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University Examinations 2013/2014

SECOND YEAR, SECOND SEMESTER EXAMINATIONS FOR DEGREE OF BACHELOR
OF SCIENCE IN INFORMATION TECHNOLOGY

SMA 2101: CALCULUS I

DATE: APRIL 2014

TIME: 2 HOURS

INSTRUCTIONS: Answer question *one* and any other *two* questions.

QUESTION ONE – (30 MARKS)

(a) Distinguish between codomain and range in relation to a function. (2 Marks)

(b) Compute the value of $f(-2)$ given that $f(x) = \frac{x^3 - x}{2}$ (2 Marks)

(c) Given that $f(x) = \frac{x-3}{2x+6}$ and $g(x) = (x+3)^2$ work out each of the following:

(i) $f^{-1}(x)$ (3 Marks)

(ii) $(fg)(x)$ (2 Marks)

(d) Use the first principles to differentiate the function $y = \frac{3}{x^2}$ with respect to x . (4 Marks)

(e) Test the continuity of the following function at the point where $x = 3$ using the idea of

limits $f(x) = \begin{cases} 2x - 5, & x > 3 \\ x - 2, & x \leq 3 \end{cases}$ (3 Marks)

(f) Evaluate the limit $\lim_{x \rightarrow 7} \frac{x^2 - 3x - 28}{x - 7}$ (3 Marks)

(g) Compute $\frac{dy}{dx}$ in each of the following equations

(i) $y = e^{2x} \sin x$ (2 Marks)

(ii) $y = 3x^2 + 4^x + \ln x$ (2 Marks)

(iii) $x^2 y^3 - y \cos x = 8$ (4 Marks)

(iv) $y = \frac{e^x}{\cos 4x}$ (2 Marks)

(h) Compute $\frac{d^2 y}{dx^2}$ given that $x = 3t^2 + 2$, $y = e^{2t^3+1}$ (3 Marks)

QUESTION TWO – (20 MARKS)

(a) List the conditions necessary for a function to be continuous at a point $x = a$. (3 Marks)

(b) Compute $\frac{dy}{dx}$ given

(i) $y = 3^x [\ln(2x + 1)]$ (4 Marks)

(ii) $x = 3t^4 - 5$ and $y = t^3 \sin t$ (4 Marks)

(iii) $4x^3 y + 8xy^3 - 3x = 5$ (4 Marks)

(c) Evaluate the integral $\int_1^3 (3 + 2y^3) dy$ (3 Marks)

QUESTION THREE – (20 MARKS)

(a) Define a function as used in calculus. (2 Marks)

(b) Evaluate the following limits

(i) $\lim_{x \rightarrow 4} \frac{2 - \sqrt{x}}{x^2 - 16}$ (4 Marks)

(ii) $\lim_{x \rightarrow \infty} \left(\frac{x^2 + 6x - 3}{4x^2 - 5x + 8} \right)$ (3 Marks)

(c) Find the inverse function of $g(x) = \frac{x-3}{5x+2}$ (4 Marks)

(d) A curve is given by the equation $x^2 + 4y^2 - 25 = 0$. Find the equations of the tangent line and normal line to this curve at the point where $x = 3$. (7 Marks)

QUESTION FOUR – (20 MARKS)

(a) Use first principles to compute $\frac{dy}{dx}$ given that $y = \sqrt{2-x^2}$ (6 Marks)

(b) Given a function $x^2 + y^2 - 4x + 8y + 11 = 0$

(i) Identify the stationary value(s) and stationary point(s) of $y(x)$ (6 Marks)

(ii) Classify each of the stationary points. (5 Marks)

(c) The function $f(x)$ and $g(x)$ are defined in the set of real numbers such that $f(x) = 3x - 1$ and $g(x) = x^2 + x$. Compute $(g \circ f)(x)$ (3 Marks)