



**Strathmore**  
UNIVERSITY

SCHOOL OF TECHNOLOGY AND ENGINEERING SCIENCES (STES)  
COMPUTER NETWORKS AND CYBER SECURITY (CNS)  
END OF SEMESTER EXAMINATION  
**CNS 1204: CALCULUS II**

DATE: 14<sup>th</sup> March 2024

Time: 2 Hours

---

**Instructions**

1. This examination consists of **FIVE** questions.
2. Answer **Question ONE (COMPULSORY)** and any other **TWO** questions.

**QUESTION ONE (30 Marks)**

a) Evaluate the following indefinite integrals

i.  $\int \tan^4 x \, dx$  (4 marks)

ii.  $\int x^3 \sqrt{5+x^4} \, dx$  (4 marks)

b) Compute the following definite integrals

i.  $\int_0^{\pi} \sin^2 x \cos^2 x \, dx$  (4 marks)

ii.  $\int_{-\pi}^{\pi} \sin^3 x \, dx$  (3 marks)

c) The region bounded by the curves  $y = x$  and  $y = x^2$  is rotated about the  $x$  axis.

Compute the volume of the resulting solid. (5 marks)

d) Find the length of the parametric curve  $x = \cos 3t$  and  $y = \sin 3t$  for  $0 \leq t \leq 2\pi$  (5 marks)

- e) A population of bacteria is growing at the rate of  $\frac{dp}{dt} = \frac{3000}{1+0.25t}$  where  $t$  is the time in days. Assuming that the initial population (when  $t=0$ ) is 1000, write an equation that gives the population at any time  $t$ , and then find the population when  $t = 3 \text{ days}$  (5 marks)

**QUESTION TWO (20 MARKS)**

- a) Evaluate the following integrals:
- i.  $\int_0^1 \frac{(\tan^{-1} x)^2}{1+x^2} dx$  (5 marks)
- ii.  $\int \frac{1}{\sqrt{9x^2+4}} dx$  (6 marks)
- b) Determine the area enclosed by the curves  $y = 4 - x^2$  and  $y = 0$  (4 marks)
- c) Use fundamental theorem of calculus to determine  $\frac{d}{dx} \left( \int_{20}^{x^3} \sqrt{t^2 + 2t - 5} dt \right)$  (5 marks)

**QUESTION THREE (20 MARKS)**

- a) Evaluate  $\int_{-2}^2 f(x) dx$  given that  $f(x) = \begin{cases} 2x-1, & x \leq 0 \\ x^2-1, & x > 0 \end{cases}$  (5 marks)
- b) Obtain the reduction formula for  $I_n = \int \cos^n x dx$  hence evaluate  $\int \cos^5 x dx$  (7 marks)
- c) Use partial fractions decomposition to evaluate  $\int \frac{4x^2 - 21x}{(x-3)^2(2x+3)} dx$  (8 marks)

**QUESTION FOUR (20 MARKS)**

- a) Estimate the absolute value of the maximum error that can occur when approximating  $\int_1^2 \frac{1}{x} dx$  by the Simpson's rule with  $n = 10$  (6 marks)
- b) Evaluate  $\int_0^1 \frac{2}{1+x^2} dx$  by Simpson's and Trapezium rule with  $n=10$  (8 marks)
- c) Evaluate  $\int x^3 \sin 4x dx$  using integration by tabular form method (6 marks)

**QUESTION FIVE (20 MARKS)**

a) Calculate the integral, if it converges  $\int_{-3}^3 \frac{y}{\sqrt{9-y^2}} dy$  (6 marks)

b) Find the length of the arc  $x = \frac{1}{8}y^4 + \frac{1}{4y^2}$  from  $y = 1$  to  $y = 2$ . (4 marks)

c) A particle moves along  $s$ -axis. Use the given information to find the position function of the particle.  $\frac{d^2s}{dt^2} = 3 \sin 3t$ ,  $v(0) = 3$ ,  $s(0) = 3$  (5 marks)

d) Evaluate  $\int_0^2 x^2 e^{5x} dx$  (5 marks)