



MAT 2002 DA-1



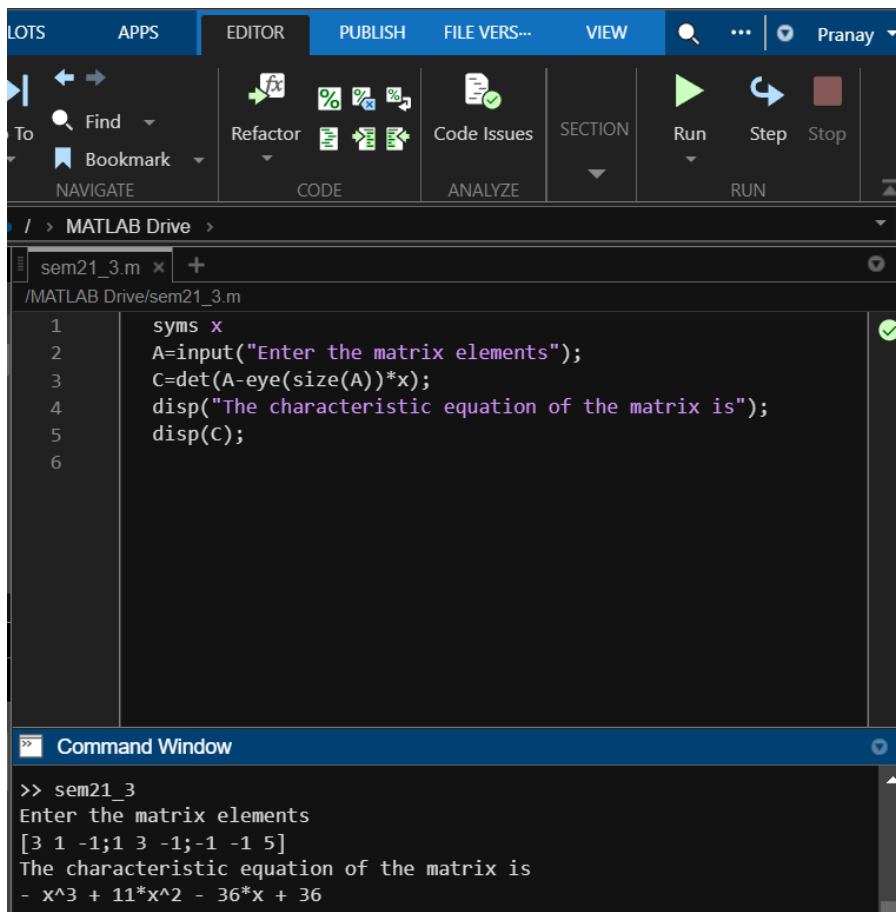
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1A)

1. Let $A = \begin{pmatrix} 3 & 1 & -1 \\ 1 & 3 & -1 \\ -1 & -1 & 5 \end{pmatrix}$

- Find characteristic equation of A (without using **poly** command).
- Find eigen values by finding the roots of characteristic equation.
- Find eigen vector X of A by solving the equation $AX = \lambda X$.
- Verify the properties of Eigen values.
- Verify Cayley-Hamilton theorem and find inverse

a) Code and Output:



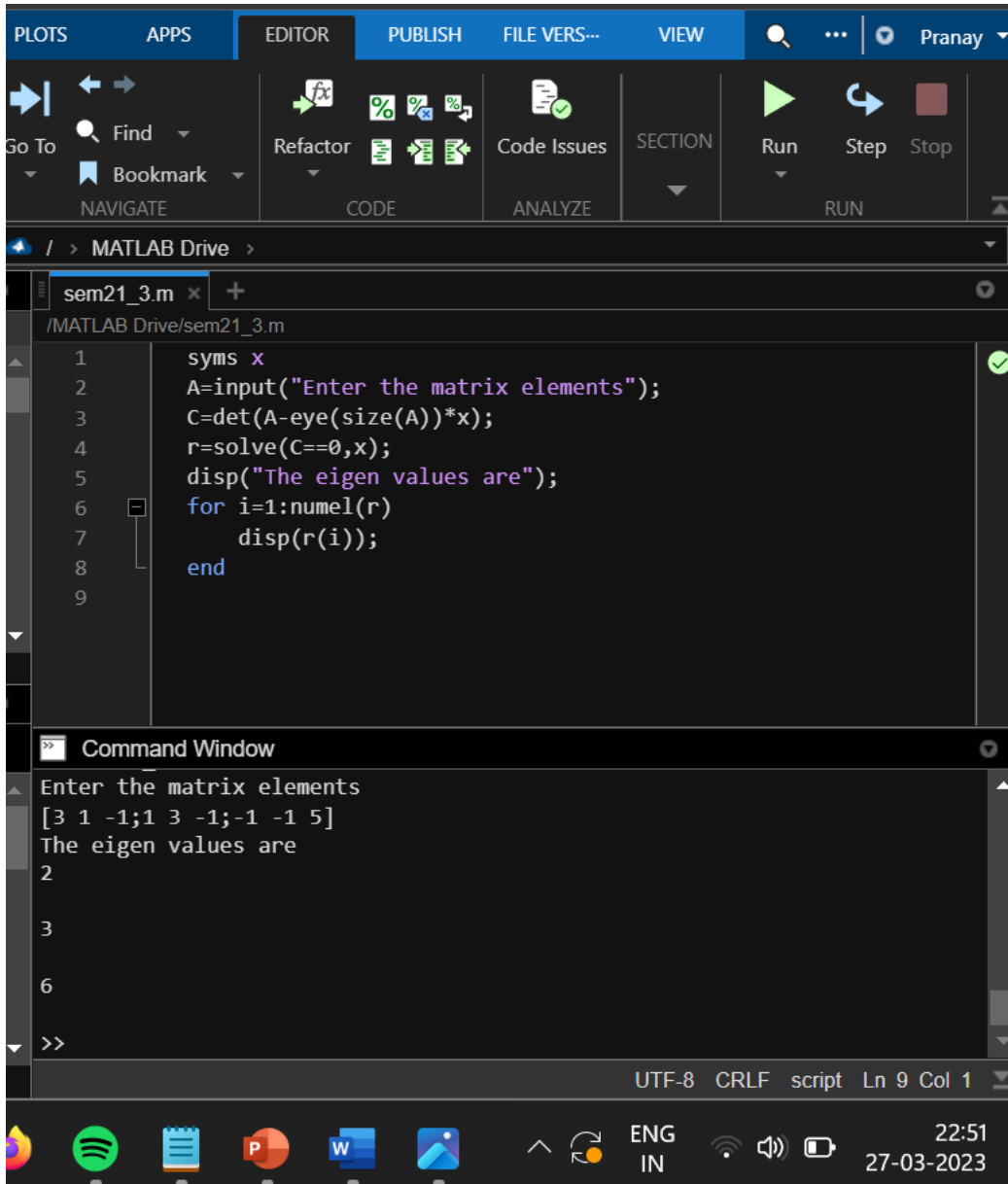
The image shows a MATLAB development environment. The top toolbar includes tabs for 'LOTS', 'APPS', 'EDITOR', 'PUBLISH', 'FILE VERS...', and 'VIEW'. Below the toolbar, there are icons for 'Find', 'Bookmark', 'Refactor', 'Code Issues', 'Run', 'Step', and 'Stop'. The main editor window displays a script named 'sem21_3.m' with the following code:

```
1 syms x
2 A=input("Enter the matrix elements");
3 C=det(A-eye(size(A))*x);
4 disp("The characteristic equation of the matrix is");
5 disp(C);
6
```

The Command Window at the bottom shows the execution output:

```
>> sem21_3
Enter the matrix elements
[3 1 -1;1 3 -1;-1 -1 5]
The characteristic equation of the matrix is
- x^3 + 11*x^2 - 36*x + 36
```

b) Code and Output:



The image shows the MATLAB R2022a software interface. The top menu bar includes PLOTS, APPS, EDITOR, PUBLISH, FILE VERS..., and VIEW. The EDITOR tab is active, displaying a script file named 'sem21_3.m' located at '/MATLAB Drive/sem21_3.m'. The script contains the following MATLAB code:

```
1 syms x
2 A=input("Enter the matrix elements");
3 C=det(A-eye(size(A))*x);
4 r=solve(C==0,x);
5 disp("The eigen values are");
6 for i=1: numel(r)
7     disp(r(i));
8 end
9
```

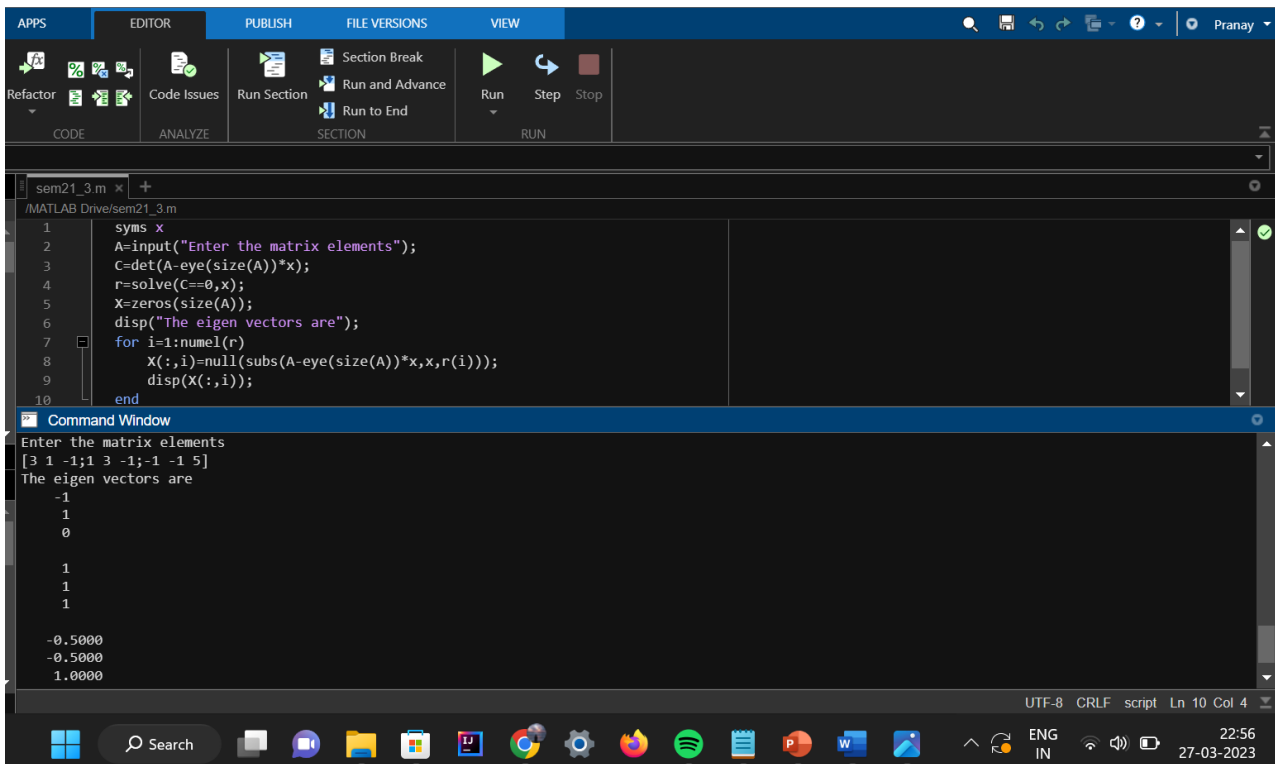
The Command Window at the bottom shows the execution output:

```
>> Enter the matrix elements
[3 1 -1;1 3 -1;-1 -1 5]
The eigen values are
2
3
6
>>
```

The status bar at the bottom indicates the file is in UTF-8 encoding, CRLF line endings, and script format, with the cursor at Line 9, Column 1. The system tray at the bottom shows the date and time as 27-03-2023, 22:51.

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c) Code and Output:



The image shows the MATLAB R2022a interface. The top toolbar includes tabs for APPS, EDITOR, PUBLISH, FILE VERSIONS, and VIEW. The EDITOR tab is active, showing a script named 'sem21_3.m'. The code in the script is as follows:

```
1 syms x
2 A=input("Enter the matrix elements");
3 C=det(A-eye(size(A))*x);
4 r=solve(C==0,x);
5 X=zeros(size(A));
6 disp("The eigen vectors are");
7 for i=1: numel(r)
8     X(:,i)=null(subs(A-eye(size(A))*x,r(i)));
9     disp(X(:,i));
10 end
```

The Command Window shows the output of the script:

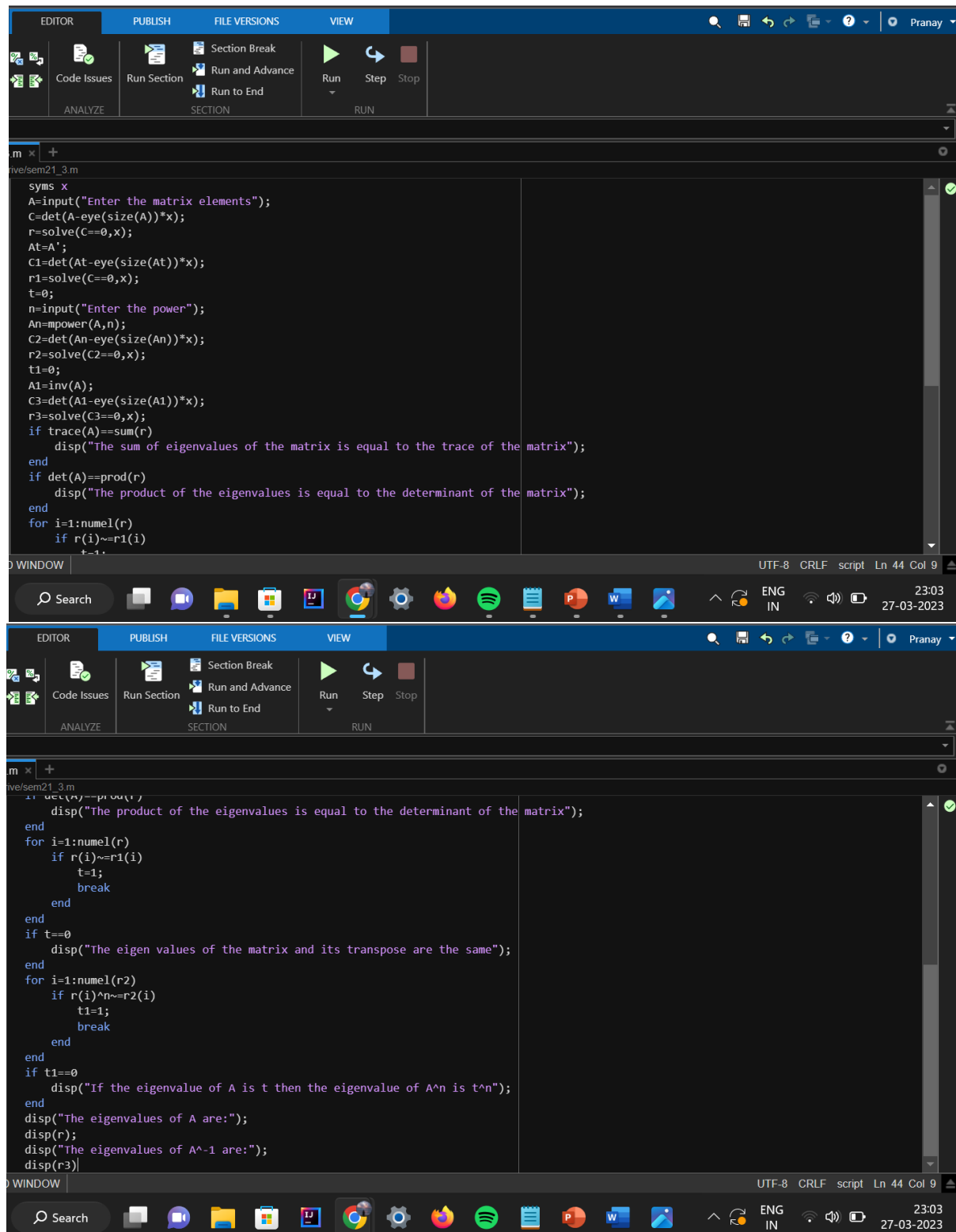
```
Enter the matrix elements
[3 1 -1; 1 3 -1; -1 -1 5]
The eigen vectors are
-1
1
0

1
1
1

-0.5000
-0.5000
1.0000
```

The status bar at the bottom indicates the file is UTF-8, CRLF, script, with the cursor at line 10, column 4. The system tray shows the date and time as 22:56 on 27-03-2023.

d) Code and Output:



The image displays two screenshots of a MATLAB script editor, showing the code and its output. The editor interface includes tabs for EDITOR, PUBLISH, FILE VERSIONS, and VIEW. The code is written in MATLAB and performs various matrix operations and eigenvalue calculations.

Top Screenshot: The code defines a matrix A and calculates its determinant, inverse, and eigenvalues. It also calculates the determinant and eigenvalues of A^T and A^n . The code includes comments and display statements for the results.

```
syms x
A=input("Enter the matrix elements");
C=det(A-eye(size(A))*x);
r=solve(C==0,x);
At=A';
C1=det(At-eye(size(At))*x);
r1=solve(C1==0,x);
t=0;
n=input("Enter the power");
An=mpower(A,n);
C2=det(An-eye(size(An))*x);
r2=solve(C2==0,x);
t1=0;
A1=inv(A);
C3=det(A1-eye(size(A1))*x);
r3=solve(C3==0,x);
if trace(A)==sum(r)
    disp("The sum of eigenvalues of the matrix is equal to the trace of the matrix");
end
if det(A)==prod(r)
    disp("The product of the eigenvalues is equal to the determinant of the matrix");
end
for i=1: numel(r)
    if r(i)~=r1(i)
        t=1;
    end
end
```

Bottom Screenshot: The code continues the calculations, displaying the eigenvalues of A and A^{-1} . It also includes a loop to calculate the eigenvalues of A^n and a final display statement for the eigenvalues of A .

```
end
disp("The product of the eigenvalues is equal to the determinant of the matrix");
end
for i=1: numel(r)
    if r(i)~=r1(i)
        t=1;
        break
    end
end
if t==0
    disp("The eigen values of the matrix and its transpose are the same");
end
for i=1: numel(r2)
    if r(i)^n~=r2(i)
        t1=1;
        break
    end
end
if t1==0
    disp("If the eigenvalue of A is t then the eigenvalue of A^n is t^n");
end
disp("The eigenvalues of A are:");
disp(r);
disp("The eigenvalues of A^-1 are:");
disp(r3)
```

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Enter the matrix elements

[3 1 -1;1 3 -1;-1 -1 5]

Enter the power

3

The sum of eigenvalues of the matrix is equal to the trace of the matrix

The product of the eigenvalues is equal to the determinant of the matrix

The eigen values of the matrix and its transpose are the same

If the eigenvalue of A is t then the eigenvalue of A^n is t^n

The eigenvalues of A are:

2

3

6

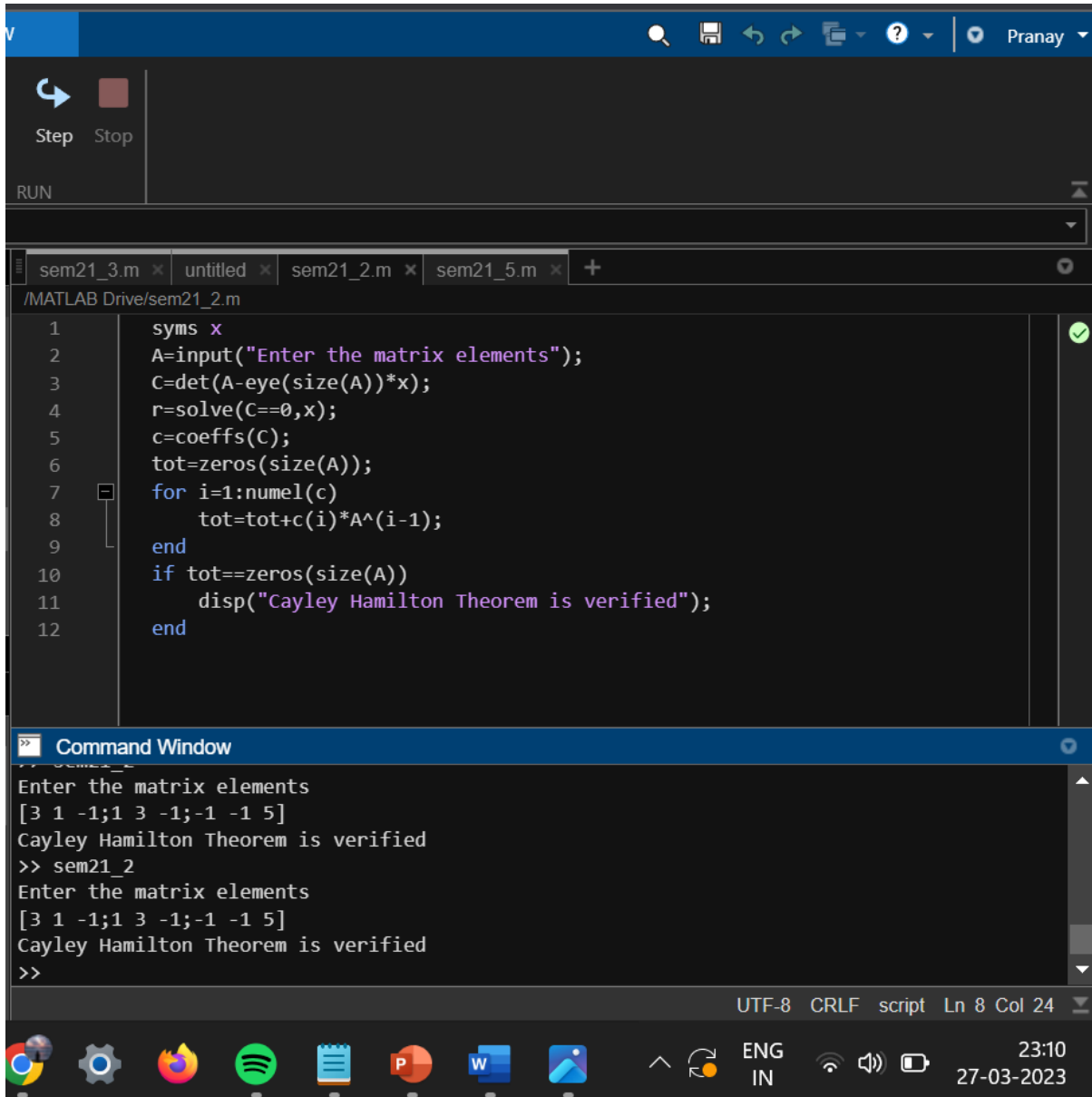
The eigenvalues of A^{-1} are:

$1/6$

$1/3$

$1/2$

e) Code and Output:



The image shows a MATLAB IDE window with the following components:

- Editor:** Contains a script named `sem21_2.m` with the following code:

```
1 syms x
2 A=input("Enter the matrix elements");
3 C=det(A-eye(size(A))*x);
4 r=solve(C==0,x);
5 c=coeffs(C);
6 tot=zeros(size(A));
7 for i=1:numel(c)
8     tot=tot+c(i)*A^(i-1);
9 end
10 if tot==zeros(size(A))
11     disp("Cayley Hamilton Theorem is verified");
12 end
```
- Command Window:** Shows the execution output:

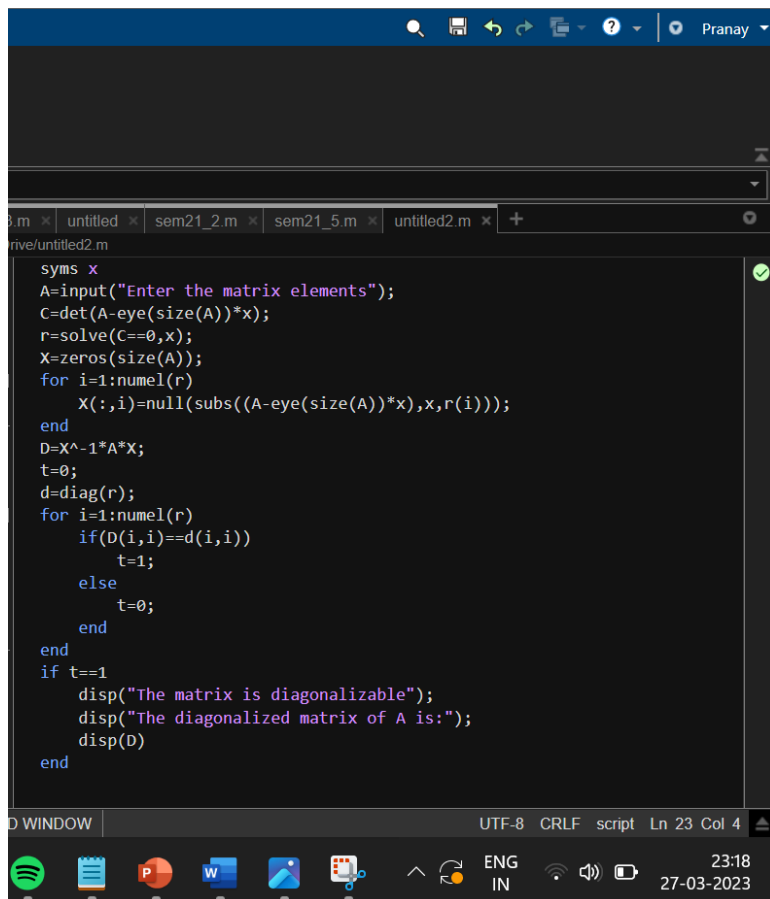
```
Enter the matrix elements
[3 1 -1;1 3 -1;-1 -1 5]
Cayley Hamilton Theorem is verified
>> sem21_2
Enter the matrix elements
[3 1 -1;1 3 -1;-1 -1 5]
Cayley Hamilton Theorem is verified
>>
```
- Status Bar:** Displays `UTF-8 CRLF script Ln 8 Col 24`.
- Taskbar:** Shows the system clock as 23:10 on 27-03-2023, along with various application icons.

1B)

1)

1. Diagonalize $A = \begin{pmatrix} 1 & 6 & 1 \\ 1 & 2 & 0 \\ 0 & 0 & 3 \end{pmatrix}$ by similarity transformation.

Code and Output:

A screenshot of a MATLAB script in an IDE. The script defines a symbolic variable 'x', takes user input for matrix 'A', calculates its characteristic polynomial 'C', finds the roots 'r', and then constructs the transformation matrix 'X' by finding null spaces of (A - r(i)*eye(size(A))). It then computes the diagonalized matrix 'D = X^-1 * A * X' and checks if it is diagonal. If diagonal, it displays the message and the matrix 'D'.

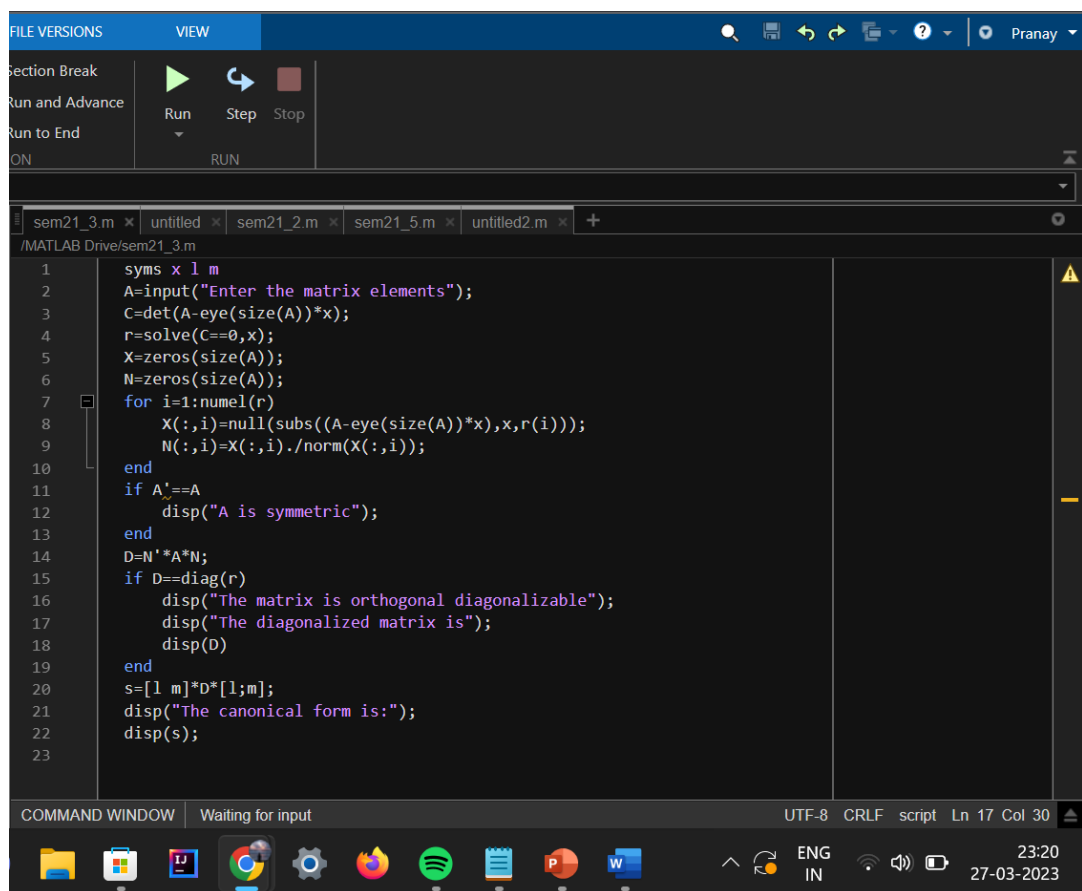
```
syms x
A=input("Enter the matrix elements");
C=det(A-eye(size(A))*x);
r=solve(C==0,x);
X=zeros(size(A));
for i=1: numel(r)
    X(:,i)=null(subs((A-eye(size(A))*x),x,r(i)));
end
D=X^-1*A*X;
t=0;
d=diag(r);
for i=1: numel(r)
    if(D(i,i)==d(i,i))
        t=1;
    else
        t=0;
    end
end
if t==1
    disp("The matrix is diagonalizable");
    disp("The diagonalized matrix of A is:");
    disp(D)
end
```

```
Enter the matrix elements
[1 6 1;1 2 0;0 0 3]
The matrix is diagonalizable
The diagonalized matrix of A is:
-1.0000    0.0000    0.0000
         0    3.0000         0
         0         0    4.0000
```


2)

2. Transform the quadratic form $13x^2 - 10xy + 13y^2$ to canonical form and specify the matrix of transformation.

Code and Output:



The screenshot shows the MATLAB IDE with a script file named 'sem21_3.m'. The code defines a function to transform a quadratic form into its canonical form. It prompts the user to enter matrix elements, checks if the matrix is symmetric, and if so, finds an orthogonal matrix N and a diagonal matrix D such that A = N'DN. The canonical form is then displayed as a sum of squares.

```
1 syms x 1 m
2 A=input("Enter the matrix elements");
3 C=det(A-eye(size(A))*x);
4 r=solve(C==0,x);
5 X=zeros(size(A));
6 N=zeros(size(A));
7 for i=1:numel(r)
8     X(:,i)=null(subs((A-eye(size(A))*x),x,r(i)));
9     N(:,i)=X(:,i)./norm(X(:,i));
10 end
11 if A'==A
12     disp("A is symmetric");
13 end
14 D=N'*A*N;
15 if D==diag(r)
16     disp("The matrix is orthogonal diagonalizable");
17     disp("The diagonalized matrix is");
18     disp(D)
19 end
20 s=[1 m]*D*[1;m];
21 disp("The canonical form is:");
22 disp(s);
23
```

```
Enter the matrix elements
[13 -5;-5 13]
A is symmetric
The matrix is orthogonal diagonalizable
The diagonalized matrix is
    8.0000    0
    0   18.0000

The canonical form is:
8*l^2 + 18*m^2
```

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