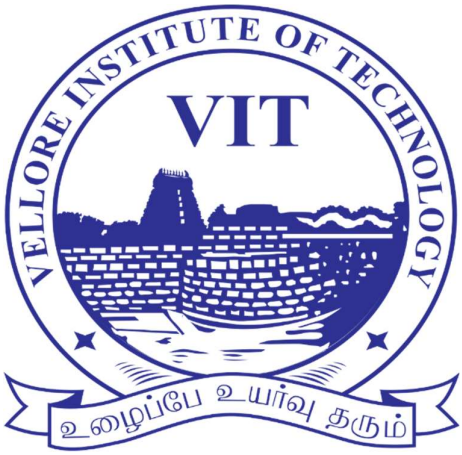

MAT 2002 – ADDE

Assignment 1

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Que)

Write a MatLab code (one single code having the subcases for two and three variables quadratic form) to execute the following.

For $x \in \mathbb{R}^3$, let $Q(x) = 3x_1^2 + 2x_2^2 + x_3^2 + 4x_1x_2 + 4x_2x_3$. Write this quadratic form as x^TAx. Reduce the quadratic form into a canonical form using change of variables suitably. Display the canonical form and the orthogonal transformation.

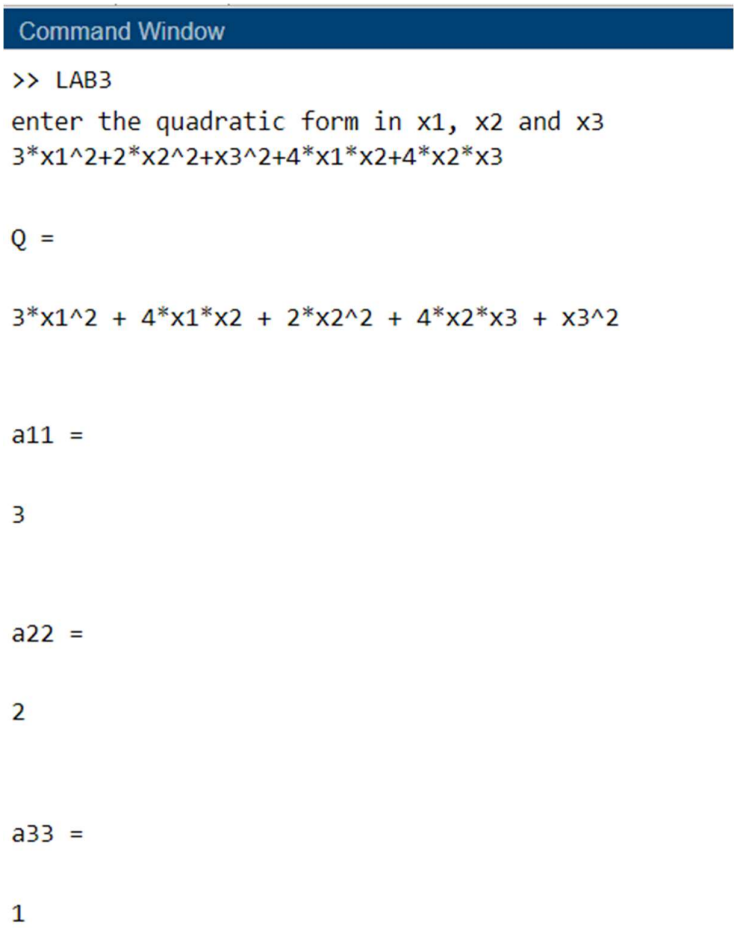
CODE-

```
syms x1 x2 x3 y1 y2 y3 X Y
Q=input('enter the quadratic form in x1, x2 and x3')
a11=(1/2)*diff(diff(Q,x1),x1)
a22=(1/2)*diff(diff(Q,x2),x2)
a33=(1/2)*diff(diff(Q,x3),x3)
a12=(1/2)*diff(diff(Q,x1),x2)
a21=a12
a13=(1/2)*diff(diff(Q,x1),x3)
a31=a13
a23=(1/2)*diff(diff(Q,x2),x3)
a32=a23
A=[a11 a12 a13;a21 a22 a23;a31 a32 a33] %matrix of the quadratic form
%finding modal matrix
[N D]=eig(A)
disp('The canonical form is')
disp(D(1,1)*y1^2+D(2,2)*y2^2+D(3,3)*y3^2)
%find orthogonal transformation matrix
X=[x1; x2; x3]
Y=[y1; y2; y3]
%assume(X, 'real');
%assume(Y, 'real');
display('The orthogonal transformation is X=NY')
X=N*Y
```

Steps)

1) Input q.
2) Hessian Matrix
3) [N Y] = eig(A)
4) X = NY

Command Window-



Command Window

```
a12 =

2


a21 =

2


a13 =

0


a31 =

0


a23 =

2
```

Command Window

```
a32 =

2


A =

[3, 2, 0]
[2, 2, 2]
[0, 2, 1]


N =

[2,  -1, 1/2]
[2, 1/2,  -1]
[1,   1,   1]


D =

[5, 0,  0]
[0, 2,  0]
[0, 0, -1]
```

Command Window

```
The canonical form is
5*y1^2 + 2*y2^2 - y3^2


X =

x1
x2
x3


Y =

y1
y2
y3

The orthogonal transformation is X=NY

X =

2*y1 - y2 + y3/2
2*y1 + y2/2 - y3
    y1 + y2 + y3
```

Que2)

. Write a MatLab code to solve the following differential equation using variation of parameters.

(a) $(D^2 + 2D + 1)y = x$.

(b) $(D^2 + D)y = x^2 + 2x + 4$.

Code-

```
syms x r c1 c2
p1 = input('Enter the coefficient of D2y: '); %a
p2 = input('Enter the coefficient of Dy: '); %b
p3 = input('Enter the coefficient of y: ');%c
eq=p1*r^2+p2*r+p3;
r=solve(eq, r);
p=real(r(1));
q=imag(r(1));
if q~=0
y1=exp(p*x)*cos(q*x);
y2=exp(p*x)*sin(abs(q)*x);
elseif r(1)==r(2)
y1=exp(r(1)*x);
y2=x*exp(r(1)*x);
else
y1=exp(r(1)*x);
y2=exp(r(2)*x);
end
y_h=c1*y1+c2*y2 %y_c
W=simplify(y1*diff(y2)-y2*diff(y1)) %%% W is the Wronskian
P = input('Enter the non-homogeneous part: ');%%% Solving of Non-Homogeneous part
Q = P/p1;
y_p=-y1*int(y2*Q/W)+y2*int(y1*Q/W)
y1=simplify(y_h+y_p); % general solution
disp('The general solution of the given ODE is ')
disp(y1)
% The following lines for solving boundary value problem on [a,b]:
```

Command Window-

a)

```
Command Window
>> LAB4
Enter the coefficient of D2y:
1
Enter the coefficient of Dy:
2
Enter the coefficient of y:
1

y_h =

c1*exp(-x) + c2*x*exp(-x)


W =

exp(-2*x)

Enter the non-homogeneous part:
x

y_p =

2*x + x*(x - 1) - x^2 - 2

The general solution of the given ODE is
x + c1*exp(-x) + c2*x*exp(-x) - 2
```

b)

```
Enter the coefficient of D2y:
1
Enter the coefficient of Dy:
1
Enter the coefficient of y:
0

y_h =

c2 + c1*exp(-x)


W =

exp(-x)

Enter the non-homogeneous part:
x^2+2*x+4

y_p =

(x*(x^2 + 3*x + 12))/3 - x^2 - 4

The general solution of the given ODE is
c2 + 4*x + x^3/3 + c1*exp(-x) - 4
```