TECHNICAL UNIVERSITY OF MOMBASA

Faculty of Applied & Health Sciences

DEPARTMENT OF MATHEMATICS & PHYSISCS

DIPLOMA IN BUILDING & CIVIL ENGINEERING
(DBCE/ARC 14J)

AMA 2150: ENGINEERING MATHEMATICS I

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

Instructions to Candidates:
You should have the following for this examination
- *Answer Booklet*
- *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 **FOUR** printed pages

Question One (Compulsory)

a) Define the following terms as used in Mathematics:

(i) An equation **(1 mark)**

(ii) A sequence **(1 mark)**

b) Simplify the following equation giving the result without functional indices.

$$F = \sqrt[3]{a^6b^3} \div \sqrt{\frac{1}{9}a^4b^6} \times \left(4\sqrt{a^6b^2}\right)^{\frac{-1}{2}}$$

(4 marks)

c) Show that the sum of n terms of an arithmetic series is given by:

$$Sn = \frac{n}{2}\left(2a + (n-1)d\right)$$

where a is the first term, n is the number of terms and d is the common difference. **(5 marks)**

d) Insert three geometric means A, B and C between 56 and 896 **(3 marks)**

e) Simplify the following:

(i) J^{42}

(ii) J^{11}

(iii) J^{7} **(3 marks)**

f) Express the following in Cartesian Form:

$$e^{1-j\pi/4}$$

(3 marks)

g) Given that $Log_aN = n$ and $Log_bN = m$ show that $\log_b N = \frac{\log_a N}{\log_a b}$ and hence find $\log_7 83.64$ **(4 marks)**

h) Solve for x in the following equation: $7\left(14.3^{x+5}\right) \times 6.24^{2x} = 294$ **(3 marks)**

i) Rewrite the following without logarithms:

(i) $\log W = 2(\log A + \log W) - (\log 32 + 2\log\pi + 2\log r + \log c)$ **(1 mark)**

(ii) $\log S = \log K - \log 2 + 2\log\pi + 2\log n + \log Y + \log r + 2\log L - 2\log h - \log g$ **(1 mark)**

(iii) $\ln I = \ln(2v) - \ln(kR + r) - \ln K + KL\}$ **(1 mark)**

Question Two

a) Derive the quadratic equation formular and hence solve the following equation below:

$$2x^2 - 3x - 4 = 0$$

(6 marks)

b) State whether or not the following can each be expressed as product of linear factors.

(i) $2x^2 - 9x + 18 = 0$ **(1 mark)**

(ii) $x^2 - 11x + 28 = 0$ **(1 mark)**

(iii) $x^2 + 5x - 24 = 0$ **(1 mark)**

(iv) $x^2 - 4x - 21 = 0$ **(1 mark)**

c) Solve for the unknowns in the following set of equations:

$$5(x+2y) - 4(3x+4z) - 2(x+3y-5z) = 16$$
$$2(3x-y) + 3(x-2z) + 4(2x-3y+z) = -16$$
$$4(y-2z) + 2(2x-4y-3) - 3(x+4y-2z) = -62$$

(7 marks)

d) The 6th term of an AP is -23 and the 10th term is -35. Find the first term, the common difference and the sum of the first 15 terms of the series. **(3 marks)**

Question Three

a) Given that $(a+b) + j(a-b) = 7 + j2$. Find the values of a and b **(3 marks)**

b) Transpose the formular below to make f the subject:

$$\frac{R}{r}\sqrt{\frac{f+p}{f-p}}$$

(4 marks)

c) Show that $\log_a b = \frac{1}{\log_b a}$ **(3 marks)**

d) Solve for the unknowns in the following set of equations below: **(6 marks)**

$$\frac{2x-1}{5} + \frac{x-2y}{10} = \frac{x+1}{4}$$
$$\frac{3y+2}{3} + \frac{4x-3y}{2} = \frac{5x+4}{4}$$

(6 marks)

e) Differentiate between an infinite and a finite sequence. **(2 marks)**

f) Given the following:

$$\sum_{n-1}^{\infty}(2n+3)$$

$$\sum_{n=1}^{6} un$$

Find (i) **(1 mark)**

$$\sum_{n=3}^{7} U_n$$

(ii) **(1 mark)**

Question Four

a) Show that:

$$\log_2 x + \log_3 x + \log_4 x = 7.079 \log_{10} x$$

(3 marks)

b) Show that $\sin^2 x + \cos^2 x = 1$ and hence derive the subsequent trigonometric identities **(7 marks)**

c) Solve for x in the equation below:

$$2\log_{10} x = 4$$

(3 marks)

d) Given that $U_n = n^2 + 3n + 1$, determine an expression for $\sum_{1}^{n} n^2 + 3n + 1$ **(6 marks)**

e) Name the two parts that make up a complex number. **(1 mark)**

Question Five

a) Given the following equation, make q the subject of the formular:

$$pq^2 + rq + z = 0$$

(2 marks)

b) Show that $e^{j\theta} = \cos\theta + j\sin\theta$ **(6 marks)**

c) Express the following in polar form:

$$z = 4 + j3$$

(2 marks)

d) Solve the following set of simultaneous equations:

$$3x + 2y - z = 19$$

$$4x - y + 2z = 4$$

$$2x + 4y - 5z = 32$$

(4 marks)

e) Determine the antilogs to the given base of the following:

(i) Antilog $\bar{3}.1267$ to base 10 **(1 marks)**

(ii) Antilog 1.263 to base 5 **(1 mark)**

(iii) Antilog 4.6234 to base e **(1 mark)**

f) Draw an Argand diagram to represent the vectors:

(i) $z_1 = 2 + j3$ **(1 mark)**

(ii) $z_1 = 2 + j3$ **(1 mark)**

(iii) $z_3 = -4 - j5$ **(1 mark)**