TECHNICAL UNIVERSITY OF MOMBASA

Faculty of Applied & Health Sciences

DEPARTMENT OF MATHEMATICS & PHYSICS

UNIVERSITY EXAMINATION FOR DEGREE OF:

BACHELOR OF SCIENCE IN FOOD QUALITY
BACHELOR OF TECHNOLOGY IN APPLIED CHEMISTRY
(BSFQ 14/BTAC 14)

AMA 4105: CALCULUS FOR SCIENCE

END OF SEMESTER EXAMINATION
SERIES: APRIL 2015
TIME ALLOWED: 2 HOURS

Instructions to Candidates:
You should have the following for this examination
- *Mathematical tables*
- *Scientific Calculator*

This paper consist of **FIVE** questions
Answer question **ONE (COMPULSORY)** and any other **TWO** questions
Maximum marks for each part of a question are as shown
This paper consists of **THREE** printed pages

Question One (Compulsory)

a) Let $g : \Re \to \Re$ be defined by

$$g(x) = \begin{cases} 2x^6 - 4 & x \geq 1 \\ 3x + 3 & x < 1 \end{cases}$$

Find: (i) g(2)
(ii) g(0)
(iii) g(-3)   **(3 marks)**

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b) Evaluate
$$\lim_{x \to 1} \frac{x^3 - 1}{x - 1}$$
(4 marks)

c) Find $\dfrac{dy}{dx}$ if: (i) $y = x^2 \sec x$

(ii) $x^2 + 2xy + y^2 = 3$ **(4 marks)**

(iii) $x = t^3 + t^2, \;\; y = t^2 + t$ at t = 1 **(4 marks)**

d) Find the equation of the tangent at the point (1, -1) to the curve $y = 2 - 4x^2 + x^3$ **(5 marks)**

e) Determine the following integrals:

(i) $\displaystyle\int_1^1 (2x - 1)^2 \, dx$ **(3 marks)**

(ii) $\displaystyle\int_0^{\pi/2} \cos 3x \, dx$ d **(2 marks)**

(iii) $5xe^{4x} dx$ **(2 marks)**

Question Two

a) (i) Identify the maximum and minimum values of the function $y = x^3 - 4x + 2$ **(8 marks)**

(ii) Sketch the graph of the function in (i) clearly showing the y-intercept and turning points

b) Viewed through a microscope a bacterium is seen to move in accordance with the equation

$$S = \left(4t + 6t^2\right) \times 10^{-6}$$

Find:
    (i) The distance travelled between 0 and 45 seconds **(3 marks)**
    (ii) The velocity after 30 seconds **(3 marks)**
    (iii) The acceleration after 30 seconds **(1 mark)**

Question Three

a) Evaluate $\displaystyle\int_1^2 x \ln x \, dx$ correct to 4 significant figures **(7 marks)**

b) A gas expands according to the law
    PV = constant

When the volume is 3m^3 the pressure is 150kPa given that the work done $\int_{v1}^{v2} Pdv$, determine the work done as the gas expands from 2m^3 to 6m^3 **(6 marks)**

c) Find the equation of:
   (i) Tangent **(4 marks)**
   (ii) Normal **(3 marks)**

to the curve $y = 1 + x - x^2$ at (-2, -5)

Question Four

a) Determine the integral:
$$\int \frac{2x^2 - 9x - 35}{(x+1)(x-2)(x+3)}\ dx$$

(10 marks)

b) (i) Sketch the area enclosed by the curve $y = 4x - x^2$ and the x-axis, clearly indicating the turning points and intercepts on your sketch **(7 marks)**
   (ii) Find the area in (i) **(3 marks)**

Question Five

a) Differentiate w.r.t x if:
   (i) $x \tan y = y^3 \cos x$ **(6 marks)**
   (ii) $x = t^2,\ y = t - 2t^2,\ at\ t = 1$ **(4 marks)**

b) Find the length of the curve $y^2 = x^3$ between x = 0 and x = 4 **(6 marks)**

c) Determine the area bounded by the curve $y = 3e^{t/4}$, the t –axis and the ordinates at t = -1 and t = 4 correct to 4 significant figures **(4 marks)**