) $\int \frac{xdx}{(x-1)(x+1)^2}\,dx$ **(3 Marks)**

b) The parabola $y = 2 - x^2$ and the line $y = -x$ encloses an area. Use integration methods to find the size of the area enclosed. **(5 Marks)**

c) The region bounded by the graph

$x^2 = y - 2, 2y - x^2 - 2 = 0, x = 0, x = 1$ is rotated $360°$about the x −axis.

Find the volume of the resulting solid **(4 Marks)**

d) A stone falls freely from the top of a cliff and its velocity v, after t seconds is given by $10t\ m/s$.

Find the distance S if it falls in 5 seconds **(5 Marks)**

e) Obtain the reduction formulae for $\boldsymbol{l_n = \int x^n e^x\,dx}$.

$\boldsymbol{Hence\ evaluate \int x^4 e^x\,dx}$ **(5 Marks)**

QUESTION TWO: (20 MARKS)

a) Use Simpson's rule with 9 ordinates correct to 4 decimal places to estimate

$\boldsymbol{\int_2^4 \frac{5\,ln\,2x}{5+ln\,2x}\,dx}$ **(7 Marks)**

b) Show that the improper integral $\boldsymbol{\int_1^\infty \frac{1}{x^2}\,dx}$ is convergent **(4 Marks)**

c) Evaluate $\boldsymbol{\int x^3\sqrt{1-x^2}dx}$ using

Integration by parts. **(4 Marks)**

d) Obtain the reduction formulae for $l_n = \int sin^n\,xdx$.

$Hence\ evaluate \int sin^4 xdx$ **(5 Marks)**

QUESTION THREE: (20 MARKS)

a) Find the integral $\int \boldsymbol{sin^3\, x\, dx}$ **(5 Marks)**

b) Find $\int \frac{\mathbf{1+x^2}}{\sqrt[4]{\mathbf{3x+x^3}}}\boldsymbol{dx}$ **(6 Marks)**

c) Find the area enclosed by the curves y=2x$-x^2$ $and\ y = 2x^2 - 4x$ **(5 Marks)**

d) Verify the fundamental theorem of calculus using the equation $\mathbf{2x^3 - 3x^2 + x - 2}$ on $[\mathbf{2, 5}]$. **(4 Marks)**

QUESTION FOUR: (20 MARKS)

a) Find $\int \frac{\boldsymbol{dx}}{\sqrt{\mathbf{1+x^2}}}\boldsymbol{dx}$ **(5 Marks)**

b) Use partial fractions to evaluate

$\int \frac{\mathbf{2x^2-11x+5}}{\mathbf{(x^2+2x-5)(x-3)}}\ \boldsymbol{dx}$ **(6 Marks)**

c) i) Evaluate $\int_0^4 \frac{1}{\sqrt{1+x^3}} dx\ using\ \boldsymbol{Simpsons\ Rule}\ with\ n = 3$ **(5 Marks)**

ii) Estimate the error involved in this approximation **(4 Marks)**

QUESTION FIVE: (20 MARKS)

a) Find $\int 2x^2\ sec(4\pi x^3 + 6)\ dx$ **(5 Marks)**

b) Evaluate the integral **I** $=\int_1^2 \frac{\mathbf{1}}{\boldsymbol{x}}\ \boldsymbol{dx}$ using trapezoidal rule using 4 equal sub intervals **(7 Marks)**

c) Evaluate the following definite integrals

$\int_0^{\pi}(\boldsymbol{x + 1})\ \boldsymbol{sin\, x\, dx}$ **(4 Marks)**

d) Using for integration find

$\int cos\ 5\ x\ cos\ 3\ x\ dx$ **(4 Marks)**