THE MOMBASA POLYTECHNIC UNIVERSITY COLLEGE

(A Constituent College of JKUAT)

Faculty of Engineering and Technology

DEPARTMENT OF ELECTRICAL & ELECTRONIC ENGINEERING

DIPLOMA IN TECHNOLOGY

EEA 2306: ENGINEERING MATHEMATICS VI

SPECIAL/SUPPLEMENTARY EXAMINATION

SERIES: FEBRUARY 2012

TIME: 2 HOURS

Instructions to Candidates:
This paper consists of **FIVE** questions
- *Answer Booklet*
- *Scientific Calculator/SMP Table*
- *Abridged Laplace transform table*

Answer question **ONE (COMPULSORY)** and any other **TWO** questions
Marks are indicated for each part of the question
This paper consists of **THREE** printed pages

Question One

a) Determine the eigenvalues of the following matrix

$$\begin{bmatrix} -2 & 5 & 4 \\ 5 & 7 & 5 \\ 4 & 5 & -2 \end{bmatrix}$$

(7 marks)

b) Diagonolise the following matrix

$$A = \begin{bmatrix} 6 & -3 \\ 2 & 1 \end{bmatrix}$$

(13 marks)

Question Two

$$f(z) = |z|^2$$

a) Show that the complex variable function   differentiable only at the origin.   (6 marks)

b) Prove that $u = x^2 - y^2$ and $V = \dfrac{y}{x^2 + y^2}$ are harmonic functions of (x, y) but are not harmonic conjugates. (8 marks)

c) Given that $W = \phi + j\varphi$ represent the complex potential for an electric field and $\varphi = x^2 - y^2 + \dfrac{x}{x^2 + y^2}$, determine the function ϕ (6 marks)

Question Three

a) Determine the Laplace transform of $t^2 e^t \sin 4t$ (7 marks)

b) Express the following function in terms of unit step junction: (4 marks)

$$f(t)\begin{cases} t-1, & 1 < t < 2 \\ 3-t, & 2 < t < 3 \end{cases}$$

c) use the Laplace transforms to determine the solution of the initial value problem (IVP)

$$y'' - 4y' + 4y = 64\sin 2t$$
$$y(0) = 0, \; y'(0 = 1)$$

(9 marks)

Question Four

$$|z| - 3j| = 3 \qquad w = \frac{1}{z}$$

a) Determine the image of $|z| - 3j| = 3$ under the mapping $w = \frac{1}{z}$ (9 marks)

b) A triangle has vertices at j, 1 + j and 1-j in the z – plane. Determine its image in the w-plane under the transformation

$$w = e^{5\pi j} \bullet z - 2 + 4j$$

(7 marks)

c) A curve is given by the equation $x^2 - y = 4$. Transform the curve under the mapping $w = z^2$ (4 marks)

Question Five

a) Given the system of simultaneous equation

$$2x_1 - x_2 = 0$$
$$-6x_1 + 2x_2 - 3x_3 = 0$$
$$-x_2 + 2x_3 = 0$$

(i) Write down the system in matrix form and let the matrix of the system be 4

(ii) Determine the eigenvalues and corresponding eigenvectors of the simultaneous equation (10 marks)

b) Derive the Cauchy-Riemann equation in Cartesian form (10 marks)