TECHNICAL UNIVERSITY OF MOMBASA

Faculty of Engineering & Technology

DEPARTMENT OF MECHANICAL & AUTOMOTIVE ENGINEERING

DIPLOMA IN MERINE ENGINEERING (Y II S I)

EMR 2121: ENGINEERING MATHEMATICS III

END OF SEMESTER EXAMINATION
SERIES: APRIL 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) An arithmetic progression has thirteen terms whose sum is 143, the third term is five. Determine:

(i) Common difference

(ii) First term **(6 marks)**

b) A piece of equipment cost a factory ksh 600,000. If it depreciates in value, 15% the first year 13.5% the second year, 12% the third year and so on. If these percentages are all applying to the original cost, determine the value of the equipment after 10 years. **(8 marks)**

c) A company predicts a yearly profit of ksh 120,000 in the year 2013. The company predicts that the yearly profit will rise by 5% each year. Determine:

(i) The predicted profit in 2016

(ii) The first year the predicted profit exceeds ksh 200,000

(iii) The total profit from year 2013 to year 2023. **(12 marks)**

d) The second term of a G.P is 24 and its sum to infinity is 100. Find the two possible values of the common ratio. **(4 marks)**

Question Two

a) Determine the inverse of the matrix:

$$A = \begin{pmatrix} 5 & -3 \\ -2 & 1 \end{pmatrix}$$

and hence show that $A \bullet A^{-1} = I$ where A^{-1} in the inverse of matrix A, and I is the unit matrix. **(5 marks)**

b) A force system is analyzed and by resolving the forces horizontally and vertically the following equations are obtained:

$$6F_1 - F_2 = 5$$
$$5F_1 + 2F_2 = 7$$

(7 marks)

Use the inverse matrix method to solve for F_1 and F_2

c) A vector system to determine the shortest distance between two moving bodies is analyzed, producing the following equations.

$$11S_1 - 10S_2 = 30$$
$$21S_2 - 20S_1 = -40$$

use the determinants method to find the values of S_1 and S_2.

Use the determinants method to find the values of S1 and S2 **(8 marks)**

Question Three

a) Sketch the curves for the following trigonometric functions for $O^o < \theta < 360^o$:

(i) $y = \sin \theta/2$

(ii) $y = \cos \theta/2$

(iii) $y = \tan \theta$ **(4 marks)**

b) A certain triangular template has the following side length 17cm, 13cm and 18cm respectively. Determine the angles between the sides. **(9 marks)**

c) Solve for θ in the equation for $O^o < \theta < 360^o$

$$\sec^2 = 3\tan\theta - 1$$

(7 marks)

Question Four

a) An arc of length 5.67cm sub tends an angle of 2.15 radians to the centre of a circle. Determine:

(i) The diameter of the circle

(ii) The circumference of the circle **(6 marks)**

b) Find the angle in radians subtended at the centre a circle of diameter 23.0mm by an arc of length 31.0mm. **(4 marks)**

c) For a circle defined by the equation $2x^2 + 2y2 \ -8x + 5y + 10 = 0$. Determine:

(i) The radius

(ii) The coordinates of the centre **(10 marks)**

Question Five

a) The earth's diameter is 12740km. Determine the length of the arc on the greater circle of the earth that subtends 1° to the centre of the earth in nautical miles. **(4 marks)**

b) Find the distance between points P (40°N, 50°E) and Q (20° 30' S, 50°E) in:

(i) Nautical miles (Nm)

(ii) Kilometeres **(8 marks)**

c) A ship leaves Mombasa (4°S, 39°E and sails due east for 98 hours to a point E (4°S, 80°E) in the Indian ocean. Calculate its average speed in:

(i) Km/hr
(ii) Knots **(8 marks)**