Strathmore UNIVERSITY

School of Computing and Engineering Sciences
Bachelor of Science in Telecommunications
End of Semester Examination
CNS 1103 -Differential Calculus

Date: 10^{th} *December* 2021 Time: 2 Hours

Instruction

1. Answer **QUESTION ONE** and any other **TWO QUESTIONS**

QUESTION ONE [30 Marks]

a) For the following functions, determine their domain, range and whether they are one-to-one or many-to-one;

i. $f(x) = \sqrt{x} + \frac{1}{x+11}$ [3 Marks]

ii. $l(w) = \frac{1}{w^2}$ [3 Marks]

b) Using an arrow diagram for functions, differentiate between an *into* and *onto* function. [2 Marks]

c) Evaluate the following limits:

i. $\lim_{x\to -1} \frac{3x-4}{8x^2+2x-2}$ [3 Marks]

ii. $\lim_{x\to 1} \frac{x-1}{x^2+x-2}$ [3 Marks]

iii. $\lim_{x\to 0} \frac{\sqrt{x^2+4}-2}{x^2}$ [4 Marks]

iv. $\lim_{x\to 0} \frac{Sin(x)}{x^3}$ [4 Marks]

d) Find $y^{'}$ given that:

i. $y = Sin^3(Cosx)$ [4 Marks]

ii. $y^3 = Tan(xy) + 3xy$ [4 Marks]

QUESTION TWO [20 Marks]

a) From first principles differentiate the following:

i. $y = -x^3 - 2x^2 + x - 2$ [3 marks]

ii. $y = \frac{2}{2-x}$ [3 Marks]

iii. $y = Cos(x)$ [5 Marks]

iv. $y = x^{-2}$ [3 Marks]

b) Find $y^{'}$ given that

i. $y = (\sqrt{x} - \frac{1}{\sqrt{x}})^4$ [3 Marks]

ii. $y = \sqrt{(x+3)^3 + (x-1)^4}$ [3 Marks]

QUESTION THREE [20 Marks]

a) Evaluate the following limits:

i. $\lim_{x\to 3} \frac{x-3}{\sqrt{x-2}-\sqrt{4-x}}$ [5 Marks]

ii. $\lim_{x\to\infty} \frac{x}{\sqrt{x^2+1}}$ [4 marks]

b) Find $y^{'}$ given that:

i. $y = \frac{(3x+1)^4}{(5x-2)^3}$ (Simplify your answer) [4 Marks]

ii. $x^y = y^x$ [3 Marks]

iii. $y = \frac{ln(Six(x))}{e^{Cos(x)}}$ [4 Marks]

QUESTION FOUR [20 Marks]

a) For the functions given below, give the x and y intercepts, vertical and horizontal asymptotes, point(s) of inflection, critical points, local maxima/minima and lines of symmetry if any. Further, determine whether it is increasing or decreasing on the intervals $(-1, 0)$, $(0, \infty)$ and sketch their graphs.

i. $f(x) = \frac{x^2}{\sqrt{x+1}}$ [10 Marks]

ii. $h(t) = \frac{t^2+t}{t^2+t-2}$ [10 Marks]

QUESTION FIVE [20 Marks]

a) Find $y^{'}$ given the following:

i. $y = Sin^6(Sin(5x))$ [4 Marks]

ii. $y = Cot^4(3x + 2x - 1)$ [4 Marks]

iii. $xy = \frac{Cos^4(3x)}{e^{6x}}$ [4 Marks]

b) Show that:

i. $\frac{d}{d\theta}(Sec(\theta) = Tan(\theta)Sec(\theta)$ hence evaluate $\frac{d}{d\theta}(Sec^3(3\theta))$ [4 Marks]

ii. $\frac{d}{dt}(Cot(t)) = -Cosec^2(t)$ hence evaluate $\frac{d}{dt}(Cot(ln(t)))$ [4 Marks]