



TECHNICAL UNIVERSITY OF MOMBASA
Faculty of Applied & Health
Sciences

DEPARTMENT OF MATHEMATICS & PHYSICS
CERTIFICATE IN MECHANICAL ENGINEERING (Y1 SII)

AMA 1150: ENGINEERING MATHEMATICS

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

Instructions to Candidates:

You should have the following for this examination

- *Answer Booklet*

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) A stone thrown vertically upwards covers a distance defined by the equation:

$$s = 3 + 14t - \frac{1}{2}(10)t^2$$

where S is distance in metres and t is time in seconds. Determine:

- (i) The time it takes to reach maximum height
- (ii) How high it reaches
- (iii) The total time it takes between the time it is thrown to the time it gets back to the thrower. **(10 marks)**

- b) Solve for θ in the trigonometric equation $\cos^2 \theta + 2 \sin \theta + 1 = 0$ **(6 marks)**

- c) Determine the angles in a triangular template of sides 6.42cm, 8.31cm and 9.78cm **(8 marks)**

- d) Differentiate from first principles:
 $y = 3x^2$ **(6 marks)**

Question Two

- a) In a G.P series, the eighth term is eight times the fifth and the sum of the sixth and the seventh term is 288. Determine:
(i) The common ratio
(ii) The first term **(5 marks)**

- b) Show that the sum of the first n terms of an arithmetic progression with first term as 'a' and common difference as 'd' is:

$$S_n = \frac{n}{2}(2a + (n-1)d)$$

(4 marks)

- c) The eighth term of an arithmetic progression is twice the third term and the sum of the first eight terms is 39.
(i) Determine the first three term

$$S_n = \frac{3n}{8}(n+5)$$

(11 marks)

- (ii) Show that the sum of the first n-terms

Question Three

- a) Sketch the curves for following trigonometric functions between 0° and 360°
 $y = \cos x$

(i)

$$y = \sin x$$

(ii)

$$y = \tan x$$

(iii)

(6 marks)

- b) A man leaves a town walking at a steady speed of 6km/hr in the direction S30°W. Another man leaves the same town cycling at a steady speed in a direction S23°E. After 4.0 hours the two men are 100KM apart. Determine the speed of the cyclist. **(8 marks)**
- c) A room 9m wide has a span roof which slopes at 32° on one side and 41° on the other. Determine the length of the roof slopes. **(6 marks)**

Question Four

$$z = \frac{1 + j3}{1 - j2}$$

- a) Given $z = \frac{1 + j3}{1 - j2}$, evaluate z^2 in the form $a + jb$ **(6 marks)**

- b) Express in polar form:

$$-5 + j$$

(i)

$$+4 + j3$$

(ii)

- b) Express in Cartesian form:

$$8 \angle 150^\circ$$

(i)

$$3.6 \angle -25^\circ$$

(ii)

(10 marks)

- c) Find the magnitude and direction of the resultant of the forces:

$$F_1 = (3 - j17)$$

Newtons

$$F_2 = (10 - j2)$$

Newtons

$$F_3 = -8 + j2$$

Newtons

(4 marks)

Question Five

- a) A mould for a family loaf is to take the shape of rectangle with a semi-cylindrical roof with 10cm width, 18cm long and 12cm high excluding the cylindrical portion. Sketch the mould and determine its volume. **(6 marks)**

$$\frac{dy}{dx}$$

- b) Determine $\frac{dy}{dx}$ given

$$y = \frac{2 \sin x}{x^2}$$

(i)

(ii) $y = 2x^2e^{2x}$

(9 marks)

- c) Determine the gradient of the curve $y = 4x^3 - 3x^2 + 2x - 4$ at point (1, -1)

(3 marks)

- d) Find $\frac{dy}{dx}$ given $y = 13 - \frac{3}{2x}$

(2 marks)