TECHNICAL UNIVERSITY OF MOMBASA

Faculty of Applied & Health Sciences

DEPARTMENT OF MATHEMATICS & PHYSICS

DIPLOMA IN ELECTRICAL & ELECTRONICS ENGINEERING (DEPE2, DEAE2, DICE2)

AMA 2150: ENGINEERING MATHEMATICS II

END OF SEMESTER EXAMINATION
SERIES: DECEMBER 2013
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) Simplify the following equations:

(i) $E = 25x^4y^3z^{1/2} \times 4^{-1/2}x^{-2}y^{-1}z^{-1/2}$ **(3 marks)**

(ii) $F = \sqrt[3]{a^6b^3} \div \sqrt{\frac{1}{9}a^4b^6} \times \left(4\sqrt{a^6b^2}\right)^{-1/2}$ giving the results without fractional indices **(3 marks)**

b) Simplify $2\log_a x - 3\log_a 2x + \log_4 x^2$ **(3 marks)**

c) Factorize the following:

(i) $(x-2y)^2 - (2x-y)^2$ **(2 marks)**

(ii) $16x^2 - 24xy - 18x + 27y$ r **(2 marks)**

d) Use the first three terms of a binomial expansion to find the approximate value of 1.98^8 **(3 marks)**

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

(ii) Simplify $(4-j3)^2$ **(2 marks)**

f) By use of demoivre's theorem, or otherwise prove that $\frac{3\tan\theta - \tan^3\theta}{1-3\tan^2\theta}$ **(6 marks)**

g) Express in radians in terms of π:

(i) 120°

(ii) 300°

(iii) 383° 17' 23" **(3 marks)**

Question Two

a) Solve for θ between $\theta = 0^o$ and 36^o the equation $\sin^2\theta - 1.707\sin\theta\cos\theta + 0.707\cos^2\theta = 0$

(4 marks)

b) Figure A below is a vertical aerial PQ 10.0m high which stands on ground which is inclined 10^o to the horizontal. A stay connects the top of the aerial P to a point R on the ground 7.00m downhill from Q, the foot of the aerial calculate:

(i) The length of the stay and **(4 marks)**

(ii) The angle which the stay makes with the ground. **(2 marks)**

P

c) Verify each of the following identities;

(i) $\tan(\theta+\phi)=\dfrac{\tan\theta+\tan\phi}{1-\tan\theta\tan\phi}$ **(2 marks)**

(ii) $\sin 2\theta = 2\sin\theta\cos\theta$ **(2 marks)**

d) (i) Prove that:

$$\frac{1}{1-\cos\theta}+\frac{1}{1+\cos\theta}=2\cos ec^2\theta$$

(3 marks)

(ii) $\cos 75^o = \dfrac{\sqrt{3}-1}{2\sqrt{2}}$ **(3 marks)**

Question Three

a) Two resistors of value R[1], Ω and $R_2\Omega$ are connected in series to give a total resistance of 10 Ω. When connected in parallel their total resistance is 2.4 Ω. Obtain an equation relating R_1 to other given values. **(4 marks)**

b) (i) Solve $ax^2+bx+c=0$, where a, b and c are constants by completing the square. **(4 marks)**

(ii) Solve $2x^2+5x-3=0$ by using formula **(2 marks)**

c) Solve $\dfrac{4}{x-3}+\dfrac{2}{x}=\dfrac{6}{x-5}$ **(4 marks)**

d) (i) Solve the following set of three equations in three unknowns:

$$3x + 4y + z = 5$$
$$2x - y - z = 4$$
$$x + 3y + z = 1$$

(4 marks)

(ii) Solve
$$7x - 4y = 23$$
$$4x - 3y = 11$$
(2 marks)

Question Four

a) (i) Write down the binomial expansion of $(2+3x)^4$ from pascal's triangle **(2 marks)**

(ii) Find the 10th term in the binomial expansion of $(1+x)^{15}$ written in ascending powers of x
(2 marks)

b) Evaluate each of the following showing your working **(6 marks)**

(i) 8_{c_3} $(ii)\ 15_{c_{12}}$ $8!$

c) Use the first three terms of a binomial expansion to find the approximate value of 1.01^6
(3 marks)

d) (i) Find the number of permutations of all the letters in the word KENYA **(2 marks)**
(ii) How many different selection of 3 books can be made from 12 books on a shelf **(1 mark)**
(iii) Show that $\binom{n-1}{r-1} + \binom{n-1}{r} = \binom{n}{r}$ **(4 marks)**

Question Five

a) If $\overline{OA} = 3 + 4j$ and $\overline{OB} = j\overline{OA}$ show that $AB^2 = OA^2 + OB^2$ **(5 marks)**

b) (i) What is the locus of the point z if $|2+3j|^2 - |2-3j|^2 = 12$ **(2 marks)**
(ii) Using $e^{jz} \bullet e^{jy} = e^{j(x+y)}$ prove $\cos 2\theta = \cos^2\theta - \sin^2\theta$ and $\sin 2\theta = 25\sin\theta\cos\theta$ by showing that

$$\begin{cases} \cos x \cos y - \sin x \sin y = \cos(x+y) \\ \sin x \cos y + \cos x \sin y = \sin(x+y) \end{cases}$$

(7 marks)

c) Find the three cube roots of $6\left(\cos 240^o + j\sin 240^o\right)$ represent them on an Argand diagram and indicate which is the principal cube root. **(4 marks)**

d) Express in the form $a + jb;\ 2\left(\cos 3\theta + j\sin 30^o\right)$ **(2 marks)**