

UNIVERSITY OF MALAWI

SCHOOL OF NATURAL & APPLIED SCIENCES

Mathematical Sciences Department

TEST 1: Introduction to MATLAB & Programming with MATLAB

(For 2nd year Science students taking MAT 213)

HSS - 6235

Wednesday, 22nd November 2023

Time: 2 hours (from 16:30hrs)

Instructions

- (1) *This is a closed book test* where you are expected to do the test alone without any assistance from some other person(s) or some other form of notes or communication.
- (2) Non-programmable calculators may be used. However, mobile phones are not allowed. If accidentally brought in, they should be switched off and packed away.
- (3) Show your method or explanation clearly. Most marks shown in square brackets at the end of each part are allocated to the method.
- (4) Attempt ALL questions.

Question 1:[43 marks]

- (a) Name *four main* features or windows of MATLAB and provide a brief description of each? [12]
- **(b)** For each of the following commands or symbols as used in MATLAB, describe their uses.

Command/symbol	Description
help	
;	
who, whos	
%	
clear Y	
:	
What	
&	
clc	
~	
dir or Is	
~ =	
pwd	

NaN	

[15]

- (c) Define any 4×4 matrix A and extract a submatrix B consisting of rows 2 and 3 and columns 1 and 2 of the matrix A. [3]
- (d) From a matrix A=[1 2 3;4 5 6;7 8 9], define a concatenated matrix B=[A 10*A;-A eye(3)]. [3]
- (e) Suppose that a matrix $H_{n\times n}$ is said to be a Hadamard matrix if and only if $H = (a_{ij})_{n\times n}$ such that $HH^T = nI_n$ where $a_{ij} = -1$ or 1. Given that

$$H = \begin{pmatrix} 1 & 1 \\ -1 & 1 \end{pmatrix}$$

- i. Demonstrate that *H* is a Hadamard matrix.
- ii. Compute the inverse of the matrix H.
- iii. Find the eigenvalues of the matrix H.
- iv. Hence, show that $H^{-1}H = HH^{-1} = I$



Question 2:[30 marks]

(a) Given the following *while...loop* MATLAB function file, provide comment on each line, and hence describe the output. [3.5]

function trial_3
x = 1;
while x <= 10
 x = 3*x;
 x
end</pre>

- (b) Consider the following quadratic equation $y = 2x^2 + 3x 4$.
 - i. Express it in the form of $ax^2 + bx + c = 0$ and deduce the values of a, b and c. [2]
 - ii. Write a MATLAB function file using an *if...else* statement to classify the type of quadratic roots of the given equation using the discriminant term $b^2 4ac$, where roots are imaginary, repeated, or non-repeated when $b^2 4ac < 0$, $b^2 4ac = 0$, or $b^2 4ac > 0$, respectively. [5.5]
 - iii. Hence, describe the output of your program for the above given equation. [1.0]
- (c) Consider the following system of linear equations

$$\begin{cases} x + 2y + 3z = 1\\ 3x + 3y + 4z = 1\\ 2x + 3y + 3z = 1 \end{cases}$$

- i. Derive an expression of the form Ax = b.
- ii. Hence, write a Matlab function file to solve for x using the LU factorization method. [5]
- (d) The square root of 2, i.e., $\sqrt{2}$ can be estimated using the recurrence equation

$$y_t = \frac{1}{2}(y_{t-1} + \frac{2}{y_{t-1}})$$

for t = 1,2,3,...n, when $y_0 = 3$,

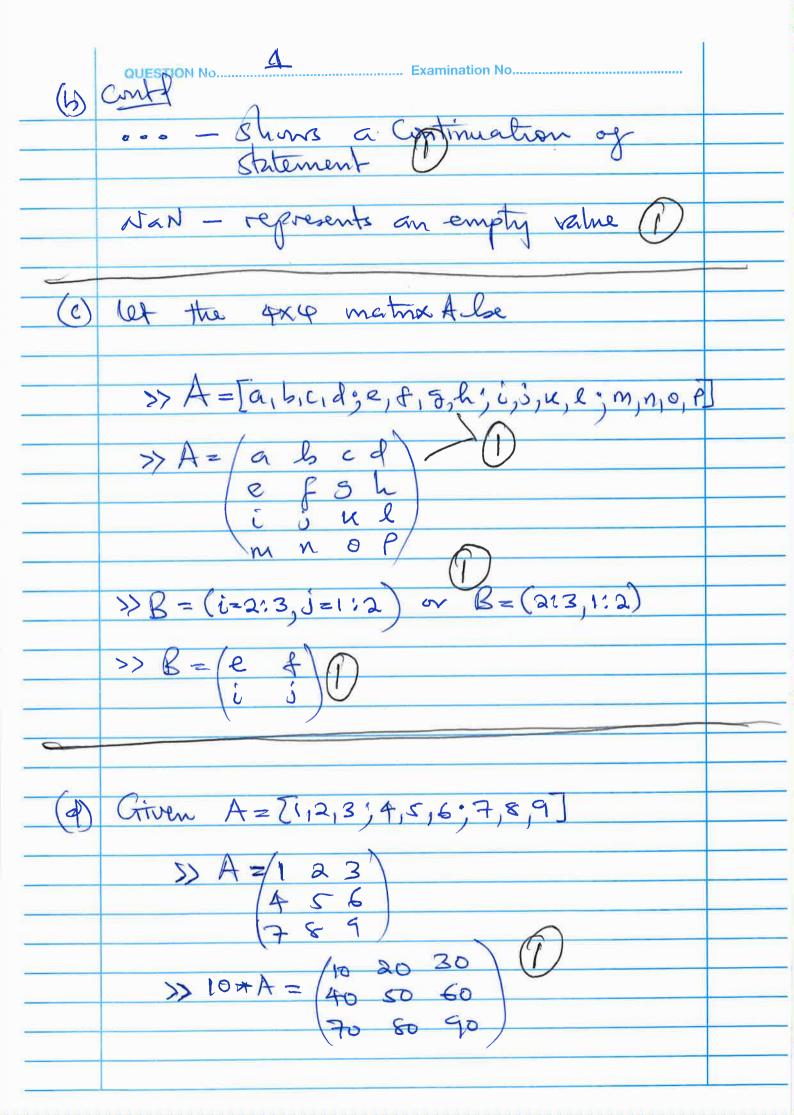
- i. Write down a pseudocode of a *for loop* function to estimate $\sqrt{2}$ when t=[1,...,7]. [5]
- ii. Hence, use your above written pseudocode to write a MATLAB function/program file that estimates $\sqrt{2}$. [5]

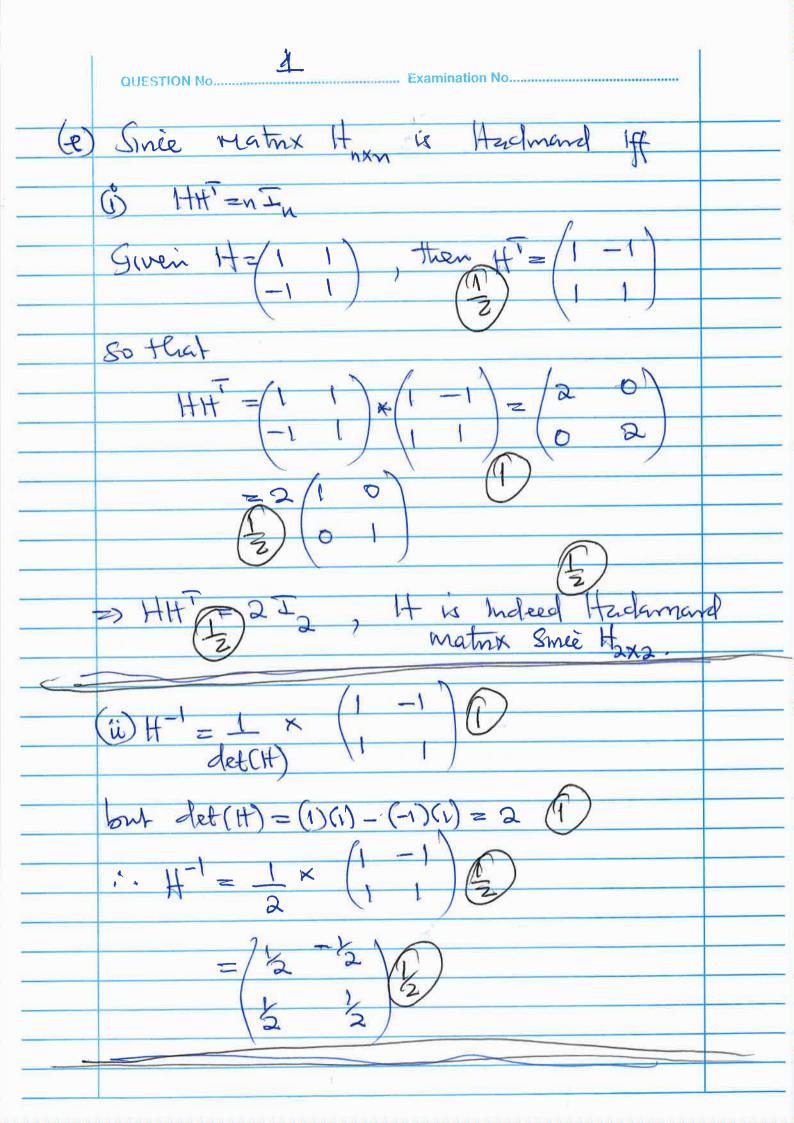
~00000000 End of Test 1 Questions 00000000~~~~



MA 215 - STLV1100 GUIDE Q.1 We have 1) Command window - need to enter Variables and to run
functions and M-files.
Azam used to displan
Immediate Computational
1881/13. all statements or Commoderals that we enter in the Command window. 3) Word spale - lists all the variables in used before So long as we have our MATTER running 4) Current Directory a Also called the of morning folder which lists of down all M-files during & the programming process.

help-provides us with general MAHall features and different items to (1) risted as a separator of rows in a defined matrix or as supressor, of output in a Mattals program (Who, who's - provides list of all variables program file () in a Matlab Clear 7 - clears a specified variable 7 or item 1 w the womespace (1) - rused as an incrementor of Consecutive numbers or array in a sequence (1) What - hists all M-files on the - logical operator for Combining (elc - Clearing the Command undow (regation symbol (1) - lists all files in the current morning clirectory - Not equal to (1) - Shows current money directory (1)





e) (iii) the eigenvalues of If are formal from the sylmtrony of the eghalian det (7 I - H) = 0 Thus AIZ Hence 2I-H => 80 that det (AI-H)= 20 => (1-1)-(1)(-1) $\frac{3^{2}-3-3+1+1}{3^{2}-23+2}=0$ A=-b+ 162-491 = -(-2)+ (2) -4(1)(2) 201 2 + 14-8 2 3/4 = 2±V-4 or 2-J-4 2+1-4

