MASENO UNIVERSITY

UNIVERSITY EXAMINATIONS 2013/2014

FIRST YEAR FIRST SEMESTER EXAMINATIONS FOR THE DEGREE OF BACHELOR OF SCIENCE IN COMPUTER SCIENCE & TECHNOLOGY

(MAIN CAMPUS)

SCS 105: ENGINEERING MATHEMATICS

Date: 27th November, 2013 *Time: 11.00 a.m. - 1.00 p.m.*

INSTRUCTIONS:

a) Attempt Question ONE and any other TWO questions.

b) Question ONE carries 30 marks. Questions 2-5 carry 20 marks each.

c) SWITCH OFF you MOBILE PHONES during this exam.

PART A — 30 Marks

Question One (30 marks)

a. State the $\epsilon - \delta$ definition of a limitand compute the limit of the function $\lim_{x\to 0}\frac{\sin x}{x}$ using L'oHopital's rule. 4marks

b. Distinguish between an even function and an odd function hence show that if $f(x)$ is even the $\int_{-a}^{a} f(x)\ dx = 2\int_{0}^{a} f(x)\ dx$ 5marks

c. Use the product rule to find the differential coefficient of $y = \sin(t)\cos(3t)$. 4marks

d. Evaluate the definite integral $\int_{0}^{\pi/6} \sin(3x+2)\ dx$ 4 marks

e. If $f(x) = 2x^5 - 4x^3 + 3x - 5$ finf $f''(x)$ 4marks

f. State chain rule. Apply chain rule and product rule combined to find the first derivative of $y = e^{-3x} + \sin(2x)$ 4marks

g. Supplies are dropped from a helicoptor and the distance fallen in a time t seconds is given by $x = \frac{1}{2}gt^2$, where $g = 9.8m/s^2$. Determine the velocity and acceleration of the supplies after it has fallen for 2 seconds. 5marks

PART B — 20 Marks Each

Question Two (20marks)

a. The velocity of a spring is found to be $V = 6\sin(3\pi t)$. Assuming that the spring is perfect, so that $v = (1/k)(dF/dt)$, where k is the spring constant (known to be 0.5), v the velocity, and F the force operating on the spring, find the force, given that it is 0N initially. 10 marks

b. Express the partial fractions of $\frac{3x}{1+x-2x^2}$ and hence evaluate $\int \frac{3x}{1+x-2x^2}$

10 marks

Question Three (20marks)

A car is travelling such that its distance, s (m), from its starting position after time t (s) is

$$s = \frac{1}{15}t^3 + 2t, \qquad 0 < t < 10$$

$$s = 22(t - 10) + 86.67, \quad t \geq 10$$

i. What is its average velocity in the first 10 s?
ii. Give the velocity as a function of time.
iii. What is the instantaneous velocity when (i) $t = 5$, (ii) $t = 10$, and (iii) $t = 15$?
iv. What is the average acceleration for the first 10 s?
v. What is the average acceleration between $t = 10$ and $t = 15$?
vi. Give the acceleration as a function of time.
vii. What is the instantaneous acceleration when (i) $t = 5$, (ii) $t = 10$, and (iii) $t = 15$?

20 marks

Question Four (20 marks)

Derive the integration by parts formula and use it to find

$$\int x \frac{x}{(x^2+1)} dx$$

20marks

Question Five(20marks)

h. The potential due to a point charge Q at a position r from the charge is given by $V = \frac{Q}{4\pi\varepsilon_0 r}$ where ε_0, the permittivity of free space, $\approx 8.85 \times 10{-}12$ Fm−1 and $\pi \approx 3.14$. Given that $Q = 1$ C, find the electric field strength at a distance of 5m using $E = -\mathrm{d}V/\mathrm{d}r$. 10marks

i. Find the area enclosed between the x *axis* and the curve $y = x^3 + 2x^2 + x + 1$ between $x = -1$ and $x = 2$ 10marks.