TECHNICAL UNIVERSITY OF MOMBASA

Faculty of Applied & Health Sciences

DEPARTMENT OF MATHEMATICS & PHYSICS

UNIVERSITY EXAMINATION FOR DEGREE OF:

BACHELOR OF TECHNOLOGY IN RENEWABLE ENERGY
BACHELOR OF TECHNOLOGY IN APPLIED PHYSICS

AMA 4216: CALCULUS FOR TECHNOLOGISTS II

END OF SEMESTER EXAMINATION
SERIES: DECEMBER 2014
TIME ALLOWED: 2 HOURS

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

This paper consist of **FOUR** 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 **TWO** printed pages

Question One (Compulsory)

a) Using reduction formulae, evaluate $\int \tan^5 x\,dx$ **(3 marks)**

b) If $f(x,y,z) = xy + yz$ and T consists of those points (x, y, z) in space that satisfy the inequalities $-1 \le x \le 1,\ 2 \le y \le 3$ and $0 \le z \le 1$. Find the triple integral order this region. **(4 marks)**

c) With n = 10 apply Simpsons approximation to $\int_0^1 e^{x^2}dx$ **(4 marks)**

d) Using Maclaurin's series expansion, find the first five terms of the function $f(x) = e^{3x}$ **(6 marks)**

e) Solve the initial value problem (IVP) for y if $\frac{d^2y}{dx^2} = 6x^2 - 5x$ given that $\frac{dy}{dx} = 0$ and y = 2 when x = 1 **(7 marks)**

Question Two

a) If $z = 2x^2 - 3xy + 4y^2$. Find z_x, z_y, z_{xx} and z_{yy} hence prove that $z_{xy} = z_{yx}$ **(6 marks)**

b) Find the length of the arc of the curve $x = t^2 \quad y = t^3$ that lies between the points (1, 1) and (4, 8) **(5 marks)**

c) Find $\int \frac{5x-4}{2x^2+x-1}\, dx$ act **(5 marks)**

d) Determine $\int_2^3 \frac{dx}{3x+1}$ **(4 marks)**

Question Three

a) Determine $\int e^{2x} \sin 3x dx$ **(2 marks)**

b) Find the total derivative $\frac{dz}{dt}$ when $z = x^2 + 3xy + 5y^2$ where $x = \sin t$ and y = cot t **(4 marks)**

c) Given $\sin 45^o = \frac{1}{\sqrt{2}}$ and $\cos 45^o \frac{1}{\sqrt{2}}$ approximate $\sin 44^o$ by use of a Taylors' series expansion up to x^3 **(7 marks)**

d) A ball is dropped from a height 6m and begins bouncing the height. Find the total distance travelled by the ball before it rests if each subsequent bounce is ¾ the previous height covered. **(7 marks)**

Question Four

a) Use Trapezoidal rule to approximate $\int_1^2 \frac{1}{x} dx$ with n = 5 **(4 marks)**

b) Find the volume of a solid that is obtained when the region under the curve $y = \sqrt{x}$ over the interval (1, 4) is revolved about the x- axis **(5 marks)**

c) Evaluate

$$\int x^2 e^x dx$$

(5 marks)

d) Determine the mass and centre of mass of a triangular lamina with vertices (0, 0), (1, 0) and (0, 2) if the density function is

$$\rho(x, y) = 1 + 3x + y$$

(6 marks)

Question Five

a) Evaluate

$$\int \sqrt{\tan x} \sec^2 x dx$$

(3 marks)

b) Determine the double integral

$$\int_0^1 \int_x^{x-1} \left(x^2 + e^y\right) dy dx$$

(5 marks)

c) A ball is thrown upward with a speed of 48m/s from the edge of a cliff 100m above the ground. Find its height above the ground t seconds later. When does it reach its maximum height? When does it hit the ground? **(5 marks)**

d) Evaluate:

$$\int \frac{x^2 + x - 2}{3x^3 - x^2 + 3x - 1} dx$$

(7 marks)