UNIVERSITY OF SWAZILAND

Faculty of Health Sciences

DIPLOMA IN ENVIRONMENTAL HEALTH YR 1

B.Sc ENVIRONMENTAL HEALTH YR 4

MAIN EXAMINATION PAPER MAY 2011

TITLE OF PAPER	:	CALCULUS FOR HEALTH SCIENCES
COURSE TITLE	:	HSM 115
DURATION	:	2 HOURS
MARKS	:	100
INSTRUCTIONS	:	READ QUESTIONS & INSTRUCTIONS CAREFULLY
	:	ANSWER ANY FOUR (4) QUESTIONS
	:	EACH QUESTION CARRIES 25 MARKS
	:	WRITE NEATLY & CLEARLY
	:	SHOW ALL YOUR WORKING
	:	NO PAPER SHOULD BE BROUGHT INTO NOR OUT OF THE EXAMINATION ROOM
	:	BEGIN EACH QUESTION ON A SEPARATE SHEET OF PAPER

DO NOT OPEN THIS QUESTION PAPER UNTIL PERMISSION IS GRANTED BY THE INVIGILATOR

QUESTION 1

1. Find the derivatives of the following functions

    (a) $y = \sqrt{x^2 + 1}$ [8 marks]

    (b) $y = \ln\left(x^2 e^{x^3} \sqrt{2x+1}\right)$ [8 marks]

    (c) $y = (x^2 + 2x + 1)^3$ [9 marks]

QUESTION 2

2. (a) Use the limit definition of the derivative to find $f'(x)$ given that

    i. $f(x) = x^2 - x$ [8 marks]

    ii. $f(x) = \dfrac{1}{1+x}$ [8 marks]

  (b) Evaluate the following limits

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

    ii. $\displaystyle\lim_{x \to \infty} \frac{x^2 + 4x + 1}{1 - x + 2x^2}$ [5 marks]

QUESTION 3

3. (a) A company that produces and sells a product has weekly profits, in dollars, that are modeled by the function $P(x) = -2x^2 + 80x - 40$ where x is the number of units of the product sold.

    i. How many items must be produced and sold by the company in order to generate the maximum profit?   [5 marks]

    ii. What is the maximum profit?   [5 marks]

  (b) For the function $y = x^3 - 3x + 1$ find and classify all stationary points, y-intercepts, intervals of increase and decrease and sketch its graph   [15 marks]

QUESTION 4

4. Evaluate the following integrals

(a) $\displaystyle\int \left(1 + 2x + \frac{1}{x} + \frac{1}{x^2}\right) dx$ [7 marks]

(b) $\displaystyle\int \frac{2x}{\sqrt{x^2 + 1}} dx$ [6 marks]

(c) $\displaystyle\int x^3 \ln x \, dx$ [6 marks]

(d) $\displaystyle\int \frac{5x + 1}{(x - 1)(x + 2)} dx$ [6 marks]

QUESTION 5

5. (a) Evaluate the following definite integrals

    i. $\displaystyle\int_{-1}^{2} (1 - x + 2x^2) \, dx$ [8 marks]

    ii. $\displaystyle\int_{0}^{2} 2x(x^2 + 1)^2 \, dx$ [7 marks]

(b) The rate of growth of the population $N(t)$ of a new city t years after its incorporation is estimated to be

$$\frac{dN}{dt} = 400 + 600\sqrt{t}$$

If the population was 5000 at the time of its incorporation, find the population after 9 years.   [10 marks]

QUESTION 6

6. (a) The Ministry of Works and Transport is planning to build a picnic park for motorists along the Mbabane-Manzini highway. The park is to be rectangular with an area of 5000 square metres and is to be fenced off on the three sides not adjacent to the highway. What is the least amount of fencing required for this job? How long and how wide should the park be for the fencing to be minimized?   [15 marks]

(b) Find the area enclosed by the curve $y = 4 - x^2$ and the x-axis.   [10 marks]

END OF EXAMINATION