TECHNICAL UNIVERSITY OF MOMBASA

Faculty of Applied & Health Sciences

DEPARTMENT OF MATHEMATICS & PHYSICS

CERTIFICATE IN ELECTRICAL ENGINERING (CEEE 3/CEPE 3)

AMA 1103: ENGINEERING MATHEMATICS III

SPECIAL/SUPPLEMENTARY EXAMINATION
SERIES: OCTOBER 2013
TIME: 2 HOURS

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

This paper consist of **FIVE** questions in **TWO** sections **A** & **B**

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

SECTION A (COMPULSORY)

Question One

a) (i) Express $z = 4 + j3$ in polar form **(3 marks)**

(ii) Express in the form $a + jb;\ 4\left(\cos 65^o + j\sin 65^o\right)$ **(3 marks)**

b) Determine the following integrals:

(i) $\int x^6 dx$ e **(1 marks)**

(ii) $\int \sec^2 x dx$ **(1 marks)**

(iii) $\int (3x+2)^4 dx$ **(4 marks)**

c) (i) Using Pascal's triangle write down the binomial expansion of $(a+b)^7$ **(3 marks)**

(ii) Using properties of combinations coefficient prove that $n_{c_{n-1}} = n_{c\,r}$ **(3 marks)**

d) Points L, M, N are mid points of the sides AB, BC, CA of the triangle ABC show that:

A

Figure 1

(i) $\overline{AB} + \overline{BC} + \overline{CA} = 0$ **(1 mark)**

(ii) $2\overline{AB} + 3\overline{BC} + \overline{CA} = 2\overline{LC}$ **(8 marks)**

(iii) $\overline{AM} + \overline{BN} + \overline{CL} = 0$ **(3 marks)**

SECTION B (Answer any TWO questions from this section)

Question Two

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

(ii) Use the binomial theorem to find the approximate value of $(0.998)^8$ **(3 marks)**

(iii) How many different selections of 6 looks can be made from 10 books **(2 marks)**

b) (I) Find the value:

(i) $\frac{5!}{13} \over 8!$

(ii) $5_{C_3} + 5_{C_4}$

(iii) **(3 marks)**

(II) Derive the binomial expansion of $\left(1+\frac{1}{n}\right)^n$

(i) Show from the expansion that $\sum_{r=0}^{\infty} \frac{1}{1!} = e$ by showing the series **(2 marks)**

(ii) Use the series expansion to find the value of $e^{0.1}$ accurate to 3 sig figure **(2 marks)**

Question Three

a) (i) Determine the value of $3x + 4 - \frac{5}{x}$ as x increases from 1 to 2 **(2 marks)**

(ii) Evaluate $\int_{\partial}^{3} (p-1)^2 dp$ **(2 marks)**

(iii) If $y = \left(q + \frac{1}{q}\right)^2 dq$. Find the value of the arbitrary constrant of integration if $y = \frac{1}{2}$ when $q = 1\frac{1}{2}$

(6 marks)

b) (I) With help of diagrams, find the area between the curve $y = x^2 - x + 2$, the ordinates x = -1 and x = 2 and the axis **(5 marks)**

(II) Evaluate each of the following definite integral:

(i) $\int_2^4 e^{2x} dx$ **(2 marks)**

(ii) $\int_0^{\pi/2} (\sin x - \cos x)\, dx$ **(3 marks)**

Question Four

a) (I) Simplify

(i) j^{12} **(1 mark)**

(ii) j^{10} **(1 marks)**

(iii) $(4 - j^3)^2$ **(1 marks)**

(iv) $(5 - ja) - (2 - j6) + (3 - j4)$ **(2 marks)**

(II) Multiply $(4 - j3)$ by an appropriate factor to give a product that is entirely real. What is the result? **(2 marks)**

(III) Simplify $\frac{4 - j5}{1 + j2}$ **(3 marks)**

b) (I) Simplify the following giving the results in polar form:

(i) $3(\cos 143^o + j\sin 143^o) \times 4(\cos 57^0 + j\sin 57^o)$ **(3 marks)**

(ii) $\frac{10(\cos 126^o + j\sin 126^o)}{2(\cos 72^o + j\sin 72^o)}$ **(3 marks)**

(iii) If $z = 2 + j5$ find the modulus and the argument of the complex number z **(4 marks)**

Question Five

a) (I) Given $\underset{\sim}{OP} = \underset{\sim}{p};\ \underset{\sim}{OQ} = \underset{\sim}{a}$ show the position of R when $\underset{\sim}{r} = \underset{\sim}{p} - \underset{\sim}{q}$ referring to figure 2 below.

Figure 2 **(4 marks)**

Q

(II) Figure 3 shows, $\overline{OH} = \bar{h} + \overline{OK} = \overline{K}$ and m is the mid point of $\overline{HK}$, find the position vector of m in term of $\bar{h}$ and $\bar{k}$ by completing a parallelogram **(4 marks)**

k

b) (I) $\overline{PQ} = 4i + 3j + 2k$ find $\left|\overline{PQ}\right|$ using a three dimensional vector illustration diagram. **(6 marks)**

(II) Find the direction $\cos ine(c, m, n)$ of the vector $\overline{OP}$ i.e. $\underset{\sim}{r} = a\underset{\sim}{i} + b\underset{\sim}{j} + c\underset{\sim}{k}$ and hence the actual direction cosine (c, m, n) of the vector $\underset{\sim}{r} = 3\underset{\sim}{i} - 2\underset{\sim}{j} + 6\underset{\sim}{k}$ **(6 marks)**