



TECHNICAL UNIVERSITY OF MOMBASA

FACULTY OF HEALTH AND APPLIED SCIENCES

DEPARTMENT OF MATHS & PHYSICS

UNIVERSITY EXAMINATION FOR:

DIPLOMA IN ELECTRICAL & ELECTRONIC ENGINEERING

DIPLOMA IN MECHANICAL ENGINEERING

AMA2151 ENGINEERING MATHEMATICS 2

END OF SEMESTER EXAMINATION

SERIES: APRIL / MAY 2016 SERIES

TIME: 2HRS

DATE: APRIL / MAY 2016

Instructions to Candidates

You should have the following for this examination

-Answer Booklet, examination pass and student ID Mathematical table, calculator, no mobile phone

This paper consists of **FIVE** questions. Attempt question ONE (Compulsory) and any other TWO questions.

Do not write on the question paper.

QUESTION ONE

a) (i) Differentiate from first principles $f(t) = kt^4$ (3 Mks)

(ii) Given $x^3 + Y^3 - 3axy$ find $\frac{dy}{dx}$ (2Mks)

(iii) Find the gradient at the point (1, 1) on the curve

$$Y = \frac{(x^3 + 4x + 1)}{(x^2 + 2x + 3)}$$
 (4 Mks)

b) (i) If $f(x) = 4x^3 - 2x^2 - 3x + 1$ find

$$\frac{f(1+b) - f(1)}{b}$$
 (3Mks)

(ii) If box with sides of length x, y, z mm is expanding along the x and y sides at a rate of 2 and 3 mm per second but contracting along the z side at a rate of 4mm per second. Find the rate of change of volume when $x=y=10\text{mm}, z=20\text{mm}$ (4 Mks)

(iii) If $S = a \sin wt$ where a and w are constants prove that

$$\frac{ds}{dt} = \pm w \sqrt{a^2 - s^2} \quad \frac{d^2s}{dt^2} = -w^2s \quad (4\text{Mks})$$

c) (i) Evaluate

$$I = \int (2x^3 - 5x^2 + 6x - 9) dx \quad (2\text{Mks})$$

(ii) Determine $\int_0^{\frac{\pi}{2}} (\sin x - \cos x) dx$ (2Mks)

(iii) Sketch the graph $y = x^3 + 2x^2 + x + 1$ between $x = -1$ and $x = 2$ and determine the area enclosed between the curve, the x -axis and between the $x = -1$ and $x = 2$ (4Mks)

d) Find the mean value of $y = 3x^2 + 4x + 1$ between $x = -1$ and $x = 2$ (2Mks)

QUESTION TWO

a) Find (i) $\lim_{n \rightarrow \infty} \frac{3n^2 - 7n - 10000}{2n^2 + n - 4}$ (3Mks)

(ii) Show that $\lim_{x \rightarrow 2} \frac{3x}{2x+1} = \frac{3}{5}$ (3Mks)

(iii) Evaluate: $\lim_{x \rightarrow 3} \frac{2+x}{3-7x}$ (3Mks)

b) (i) Determine algebraically, from first principles the gradient of the graph of $y = 5x^2 + 2$ at the point p where $x = -1.6$ (4Mks)

(ii) Investigate the stationary points on the graph of $y = x^2 e^{-x}$ and sketch the curve (7Mks)

QUESTION THREE

a) (I) Given that $h(x) = x^2 - x$ find the values of

(i) $h(10)$ (2Mks)

(ii) $h(t+1)$ (2Mks)

(iii) $h(5k)$ (2Mks)

(II) If $f(x) = 7x$ and $g(x) = x+3$ and $fg : x \rightarrow y$ express as simply as possible the rule which maps x onto y . Find the values of p, q, r such that

- i) $fg : 5 \rightarrow p$ (2Mks)
- ii) $fg : 10 \rightarrow q$ (2Mks)
- iii) $fg : r \rightarrow 35$ (2Mks)

b) (i) prove the identity $\cosh^2 x - \sinh^2 x = 1$ from the definition (3Mks)

(ii) Prove that $\sinh^{-1} x = \ln\{x + \sqrt{1+x^2}\}$ (3Mks)

QUESTION FOUR

a) (i) Find $\int \frac{1}{\sqrt{(x^2+2x+10)}} dx$ by completing the square and substitution of

$$x+1 = 3\sin \theta. \quad (4Mks)$$

(ii) Find $I = \int \sqrt{a^2-x^2} dx$ by putting $x = a \sin \theta$ (4Mks)

b) (i) Integrate $\frac{1}{(x+1)^2(x+4)}$ (6 mks)

(ii) Find $I = \int x \sin x dx$ (3Mks)

(iii) If $\tanh x = 1/3$ what is $\operatorname{sech} x$? (3Mks)

QUESTION FIVE

a) Evaluate

(i) $I = \int_1^2 \int_0^{\pi} \int_0^{\pi} (3 + \sin \theta) d\theta dr$ (3Mks)

(ii) $I = \int_1^2 \int_0^3 \int_0^1 (p^2+q^2-r^2) dpdqdr$ (4Mks)

b) Show that

(i) $V = (Ar^n + B/r^n) \cos(n\theta - \phi)$
Satisfies the equation

$$\frac{d^2v}{dr^2} + \frac{1}{r} \frac{dv}{dr} + \frac{1}{r^2} \frac{d^2v}{d\theta^2} = 0 \quad (6Mks)$$

(ii) If $z = \sin(x+y)$ where $x = \mu^2 + v^2$ and $y = 2\mu v$ find

$$\frac{dz}{d\mu} \text{ and } \frac{dz}{dv} \quad (7Mks)$$