TECHNICAL UNIVERSITY OF MOMBASA

Faculty of Applied & Health Sciences

DEPARTMENT OF MATHEMATICS & PHYSISCS

DIPLOMA IN ELECTRICAL ENGINEERING & ELECTRICAL POWER ENGINEERING
(DEEE I, DEPE I)

AMA 2150: ENGINEERING MATHEMATICS I

END OF SEMESTER EXAMINATION
SERIES: AUGUST 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 **FOUR** printed pages

Question One (Compulsory)

a) Solve the following simultaneous linear equations:

$$3x + 2y - z = 19$$
$$4x - y + 2z = 4$$
$$2x + 4y - 5z = 32$$

(5 marks)

b) Solve the following:

(i) $2^x = 8$ **(2 marks)**

(ii) $3^{x+1} = 2^{2x-3}$ **(3 marks)**

c) Simplify $\left(4a^3b^{-1}c\right)^2 \times \left(a^{-2}b^4c^{-2}\right)^{1/2} \div \left(64\left(a^6b^4c^2\right)^{-1/2}\right)$ **(3 marks)**

d) Evaluate $(0.998)^8$ using the binomial theorem correct to 3 decimal places. **(3 marks)**

e) (i) Express (-2, -3) in polar co-ordinates **(4 marks)**

(ii) If $\overline{OA} = 3 + j4$ and $\overline{OB} = j\overline{OA}$ show that $AB^2 = OA^2 + OB^2$ **(3 marks)**

f) (I) Express in radians in terms of π **(3 marks)**

(i) 150^o
(ii) 270^o
(iii) 37.5^o

(ii) Demonstrate the validity of the following identity $\tan^2\theta - \sin^2\theta = \sin^4\theta \sec^2\theta$

(4 marks)

Question Two

a) (I) The voltage V_t across a certain component in an electric circuit 't' seconds after the supply is disconnected is given by $V_t = 100e^{-0.1t.}$

(i) Find the value of V_t after 45.5 seconds **(3 marks)**

(ii) After what time does V_t = 50 volts **(3 marks)**

(II) Evaluate by changing to base 10 the following showing the working:

(i) $\log_3 6$ **(2 marks)**

(ii) ln 2.715 **(2 marks)**

(NB no marks for direct calculators answers)

b) (I) Show that:

$$\log_{25} 10 = \tfrac{1}{2}\log_5 10$$

(i) **(2 marks)**

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

(ii) **(2 marks)**

(II) Evaluate:

$$\frac{\log_x 32 - \log_x 4 + \log_x 8}{\log_x 256}$$

(i) **(3 marks)**

$$\log x^4 - \log x^3 = \log 3x - \log 2x$$

(ii) **(3 marks)**

Question Three

a) (I) A ship steaming due east at 65km/hr is sighted by a stationary observer situated at a bearing 525ºE from the ship. One hour later the ship is at a bearing N35ºE from the observer. Determine the distance between the observer and the ship at both sightings and also the shortest distance between observer and ship as the ship proceeds, by completing and using below figure 1 diagram

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(II) (i) Find all three sides of triangle ABC in which a = 4.6, b = 5.9 and $\hat{c} = 35$ **(2 marks)**

(ii) Determine the area of the triangle using Heron's formula. **(3 marks)**

b) (i) Show that $\dfrac{1 - \sin\theta \tan\theta}{1 + \sec\theta} = \cos\theta$ **(4 marks)**

(ii) Solve for θ between $\theta = 0^o$ and 360^o the equation:

$$\sin^2\theta - 1.707 \sin\theta\cos\theta + 0.707\cos^2\theta = 0$$

(5 marks)

Question Four

a) (i) How many different selections of 9 books an be made from 15 books on a shelf. **(2 marks)**

(ii) Write down the first 3 terms in the expansion of $(1 + 2x)^{10}$ **(3 marks)**

$$\left(2-3/8\right)^{8}$$

b) (I) In the Binomial expansion of written in terms of descending powers of x, find:

(i) The 4th term **(4 marks)**

(ii) The coefficient of x^{-4} **(3 marks)**

$$\left(1+\frac{1}{n}\right)^{n}$$

(II) Use the Binomial expansion of to prove:

$$\sum_{r=0}^{\alpha}\frac{1}{r!}=\frac{1}{0!}+\frac{1}{1!}+\frac{1}{2!}+\frac{1}{3!}+.....$$

(i) **(4 marks)**

(ii) Then from series expansion of e^{x} find the value of $e^{-0.25}$ accurate to 3 decimal places. **(4 marks)**

Question Five

$$a+jb=r\cos\theta+jr\sin\theta,\qquad \tan\theta=\frac{b}{a}$$

a) (i) If with aid of a diagram show that **(4 marks)**

$$-1-j\sqrt{3}$$

(ii) Put into polar form for an angle between -180° and +180° **(3 marks)**

b) (I) Rationalize

$$\frac{a+jb}{c+jd}$$

(i) **(2 marks)**

$$\frac{(2-j)(3+j2)}{(3-j4)}=N(\cos\theta+j\sin\theta)$$

(ii) If find N. **(5 marks)**

$$5x^{3}+2x^{2}-26x-20=0$$

(II) Solve the equation **(6 marks)**