



TECHNICAL UNIVERSITY OF MOMBASA
Faculty of Applied & Health
Sciences

DEPARTMENT OF MATHEMATICS & PHYSICS
UNIVERSITY EXAMINATION FOR DEGREE OF:
**BACHELOR OF SCIENCE IN INFORMATION COMMUNICATION
TECHNOLOGY**

AMA 4216: MATHEMATICS FOR BIOLOGISTS

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) Find the derivatives of the function below using the first principles:

$$y = x^3 + 3$$

(4 marks)

b) Integrate the following functions:

$$\int 6x(3x^2 + 4)dx$$

(i)

(4 marks)

$$\int \frac{2x^3 - 3x}{4x} dx$$

(ii)

(3 marks)

(iii) $\int 4 \cos(3x^2 + 2) dx$ (4 marks)

- c) Suppose that the average salesperson for office supplies drives $\mu = 1200$ miles per month in a company car, with standard deviation $\sigma = 150$ miles. Assume that the number of miles driven is closely approximated by a normal curve. Find the percent of all drivers travelling:
- (i) Between 1200 and 1600 miles per month (4 marks)
 - (ii) Between 1000 and 1500 miles per month (4 marks)

- d) The number of action potentials produced by a nerve, t seconds after a stimulus, is given by:

$$N(t) = 25t + \frac{4}{t^2 + 2} - 2$$

Find the rate of action potentials produced by the nerve (3 marks)

- e) Suppose a machine is designed to produce metal rods having mean length 120mm and standard deviation 4mm. What conclusions would be made about the machine, if a random sample of the 50 rods had mean length 120.97mm? Test at 5% level of significance (4 marks)

Question Two

$$y = 2xe^{-3x} \quad \frac{d^2y}{dx^2} + 6\frac{dy}{dx} + 9y = 0$$

- a) Given $y = 2xe^{-3x}$ show that $y = x^2 - 3x + 2$ (7 marks)

- b) Find the equation of the tangent to the curve $y = x^2 - 3x + 2$ at the point where it cuts the y-axis (5 marks)

- c) Find the area under the standard normal distribution.

$$\Pr(0 \leq z \leq 2.5)$$

- (i) (2 marks)

$$\Pr(z > 2.5)$$

- (ii) (2 marks)

$$\Pr(-1 \leq z \leq 1.5)$$

- (iii) (2 marks)

- (iv) To the left of $Z = -1.83$ (2 marks)

Question Three

- a) The displacement x metres travelled by a vehicle in time t seconds after the brakes are applied is given

$$x = 20t - \frac{5}{3}t^2$$

by \dots . Determine:

- (i) The speed of the vehicle (in km/h) at the instant the brakes are applied (4 marks)
- (ii) The distance the car travels before it stops (4 marks)

$$\int_2^5 (6x^2 - 3x + 5) dx$$

b) Evaluate (4 marks)

$$x^2 + 2xy - 2y^2 + x = 2$$

c) Differentiate with respect to x hence find the gradient at the point (-4, 1) (4 marks)

$$\theta = \theta_0 e^{-kt}$$

d) The Newton's Law of cooling is given by: $\theta = \theta_0 e^{-kt}$, where the excess temperature at zero time is $\theta_0 C$ and at the t seconds is $\theta^6 C$. Determine the rate of change of temperature after 40s, given that $\theta_0 = 16^\circ C$ and $K = 0.03$ (4 marks)

Question Four

a) The relationship between the length (in metres) and weight W(in kgms) of a species of fish in the pacific ocean is given by $W = 10.375L^3$. The rate of growth in length is given by

$$\frac{dL}{dt} = 0.36 - 0.18L$$

where t is measured in years.

$$\frac{dW}{dt}$$

(i) Determine a formula for the rate of growth in weight in terms of L (3 marks)

(ii) If a fish weighs 30 kilograms approximate its rate of growth in weight using formula found in (i) above (5 marks)

b) Determine the coordinates and nature of any turning points on the curve represented by the function $y = x^3 - 7.5x^2 - 18x + 6$ (8 marks)

$$\int \frac{2x^3 - 3x}{4x} dx$$

c) Evaluate (4 marks)

Question Five

$$y = 2x - x^2$$

a) Given $y = 2x - x^2$, determine the approximate change in y if, x changes from 2.50 to 2.51 (5 marks)

b) Sixty percent of the applicants to TUM are accepted. What is the probability that exactly four of the next five applicants will be accepted? (4 marks)

c) Evaluate:

$$\frac{d}{dx} [\ln(2x^3)]$$

(i) (4 marks)

$$\frac{dy}{dx} \quad y = (x + 2)^x$$

(ii) when $x = -1$ given (7 marks)

