TECHNICAL UNIVERSITY OF MOMBASA
FACULTY OF ENGINEERING & TECHNOLOGY

DEPARTMENT OF BUILDING AND CIVIL ENGINEERING
DIPLOMA IN CIVIL ENGINEERING
DIPLOMA IN QUANTITY SURVEY

AMA 2151 ENGINEERING MATHEMATICS II

END OF SEMESTER EXAMINATIONS

SERIES: AUGUST 2019

TIME ALLOWED: 2 HOURS

Instructions to Candidates:

1. You should have the following for this examination
   - Answer Booklet
   - Scientific Calculator. Programmable calculators are prohibited.

2. This paper consists of FIVE questions. Answer ANY THREE questions
3. Maximum marks for each part of a question are as shown
4. Use neat, large and labeled diagrams where required
5. Each new question to begin on a new page

QUESTION ONE

i. Differentiate from first principle $f(x) = x^2$ and determine the value of the gradient of the curve at $x = 2$. **(6 marks)**

ii. Differentiate, with respect to x, $y = 5x^4 + 4x - \frac{1}{x^2} + \frac{1}{\sqrt{x}}$ **(6 marks)**

iii. Find the gradient of the curve $y = 3x^4 - 2x^2 + 5x - 2$ at the points (0, -2) and (1, 4). **(4 marks)**

iv. Find the derivative of $y = \sec 3x$. **(4 marks)**

QUESTION TWO

i. The length l metres of a certain metal rod at temperature θ° C is given by $l = 1 + 0.00005\theta + 0.0000004\theta^2$. Determine the rate of change of length in mm/°C, when the temperature is:

(a) 100° C

(b) 450° C. **(6 marks)**

ii. The distance x metres moved by a car in a time t seconds is given by $x = 3t^3 - 2t^2 + 4t - 1$. Determine the velocity and acceleration when;

(a) t =0 and

(b) t =1.5s. **(6 marks)**

iii. Find the coordinates of the maximum and minimum values of the curve $y = x^3 - 3x + 5$.

(4 marks)

iv. Differentiate $y = e^{cos\ 2x} + In\ (sin\ 2x)$. **(4 marks)**

QUESTION THREE

i. Determine the equations of the tangent and normal to the curve $y = \frac{x^3}{5}$ at the point (-1, - $\frac{1}{5}$). **(6 marks)**

ii. Determine the equation of the tangent drawn to the ellipse x =3 $\cos\theta$, $y = 2\sin\theta$ at θ $= \frac{\pi}{6}$. **(4 marks)**

iii. Differentiate $y = \frac{x^3 In\ 2x}{e^x \sin x}$. **(6 marks)**

iv. A rectangular block of metal with a square cross-section has a total surface area of 250 cm^2. Determine the maximum volume of the block of metal. **(4 marks)**

QUESTION FOUR

i. Find $\frac{dy}{dx}$ given $y = sin^{-1}5x^2$ **(4 marks)**

ii. An open, rectangular fish tank is to have a volume of $13.5m^3$. Determine the least surface area of glass required. **(6 marks)**

iii. Find first derivative given, $y = cosech\ \theta$. **(2 marks)**

iv. If *z* =5*x*4 +2*x*3*y*2 -3*y* find:

(a) $\frac{\partial z}{\partial x}$

(b) $\frac{\partial z}{\partial y}$ **(4 marks)**

v. The height of a right circular cone is increasing at 3mm/s and its radius is decreasing at 2mm/s. Determine, correct to 3 significant figures, the rate at which the volume is changing (in cm^3/s) when the height is 3.2 cm and the radius is 1.5 cm. **(4 marks)**

QUESTION FIVE

i. An open rectangular container is to have a volume of $32m^3$. Determine the dimensions and the total surface area such that the total surface area is a minimum. **(6 marks)**

ii. The time of oscillation, t, of a pendulum is given by $t = 2\pi\sqrt{\frac{l}{g}}$ where *l* is the is the length of the pendulum and g the free fall acceleration due to gravity. Determine:

(a) $\frac{\partial t}{\partial l}$

(b) $\frac{\partial t}{\partial l}$ **(6 marks)**

iii. Find $\frac{dy}{dx}$ given $4x^2 + 2x\,y^3 - 5\,y^2 = 0$ **(4 marks)**

iv. If $f(x) = 2.5x^2 - 6x + 2$, determine the coordinates at the point at which the gradient is – 1. **(4 marks)**