Document No : UniKL MFI_SD_AC41
Revision No: 02
Effective Date: 01 December 2008

CONFIDENTIAL

SET A

UNIVERSITI KUALA LUMPUR
Malaysia France Institute

FINAL EXAMINATION

SEPTEMBER 2014 SESSION

SUBJECT CODE	:	**FKB10103 / FKB13102**
SUBJECT TITLE	:	**ENGINEERING TECHNOLOGY MATHEMATICS 1**
LEVEL	:	**BACHELOR**
TIME / DURATION	:	**9.00 AM – 12.00 PM (3 HOURS)**
DATE	:	**30 DECEMBER 2014**

INSTRUCTIONS TO CANDIDATES

1. **Please read the instructions given in the question paper CAREFULLY.**
2. **This question paper is printed on both sides of the paper.**
3. **Please write your answers on the answer booklet provided.**
4. **Answer should be written in blue or black ink except for sketching, graphic and illustration.**
5. **This question paper consists of ONE (1) section only. Choose and answer 5 out of 6 questions.**
6. **Answer all questions in English.**
7. **Standard Transformation Table is appended.**

THERE ARE 5 PAGES OF QUESTIONS EXCLUDING APPENDIX 1 AND THIS PAGE.

(Total: 100 marks)

INSTRUCTION: There are six questions. ANSWER FIVE (5) questions only.

Please use the answer booklet provided.

Question 1

(a) What value of x satisfies the matrix equation

$$\begin{bmatrix} 0 & -x \\ 3x-2 & 5 \end{bmatrix} = \begin{bmatrix} 0 & 7x+14 \\ x+8 & 5 \end{bmatrix}^T \quad ?$$

(3 marks)

(b) Given $B = \begin{bmatrix} \frac{3}{2} & \frac{1}{2} \\ x & y \end{bmatrix}$ and $A = \begin{bmatrix} 2 & 1 \\ -1 & 0 \end{bmatrix}$

Compute the values of x and y if $B^2 = A$.

(7 marks)

(c) Given the determinant of matrix $A = \begin{bmatrix} 1 & -1 & 0 & 0 \\ 0 & 1 & -a & 0 \\ -1 & 0 & 1 & 1 \\ -t & 0 & 0 & 1 \end{bmatrix}$ is $1-a+at$.

Use Cramer's rule to show that the solution of the following system of equation for x is given by $x = \dfrac{b-aT+G-Gt}{1-a+at}$

$$\begin{bmatrix} 1 & -1 & 0 & 0 \\ 0 & 1 & -a & 0 \\ -1 & 0 & 1 & 1 \\ -t & 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} w \\ x \\ y \\ z \end{bmatrix} = \begin{bmatrix} G \\ b \\ 0 \\ T \end{bmatrix}$$

(10 marks)

Question 2

(a) Given matrix $A = \begin{bmatrix} 2 & 3+4i \\ 3-4i & 2 \end{bmatrix}$,

(i) Determine the eigenvalues of matrix A.

(5 marks)

(ii) Determine the corresponding eigenvectors of matrix A for $\lambda = -3$.

(5 marks)

(b) The transformation **S** maps the point P(x,y,z) onto the point $P'(X', Y', Z')$ under the transformation

$$x + y - z = X'$$
$$y + z = Y'$$
$$z = Z'$$

(i) Determine the matrix operator for the transformation **S.**

(1 mark)

The transformation **T** has the matrix operator

$$\begin{pmatrix} 1 & -2 & 2 \\ 2 & -1 & -2 \\ 2 & 2 & 1 \end{pmatrix}$$

Given that **U** is the compound transformation consisting of **T** followed by **S**

(ii) Find the matrix operator for this compound transformation **U.**

(4 marks)

(iii) Find the image of the point A(4,8,4) under the transformation **U**.

(3 marks)

(c) Matrix **N** represents reflection in the line 3y=6x. Find the matrix operator **N.**

(2 marks)

Question 3

(a) Determine a complex number ***z*** such that the determinant **,**

$$\begin{vmatrix} 1 & 1-i & -i \\ 0 & z & 1+i \\ 0 & 0 & 1+i \end{vmatrix} = 3+i$$

(5 marks)

(b) Determine the roots of the quadratic equation $z^2 - 3(1+i)z + 5i = 0$ in the form $x + iy$, where *x* and *y* are real number.

(15 marks)

Question 4

(a) Given polynomial $P(z) = z^3 - z^2 + (k-5)z + (k^2 - 7)$.

(i) Determine the value of k ,given that 3 is a zero of P(z).

(4 marks)

(ii) Hence, ***factorize completely*** $P(z)$ in ***real domain*** for *k*=1.

(5 marks)

(b) The transform of a signal is given by $F(s) = \dfrac{-6s+2}{s^2+2s+10}$.

Decompose $F(s)$ completely in the **Complex Domain**.

(11 marks)

Question 5

(a) A particle is under the action of the following forces F_1, F_2, F_3 and F_4 shown in **Figure 1**. Calculate the magnitude and the direction of the resultant force to the horizontal line.

(8 marks)

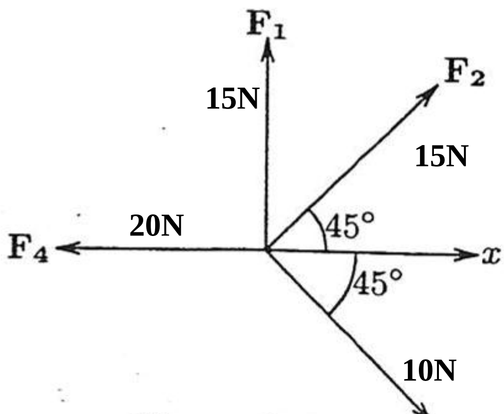

Figure 1

(b) Given vectors $\underset{\sim}{a} = 6\underset{\sim}{i} + 3\underset{\sim}{j} - 2\underset{\sim}{k}$ and $\underset{\sim}{b} = -2\underset{\sim}{i} + t\underset{\sim}{j} - 4\underset{\sim}{k}$.

(i) Calculate $|\underset{\sim}{a}|$, $|\underset{\sim}{b}|$ and dot product, $\underset{\sim}{a} \cdot \underset{\sim}{b}$

(5 marks)

(ii) Determine scalar ***t*** if the angle between vectors $\underset{\sim}{a}$ and $\underset{\sim}{b}$ is $\cos^{-1}\left(\frac{4}{21}\right)$.

(7 marks)

Question 6

(a) Given the vectors $\overrightarrow{OA} = 2\underset{\sim}{i} + 3\underset{\sim}{j} - \underset{\sim}{k}$, $\overrightarrow{OB} = \underset{\sim}{i} - 2\underset{\sim}{j} + 3\underset{\sim}{k}$

(i) Determine the vector $\overrightarrow{OC}$ where $\overrightarrow{OC} = \overrightarrow{OA} \times \overrightarrow{OB}$.

(3 marks)

(ii) Hence, calculate the area of the triangle ABC, giving your answer to 3 decimal places.

(7 marks)

(b) Let the vectors $\underset{\sim}{v}$ *and* $\underset{\sim}{u}$ be defined by

$$\underset{\sim}{v} = 5\underset{\sim}{i} + 3\underset{\sim}{j} + 7\underset{\sim}{k} \qquad \underset{\sim}{u} = 15\underset{\sim}{i} + m\underset{\sim}{j} + 21\underset{\sim}{k}$$

(i) Find *m* such that $\underset{\sim}{v}$ *and* $\underset{\sim}{u}$ are perpendicular.

(4 marks)

(ii) If *m*=6, find the angle between $\underset{\sim}{v}$ *and* $\underset{\sim}{u}$, giving your answer to 2 decimal places.

(6 marks)

END OF QUESTION

APPENDIX 1

STANDARD TRANSFORMATIONS

(1)	Rotation through an angle , θ , about the origin	$M = \begin{pmatrix} \cos\theta & -\sin\theta \\ \sin\theta & \cos\theta \end{pmatrix}$
(2)	Rotation through $\frac{\pi}{2}$ ***clockwise*** about the origin	$M = \begin{pmatrix} 0 & 1 \\ -1 & 0 \end{pmatrix}$
(3)	Rotation through $\frac{\pi}{2}$ ***anti -clockwise*** about the origin	$M = \begin{pmatrix} 0 & -1 \\ 1 & 0 \end{pmatrix}$
(4)	Enlargement / Reduction by a factor of k along the x – axis	$M = \begin{pmatrix} k & 0 \\ 0 & 1 \end{pmatrix}$
(5)	Enlargement / Reduction by a factor of k along the y - axis	$M = \begin{pmatrix} 1 & 0 \\ 0 & k \end{pmatrix}$
(6)	Enlargement / Reduction by k units	$M = \begin{pmatrix} k & 0 \\ 0 & k \end{pmatrix}$
(7)	Reflection in the **x-axis**	$M = \begin{pmatrix} 1 & 0 \\ 0 & -1 \end{pmatrix}$
(8)	Reflection in the **y-axis**	$M = \begin{pmatrix} -1 & 0 \\ 0 & 1 \end{pmatrix}$
(9)	Reflection in the **line** : $y = x$ or $y - x = 0$	$M = \begin{pmatrix} 0 & 1 \\ 1 & 0 \end{pmatrix}$
(10)	Reflection in the **line** : $y = -x$ or $y + x = 0$	$M = \begin{pmatrix} 0 & -1 \\ -1 & 0 \end{pmatrix}$

(11)	Shear of θ^O in the direction O_x	$M = \begin{pmatrix} 1 & \tan\theta \\ 0 & 1 \end{pmatrix}$
(12)	Shear of θ^O in the direction Oy	$M = \begin{pmatrix} 1 & 0 \\ \tan\theta & 1 \end{pmatrix}$
(13)	Reflection in the line : $y = mx$ or $y = x\tan\theta$ NOTE : $m = \tan\theta$	$M = \begin{pmatrix} \cos 2\theta & \sin 2\theta \\ \sin 2\theta & -\cos 2\theta \end{pmatrix}$ where : $\cos 2\theta = \frac{1-\tan^2\theta}{1+\tan^2\theta} = \frac{1-m^2}{1+m^2}$ $\sin 2\theta = \frac{2\tan\theta}{1+\tan^2\theta} = \frac{2m}{1+m^2}$
(14)	Rotation about y-axis (measured from z-axis)	$\begin{pmatrix} \cos\theta & 0 & \sin\theta \\ 0 & 1 & 0 \\ -\sin\theta & 0 & \cos\theta \end{pmatrix}$
(15)	Rotation about z-axis (measured from x-axis)	$\begin{pmatrix} \cos\varphi & -\sin\varphi & 0 \\ \sin\varphi & \cos\varphi & 0 \\ 0 & 0 & 1 \end{pmatrix}$
(16)	Rotation about x-axis (measured from y-axis)	$\begin{pmatrix} 1 & 0 & 0 \\ 0 & \cos\psi & -\sin\psi \\ 0 & \sin\psi & \cos\psi \end{pmatrix}$