

MTH643 Mega For Final Term March 2022

Prepared by Everblue

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Important and Solved Questions for Mid Term Exam

```
yy=eval(vectorize(y));  
zz=eval(vectorize(z));  
plot(t,xx,t,yy,t,zz)  
xlabel('x-axis')  
ylabel('y-axis')  
title('Graph of solution curves of DE')  
grid
```

L08_Q40: Find Numerical solution of the following differential equation on the interval [0,1] using Euler's Formula for $n=10$, $\frac{dy}{dx} = \sin(xy)$, $y(0) = \pi$ (**P#225-229 – LECT#08**)

```
function [xvalues,yvalues]=euler(f,x0,y0,xn,n);  
format long  
x0=0;  
y0=pi;  
xn=1;  
n=10;  
x(1)=x0;  
y(1)=y0;  
xn=1;  
dx=(xn-x0)/n;  
for k=1:n  
    x(k+1)=x(k)+dx;  
    y(k+1)=y(k)+sin(x(k)*y(k))*dx;  
end  
xvalues=x'  
yvalues=y'  
plot(xvalues,yvalues)
```

L08_Q41: Find the numerical solution of the following differential equation on the interval [0; 1] using Euler's method for $n = 20$. $\frac{dy}{dx} = \frac{y-x}{y+x}$, $y(0) = 0.5$

(**FOLLOW P#225-229 – LECT#08**)

%Find the numerical solution of the following differential equation on the interval [0,1]

%using Euler's method for $n = 20$. $dy/dx=(y-x)/(y+x)$, $y(0)=0.5$

```
function [xvalues,yvalues]=euler(f,x0,y0,xn,n);  
format long  
x0=0;  
y0=0.5;  
xn=1;  
n=20;  
x(1)=x0;  
y(1)=y0;  
xn=1;  
dx=(xn-x0)/n;  
for k=1:n  
    x(k+1)=x(k)+dx;  
    y(k+1)=y(k)+((y(k)-x(k))/(y(k)+x(k)))*dx;  
end  
xvalues=x'  
yvalues=y'  
plot(xvalues,yvalues)
```

**Important and Solved Questions for Mid Term Exam**

L08_Q42: Find the numerical solution of the following differential equation on the interval $[0; 1]$ using improved Euler's Formula for $n=10$, $\frac{dy}{dx} = \sin(xy)$, $y(0) = \pi$

(P#231-235 – LECT#08)

%Find the numerical solution of the following differential equation on the interval $[0,1]$

%using improved Euler's Formula for $n=10$, $dy/dx=\sin(xy)$, $y(0)=\pi$

function [xvalues,yvalues]=impeuler(f,x0,y0,xn,n);

format long

$f=@(x,y)\sin(x.*y);$

$x0=0;$

$y0=\pi;$

$xn=1;$

$n=10;$

$x(1)=x0;$

$y(1)=y0;$

$xn=1;$

$dx=(xn-x0)/n;$

for k=1:n

$x(k+1)=x(k)+dx;$

$y(k+1)=y(k)+dx/2*(f(x(k),y(k))+f(x(k)+dx,y(k)+dx*y(k)));$

end

$xvalues=x'$

$yvalues=y'$

$plot(xvalues,yvalues)$

L08_Q43: Find the numerical solution of the following differential equation on the interval $[0,1]$ using Improved Euler's method for $n = 20$. $\frac{dy}{dx} = \frac{y-x}{y+x}$, $y(0) = 0.5$

(FOLLOW P#231-235 – LECT#08)

%Find the numerical solution of the following differential equation on the interval $[0,1]$

%using Improved Euler's method for $n = 20$. $dy/dx=(y-x)/(y+x)$, $y(0)=0.5$

function [xvalues,yvalues]=impeuler(f,x0,y0,xn,n);

format long

$f=@(x,y)((y-x)/(y+x));$

$x0=0;$

$y0=0.5;$

$xn=1;$

$n=20;$

$x(1)=x0;$

$y(1)=y0;$

$xn=1;$

$dx=(xn-x0)/n;$

for k=1:n

$x(k+1)=x(k)+dx;$

$y(k+1)=y(k)+dx/2*(f(x(k),y(k))+f(x(k)+dx,y(k)+dx*y(k)));$

end

$xvalues=x'$

$yvalues=y'$

$plot(xvalues,yvalues)$

**Important and Solved Questions for Mid Term Exam**

L08_Q44: Find the numerical solution of the following initial value problem on the interval $[0,1]$ using improved Euler's method by taking step size $\Delta t = 0.01$, Moreover, plot the graph of the approximated solution curve. $\frac{dy}{dt} = \frac{y-t}{y+t}$, $y(0) = 0.5$

Note: The iterative form of the improved Euler's method is given below;

$$y_{k+1} \approx y_k + \frac{\Delta t}{2} (y'_k + f(t_{k+1}, y_k + \Delta t y'_k)), k = 0, 1, 2, \dots, n-1$$

(FOLLOW P#231-235 – LECT#08) –

(ABU SULTAN MID TERM Q#1 – 26 DEC 2019 – 12:00 pm)

%Find the numerical solution of the following initial value problem on the interval $[0,1]$

%using improved Euler's method by taking step size $\Delta t=0.01$,

%Moreover, plot the graph of the approximated solution curve. $dy/dt=(y-t)/(y+t)$, $y(0)=0.5$

function [yvalues,tvalues]=impeuler(f,y0,t0,yn,n);

format long

f=@(y,t)((y-t)/(y+t));

y0=0;

t0=1;

yn=0.5;

n=20;

y(1)=y0;

t(1)=t0;

yn=1;

dt=0.01;

for k=1:n

y(k+1)=y(k)+dt;

t(k+1)=t(k)+dt/2*(f(y(k),t(k))+f(y(k),t(k)+dt*t(k)));

end

yvalues=y'

tvalues=t'

plot(yvalues,tvalues)

L08_Q45: Find the numerical solution of the following differential equation on the interval $[0, 1]$ using Runge–Kutta method of fourth order for $n=10$, $\frac{dy}{dx} = \sin(xy)$, $y(0) = \pi$

(SOLUTION P#237-244 - LECT#08)

%Find the numerical solution of the following differential equation on the interval $[0,1]$

%using Runge–Kutta method of fourth order for $n=10$, $dy/dx=\sin(xy)$, $y(0)=\pi$

function [xvalues,yvalues]=RungeKutta(f,x0,y0,xn,n);

format long

f=@(x,y)sin(x.*y);

x0=0;

y0=pi;

xn=1;

n=10;

x(1)=x0;

y(1)=y0;

dx=(xn-x0)/n;

for k=1:n

x(k+1)=x(k)+dx;

k1=f(x(k),y(k));

k2=f(x(k)+dx/2,y(k)+dx/2*(k1));

k3=f(x(k)+dx/2,y(k)+dx/2*(k2));

k4=f(x(k+1),y(k)+dx*(k3));



Important and Solved Questions for Mid Term Exam

```
y(k+1)=y(k)+dx/6*(k1+2*k2+2*k3+k4);  
end  
xvalues=x'  
yvalues=y'  
plot(xvalues,yvalues)  
title('Runge Kutta Method of order four');  
grid;  
xlabel('x-axis');  
ylabel('y-axis');
```

L08_Q46: $\frac{dy}{dx} = \cos(x + y), n = 10, [0,1], y(0) = \pi$. Solve by using Range-kutta method.

(FOLLOW SOLUTION P#237-244 - LECT#08)

% dy/dx=Cos(x+y),n=10,[0,1],y(0)=pi

% Solve by using Range-kutta method.

```
function [xvalues,yvalues]=RungeKutta(f,x0,y0,xn,n);
```

```
format long
```

```
f=@(x,y)cos(x+y);
```

```
x0=0;
```

```
y0=pi;
```

```
xn=1;
```

```
n=10;
```

```
x(1)=x0;
```

```
y(1)=y0;
```

```
dx=(xn-x0)/n;
```

```
for k=1:n
```

```
    x(k+1)=x(k)+dx;
```

```
    k1=f(x(k),y(k));
```

```
    k2=f(x(k)+dx/2,y(k)+dx/2*(k1));
```

```
    k3=f(x(k)+dx/2,y(k)+dx/2*(k2));
```

```
    k4=f(x(k+1),y(k)+dx*(k3));
```

```
    y(k+1)=y(k)+dx/6*(k1+2*k2+2*k3+k4);
```

```
end
```

```
xvalues=x'
```

```
yvalues=y'
```

```
plot(xvalues,yvalues)
```

```
title('Runge Kutta Method of order four');
```

```
grid;
```

```
xlabel('x-axis');
```

```
ylabel('y-axis');
```

L08_Q47: Find the numerical solution of the following differential equation on the interval [0,1] using Runge–Kutta method of fourth order for $n = 20$ $\frac{dy}{dt} = \frac{y-x}{y+x}, y(0) = 0.5$

(FOLLOW SOLUTION P#237-244 - LECT#08)

% Find the numerical solution of the following differential equation on

% the interval [0, 1] using Runge–Kutta method of fourth order for $n = 20$

% dy/dt=(y-x)/(y+x) ,y(0)=0.5

```
function [xvalues,yvalues]=RungeKutta(f,x0,y0,xn,n);
```

```
format long
```

```
f=@(x,y)((y-x)/(y+x));
```

```
x0=0;
```

```
y0=0.5;
```



Important and Solved Questions for Mid Term Exam

```
xn=1;
n=20;
x(1)=x0;
y(1)=y0;
dx=(xn-x0)/n;
for k=1:n
    x(k+1)=x(k)+dx;
    k1=f(x(k),y(k));
    k2=f(x(k)+dx/2,y(k)+dx/2*(k1));
    k3=f(x(k)+dx/2,y(k)+dx/2*(k2));
    k4=f(x(k+1),y(k)+dx*(k3));
    y(k+1)=y(k)+dx/6*(k1+2*k2+2*k3+k4);
end
xvalues=x'
yvalues=y'
plot(xvalues,yvalues)
title('Runge Kutta Method of order four');
grid;
xlabel('x-axis');
ylabel('y-axis');
```

L08_Q48: Find Numerical solution of the following differential equation on the interval $[0,1]$ using Taylor's Formula for $n=10$, $\frac{dy}{dx} = \sin(xy)$, $y(0) = \pi$

(SOLUTION P#245-250 - LECT#08)

%tical solution of the following differential equation on the interval

%[0,1] using Taylor's Formula for $n=10$, $dy/dx = \sin(xy)$, $y(0) = ?$

```
function [xvalues,yvalues]=TaylorOrder(f,x0,y0,xn,n);
```

```
format long
```

```
f=@(x,y)sin(x.*y);
```

```
x0=0;
```

```
y0=pi;
```

```
xn=1;
```

```
n=10;
```

```
x(1)=x0;
```

```
y(1)=y0;
```

```
dx=(xn-x0)/n;
```

```
for k=1:n
```

```
    x(k+1)=x(k)+dx;
```

```
    y(k+1)=y(k)+f(x(k),y(k))*dx+(y(k)*cos(x(k)*y(k))+x(k)*cos(x(k)*y(k))*f(x(k),y(k)))*(dx)^2/2;
```

```
end
```

```
xvalues=x'
```

```
yvalues=y'
```

```
plot(xvalues,yvalues)
```

```
title('Taylor's Method of Second Order');
```

```
grid;
```

```
xlabel('x-axis');
```

```
ylabel('y-axis');
```

**Important and Solved Questions for Mid Term Exam**

L08_Q49: Find the numerical solution of the following differential equation on the interval $[0,1]$ using Taylor's method of second order for $n = 20$. $\frac{dy}{dx} = \frac{y-x}{y+x}$, $y(0) = 0.5$

(FOLLOW SOLUTION P#245-250 - LECT#08)

%Find the numerical solution of the following differential equation on

% the interval $[0,1]$ using Taylor's method of second order for $n = 20$.

% $dy/dx=(y-x)/(y+x)$, $y(0)=0.5$

function [xvalues,yvalues]=TaylorOrder(f,x0,y0,xn,n);

format long

$f=@(x,y)((y-x)/(y+x));$

$x0=0;$

$y0=0.5;$

$xn=1;$

$n=20;$

$x(1)=x0;$

$y(1)=y0;$

$dx=(xn-x0)/n;$

for $k=1:n$

$x(k+1)=x(k)+dx;$

$y(k+1)=y(k)+f(x(k),y(k))*dx+(y(k)*\cos(x(k)*y(k))+x(k)*\cos(x(k)*y(k))*f(x(k),y(k)))*(dx)^2/2;$

end

$xvalues=x'$

$yvalues=y'$

$plot(xvalues,yvalues)$

$title('Taylor's Method of Second Order');$

$grid;$

$xlabel('x-axis');$

$ylabel('y-axis');$

L08_Q50: Solve by Taylor method $\frac{dy}{dx} = \cos(xy)$, $y(0) = 1$, here $n = 10$ order.

(FOLLOW SOLUTION P#245-250 - LECT#08)

%Solve by Taylor method $dy/dx=\cos(xy)$, $y(0)=1$, here $n=10$ order

function [xvalues,yvalues]=TaylorOrder(f,x0,y0,xn,n);

format long

$f=@(x,y)\cos(x.*y);$

$x0=0;$

$y0=1;$

$xn=1;$

$n=10;$

$x(1)=x0;$

$y(1)=y0;$

$dx=(xn-x0)/n;$

for $k=1:n$

$x(k+1)=x(k)+dx;$

$y(k+1)=y(k)+f(x(k),y(k))*dx+(y(k)*\cos(x(k)*y(k))+x(k)*\cos(x(k)*y(k))*f(x(k),y(k)))*(dx)^2/2;$

end

$xvalues=x'$

$yvalues=y'$

$plot(xvalues,yvalues)$

$title('Taylor's Method of Second Order');$



Important and Solved Questions for Mid Term Exam

```
grid;  
xlabel('x-axis');  
ylabel('y-axis');
```

MIX_Q51: Find the solution of the following second order differential equation

$$y''(t) + 8y'(t) + 2y(x) = \cos(x). \quad (\text{PAST PAPERS})$$

%Find the solution of the following second order differential equation

```
%y''(t)+8y'(t)+2y(x)=Cos(x) .
```

```
clc
```

```
clear all
```

```
close all
```

```
eq1='D2y+8*Dy+2*y(x)=cos(x) '
```

```
dsolve(eq1, 't')
```

MIX_Q52: Plt to the contour plots of the expression $z=x*\exp(-x^2-y^2)$ range is $-2 < x < 2$ and $-3 < y < 3$. Label the horizontal axis with x and vertical axis with y. keep the title of graph contour plots of the expression.

(ABU SULTAN MID TERM Q#2 – 26 DEC 2019 – 12:00 pm)

```
%Plt to the contour plots of the expression z=x*exp(-x^2-y^2)
```

```
%range is -2<x<2 and -3<y<3
```

```
%Label the horizontal axis with x and vertical axis with y
```

```
%keep the title of graph contour plots of the expression
```

```
clc
```

```
clear all
```

```
close all
```

```
syms x y
```

```
[X,Y]=meshgrid(-2:0.5:2,-3:0.5:3);
```

```
contour(X,Y,X.*exp(-X.^2-Y.^2));
```

```
xlabel('x-axis');
```

```
ylabel('y-axis');
```

```
title('Graph of Contour plots of the expression');
```

```
grid;
```

The End

**Don't look for someone who can solve your problems,
Instead go and stand in front of the mirror,
Look straight into your eyes,
And you will see the best person who can solve your problems!
Always trust yourself.**

(BY ABU SULTAN)



MTH643 - INTRODUCTION TO MATLAB (BY ABU SULTAN)

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SOLVED QUESTIONS FOR FINAL TERM EXAM [LECT 09 TO 15]

L09&15_Q01: Find the numerical plot of the following initial value problem on [0,2]:

$$y'(x) = y - x^2 + 1, y(0) = 0.5$$

%Find the numerical plot of the following initial value problem on [0,2]:

```
% y'(x)=y-x^2+1 , y(0)=0.5
```

```
clc
```

```
clear all
```

```
close all
```

```
f=@(x,y) (y-x.^2+1+x*y)
```

```
ode45(f, [0,2], 0.5)
```

```
xlabel('x-axis')
```

```
ylabel('y-axis')
```

```
title('Numerical Plot of IVP')
```

```
grid
```

Malik hafeez current papers

L09&15_Q02: Plot the family of the approximate solutions of the following Initial Value Problem (IVPs): $y'(x) = y - x^2 + 1, y(0) = 0.5:0.3:3$

%Plot the family of the approximate solutions of the following Initial Value Problem (IVPs):

```
% y'(x)=y-x^2+1 , y(0)=0.5:0.3:3
```

```
clc
```

```
clear all
```

```
close all
```

```
f=@(x,y) (y-x.^2+1)
```

```
ode45(f, [0,2], 0.5:0.3:3)
```

```
xlabel('x-axis')
```

```
ylabel('y-axis')
```

```
title('Family of the approximate solutions of IVPs')
```

```
grid
```

Malik hafeez current papers

Imp by Sultan

L09&15_Q03: Compute the numerical values of the approximate solution of the following IVP at $x=0:0.2:2$, $y'(x) = y - x^2 + 1, y(0) = 0.5$

%Compute the numerical values of the approximate solution of the following IVP

```
% at x= 0:0.2:2, y'(x)=y-x^2+1 , y(0)=0.5
```

```
clc
```

```
clear all
```

```
close all
```

```
f=@(x,y) (y-x.^2+1)
```

```
[x,ya]=ode45(f, 0:0.2:2, 0.5)
```

```
plot(x,ya)
```

Malik hafeez current papers

Imp by Sultan

L09&15_Q04: Find the exact solution of the following IVPs, then compute its approximate solution at $x=0:0.2:2$ using ode45 command. Finally, makes the table of values at t, y_a and $y(\text{exact solution})$.
 $y'(x) = y - x^2 + 1, y(0) = 0.5$

%Find the exact solution of the following IVPs,

%then compute its approximate solution at $x=0:0.2:2$ using ode45 command.

%Finally, makes the table of values at t, y_a and $y(\text{exact solution})$.

```
%y'(x)=y-x^2+1 , y(0)=0.5
```

```
clc
```

```
clear all
```

```
close all
```

```
eq='Dy=y-x^2+1';
```

```
initialcond='y(0)=0.5';
```

```
y=dsolve(eq, initialcond, 'x')
```

```
f=@(x,y) (y-x.^2+1)
```

```
[x,ya]=ode45(f, 0:0.2:2, 0.5)
```

```
[x,ya,2.*x-exp(x)./2+x.^2+1]
```

L09_Q05: Find the exact solution of the following IVPs at some specific domain elements, $x=-0.2,-0.4,-0.6,-0.8,-1.0$ in the interval $[-1,0]$ using ode45 command.

$$y'(x) = y - x^2 + 1, y(0) = 0.5$$

% Find the exact solution of the following IVPs at some specific domain elements,



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SOLVED QUESTIONS FOR FINAL TERM EXAM [LECT 09 TO 15]

```
% x=-0.2,-0.4, -0.6, -0.8, -1.0 in the interval [-1,0] using ode45 command.
% y'(x)=y-x^2+1, y(0)=0.5
clc
clear all
close all
f=@(x,y) (y-x.^2+1)
ode45(f,0:-0.2:-1,0.5)
xlabel('x-axis')
ylabel('y-axis')
title('Graphical view of IVP when initial condition is mentioned at the right end
pont')
grid
```

L09_Q06: Plot the family of the approximate solutions of the following IVP on the interval [-1, 2] using ode45 command. $y'(x) = y - x^2 + 1, y(0) = 1:0.2:3$

```
%Plot the family of the approximate solutions of the following IVP on the interval
[-1, 2]
% using ode45 command. y'(x)=y-x^2+1 ,y(0)=1:0.2:3
clc
clear all
close all
f=@(x,y) (y-x.^2+1)
[x,y]=ode45(f,[0,-2],1:0.2:3);
plot(x,y)
hold on
[x1,y1]=ode45(f,[0,2],1:0.2:3);
plot(x1,y1)
hold off
xlabel('x-axis')
ylabel('y-axis')
title('Family of approximation solutions of IVPs')
grid
```

L09_Q07: Find the numerical solution of system of non linear initial value problems.

$$\frac{dx}{dt} = -x + 3z, \quad \frac{dy}{dt} = -y + 2z, \quad \frac{dz}{dt} = x^2 - 2z$$

$x(0) = 1, y(0) = \frac{1}{2}, z(0) = 3, tspan = [0,3]$ by using ode45 command.

```
%Find the numerical solution of system of Non linear initial value problems.
%dx/dt=-x+3z,dy/dt=-y+2z,dz/dt=x^2-2z
%x(0)=1,y(0)=1/2,z(0)=3,tspan=[0,3] by using ode45 command
clc
clear all
close all
format short
tspan=[0,1.5];
x0=1;
y0=0.5;
z0=3;
f=@(t,x) [-x(1)+3*x(3);-x(2)+2*x(3);x(1)^2-2*x(3)];
[t,x]=ode45(f,tspan,[x0 y0 z0])
plot3(x(:,1),x(:,2),x(:,3))
xlabel('x-axis')
ylabel('y-axis')
title('Numerical Solution of IVP')
grid
```

L09_Q08: Find the numerical solution of system of initial value problems. $\frac{dy}{dt} = 2t, y(0) = 0, tspan = [0,5]$ by using ode45 command. [Malik hafeez current papers](#)

```
%Find the numerical solution of system of initial value problems.
%dy/dt=2t
%y(0)=0,tspan=[0,5] by using ode45 command
```



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SOLVED QUESTIONS FOR FINAL TERM EXAM [LECT 09 TO 15]



```
clc
clear all
close all
f=@(t,y) (2*t);
tspan=[0,5];
y0=0;
[t,y]=ode45(f,tspan,y0)
plot(t,y)
xlabel('x-axis')
ylabel('y-axis')
title('Numerical Solution of IVP')
grid
```

Imp by sultan

L09_Q09: Compare the exact and approximate solution of $\frac{dy}{dt} = t + y$, $y(0) = 3$, $tspan = [0,5]$ by using ode45 command.

```
%Compare the exact and approximate solution of dy/dt=t+y ,
%y(0)=3,tspan=[0,5] by using ode45 command
clc
clear all
close all
format short
f=@(t,y) (t+y);
tspan=[0,5];
y0=3;
[t,y]=ode45(f,tspan,y0);
exactsoln=dsolve('Dy=t+y','y(0)=3','t');
exact=eval(vectorize(exactsoln));
table=[t,y,exact]
plot(t,y,'b',t,exact,'r')
legend('Approximate','Exact')
xlabel('x-axis')
ylabel('y-axis')
title('Comparing exact and approximate solution of ODE')
```

L10_Q10: Create ROW VECTOR by following four ways. Elements separated by commas, elements separated by spaces, by using colon when elements of row vector iterate with equal interval, by using colon sign and increment value by between starting and ending element.

```
%Create ROW VECTOR by following four ways.
% 1. Elements separated by commas.
% 2. Elements separated by spaces.
% 3. By using colon when elements of row vector iterate with equal interval.
% 4. By using colon sign & increment value by b/w starting & ending element.
clc
clear all
close all
echo on
RV1=[2,3,4,5,6]
RV2=[2 3 4 5 6]
RV3=2:6
RV4=2:1:6
echo off
```

L10_Q11: Create COLUMN VECTOR by following ways. Elements separated by semi colon, elements separated by spaces or commas and then taking transpose.

```
% Create COLUMN VECTOR by following ways.
% 1. Elements separated by semi colon
% 2. Elements separated by spaces or commas and then taking transpose.
clc
clear all
close all
echo on
```



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```
CV1=[2;3;4;5;6]
RV1=[2 3 4 5 6];
CV2=RV1'
RV2=[2 3 4 5 6];
CV3=RV2'
echo off
```

L10_Q12: Create a matrix of 2 or more rows and columns. Elements in each row are separated by spaces or commas while elements in each column are separated by semicolon.

```
% Create a matrix of 2 or more rows and columns.
% Elements in each row are separated by spaces or commas
% while elements in each column are separated by semicolon.
clc
clear all
close all
echo on
M2by5=[2,3,4,5,6;12,13,14,15,16]
M2by5=[2 3 4 5 6;12 13 14 15 16]
echo off
```

L10_Q13: Generate a symmetric matrix by using pascal built-in function.

```
% Generate a symmetric matrix by using pascal built-in function.
clc
clear all
close all
echo on
A=pascal(2)
AA=transpose(A)
echo off
```

L10_Q14: Generate a anti symmetric matrix by using magic built-in function.

```
% Generate a anti symmetric matrix by using magic built-in function.
clc
clear all
close all
echo on
A=magic(3)
AA=transpose(A)
echo off
```

L10_Q15: Generate a diagonal matrix by using a vector and diag built-in function.

```
% Generate a diagonal matrix by using a vector and diag built-in function.
clc
clear all
close all
echo on
A=[1,2,3,4]
B=diag(A)
echo off
```

L10_Q16: Generate a diagonal vector of a magic matrix by using diag built-in function.

```
% Generate a diagonal vector of a magic matrix by using diag built-in function.
clc
clear all
close all
echo on
A=magic(3)
AA=diag(A)
AA=diag(A')
echo off
```



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L10_Q17: Generate 4-by-4 matrix on ones by using built-in function 'ones'. Generate 4-by-4 identity matrix by using built-in function 'eye'. Generate 4-by-4 null matrix by using built-in function 'zero'.

```
% Generate 4-by-4 matrix on ones by using built-in function 'ones'.  
% Generate 4-by-4 identity matrix by using built-in function 'eye'.  
% Generate 4-by-4 null matrix by using built-in function 'zero'.  
clc  
clear all  
close all  
echo on  
A=ones(4)  
A=eye(4)  
A=zeros(4)  
echo off
```

L10_Q18: Add and subtract scalar to each element of a vector.

```
% Add and subtract scalar to each element of a vector.  
clc  
clear all  
close all  
echo on  
A=[1 2 3 4]  
AA=A+3  
AA=A-3  
echo off
```

L10_Q19: Addition of two matrixes with same order.

```
% Addition of two matrixes with same order.  
clc  
clear all  
close all  
echo on  
A=[1 2 3 4];  
B=[3 5 6 7];  
C=A+B  
D=A-B  
echo off
```

Imp by sultan

L10_Q20: Find determinant of a matrix.

```
% Find determinant of a matrix.  
clc  
clear all  
close all  
echo on  
A=[1 2 3; 4 5 6; 5 2 1];  
B=det(A)  
echo off
```

Imp by sultan

L10_Q21: Find inverse matrix of a matrix.

```
% Find inverse matrix of a matrix.  
clc  
clear all  
close all  
format short  
echo on  
A=[1 2 3; 4 5 6; 5 2 1];  
B=inv(A)  
echo off
```

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L10_Q22: Multiplication of two matrixes by using for loop.



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% Multiplication of two matrixes by using for loop.

```
clc
clear all
close all
format short
echo on
A=[1 2 3;4 5 6];
%order of A=2 by 3
B=[3 4 6;4 5 1;4 3 1];
%order of B=3 by 3
for i=1:2
    for j=1:3
        C(i,j)=A(i,:)*B(:,j)
    end
end
C
C1=A*B
echo off
```

L10_Q23: By using sum command compute a vector of row elements.

% By using sum command compute a vector of row elements.

```
clc
clear all
close all
echo on
A=sym([3 4/3 6;4 5 1;4 3 1]);
B=sum(A)
A=[3 4/3 6;4 5 1;4 3 1];
B=sum(A)
echo off
```

L10_Q24: By using sum command compute a vector of column elements.

% By using sum command compute a vector of column elements.

```
clc
clear all
close all
echo on
A=sym([3 4 6;4 5 1;4 3 1]);
B=sum(A')
A=[3 4 6;4 5 1;4 3 1];
B=sum(A')
echo off
```

L10_Q25: By using sum and end command compute a vector of row elements.

% By using sum and end command compute a vector of row elements.

```
clc
clear all
close all
echo on
A=sym([3 4 6;4 5 1;4 3 1]);
B=sum(A(:,1))
B=sum(A(:,2))
B=sum(A(:,end))
echo off
```

L10_Q26: Multiplication of two matrices by using for loop.

% Multiplication of two matrixes by using for loop.

```
clc
clear all
```



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```
close all
format short
echo on
A=[1;2;3];
%order of A=3 by 1
B=[3 5 1];
%order of B=1 by 3
for i=1:3
    for j=1:3
        C(i,j)=A(i,:)*B(:,j)
    end
end
C
C1=A*B
echo off
```

L10_Q27: Multiplication of two matrixes by using for loop.

```
% Multiplication of two matrixes by using for loop.
clc
clear all
close all
format short
echo on
A=sym([5/6,1/6,0;1/6,0,5/6;0,5/6,1]);
%order of A=3 by 3
B=sym([5/2,1/2,0;1/3,0,5/3;0,5/6,1]);
%order of B=3 by 3
for i=1:3
    for j=1:3
        C(i,j)=A(i,:)*B(:,j)
    end
end
C
C1=A*B
echo off
```

L10_Q28: Find the sum of second column or second row of a matrix.

```
% Find the sum of second column or second row of a matrix.
clc
clear all
close all
echo on
A=[2 4 6;3 1 9;2 4 6];
SumCol2=sum(A(:,2))
SumRow1=sum(A(2,:))
echo off
```

Imp by sultan

L11_Q29: Compute the Eigen values and Eigen vectors of the following matrix

$$B = \begin{bmatrix} 0 & 1 & 3 \\ 2 & 4 & 1 \\ 6 & 1 & 8 \end{bmatrix}$$

```
% Compute the Eigen values and Eigen vectors of the following matrix
clc
clear all
close all
echo on
A=[0,1,3;2,4,1;6,1,8]
eig(A)
[V,D]=eig(A)
echo off
```



L11_Q30: Find reduced row echelon form of the following matrix

$$B = \begin{bmatrix} 0 & 1 & 3 \\ 2 & 4 & 1 \\ 6 & 1 & 8 \end{bmatrix}$$

```
% Find reduced row echelon form of the following matrix
clc
clear all
close all
echo on
A=[0,1,3;2,4,1;6,1,8]
RREFA=rref(A)
echo off
```

L11_Q31: Find solution of the following system of linear equations.

$$x_1 + 3x_2 = -2, \quad 2x_1 + 4x_2 = 1$$

```
% Find solution of the following system of linear equations.
% x1+3x2=-2; 2x1+4x2=1
clc
clear all
close all
echo on
CoefmA=sym([1,3;2,4])
ColmB=sym([-2;1])
C=inv(CoefmA);
X=C*ColmB
echo off
```

L11_Q32: Solve following system of linear equations by using **solve** command.

$$3x + 2y + z = 1, \quad y = 2, \quad x + 2y = 3$$

```
% Solve following system of linear equations by using solve command.
%3x+2y+z=1; y=2; x+2y=3
clc
clear all
close all
echo on
eq1='3*x+2*y+z=1'
eq2='y=2'
eq3='x+2*y=3'
soln=solve(eq1,eq2,eq3)
X=double([soln.x,soln.y,soln.z])
echo off
```

L11_Q33: Solve following system of linear equations by following four methods

$$x + 2y + 4z = 1, \quad 3x + 2y + 4z = 2, \quad 2x + 4y + 5z = 5$$

By 'integer division', By 'inverse if possible', By using 'solve command' and by using 'mldivide command'.

```
% Solve following system of linear equations by following four methods
%x+2y+4z=1; 3x+2y+4z=2; 2x+4y+5z=5
% 1. By 'integer division', 2. By 'inverse if possible',
% 3. By using 'solve command' 4. By using 'mldivide command'.
clc
clear all
close all
echo on
A=[1,2,4;3,2,4;2,4,5]
B=[1;2;5]
% 1. By 'integer division'.
X=A\B
```



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```
%2. By 'inverse if possible',  
C=inv(A);  
X=C*B  
% 3. By using 'solve command'  
eq1='x+2*y+4*z=1';  
eq2='3*x+2*y+4*z=2';  
eq3='2*x+4*y+5*z=5';  
soln=solve(eq1,eq2,eq3);  
X=double([soln.x,soln.y,soln.z])'  
%4. By using 'mldivide command'.  
X=mldivide(A,B)  
echo off
```

L11_Q34: Consider the system of linear equations;

$$3x + 2y + z = 1, \quad y = 2, \quad x + 2y = 3$$

Enter it into MATLAB as an augmented matrix named Ab; Use elementary row operations to reduced echelon form.

```
% Consider the system of linear equations;  
% 3x+2y+z=1; y=2 ; x+ 2y=3  
% Enter it into MATLAB as an augmented matrix named Ab;  
% Use elementary row operations to reduced echelon form.  
clc  
close all  
clear all  
echo on  
format short  
A=[3,2,1;0,1,0;1,2,0];  
b=[1,2,3]';  
Ab=[A,b];  
Ab(1,:)=1/3*Ab(1,:);  
Ab(3,:)=Ab(3,:)-Ab(1,:);  
Ab(1,:)=Ab(1,:)-0.6667*Ab(2,:);  
Ab(3,:)=Ab(3,:)-1.3333*Ab(2,:);  
Ab(3,:)=1/-0.3333*Ab(3,:);  
Ab(1,:)=Ab(1,:)-0.3333*Ab(3,:);  
X=Ab(:,4)
```

L11_Q35: Show that $\begin{pmatrix} a \\ b \end{pmatrix}$ is in the span of $\begin{pmatrix} -2 & 1 \\ 1 & 6 \end{pmatrix}$.

```
% Show that [a;b] is in the span of [-2,1;1,6]  
clc  
close all  
clear all  
echo on  
format short  
syms a b  
A=[-2,1;1,6];  
b=[a;b];  
Ab=[A b];  
sol=rref(Ab)  
disp('Possible values of weights');  
X=sol(:,3)
```

L11_Q36: Consider the system of linear equations;

$$x_1 + 2x_2 - 3x_3 = -3, \quad -4x_1 - 5x_2 + 2x_3 = -2, \quad 2x_1 + 3x_2 - x_3 = 2$$

Enter it into MATLAB as an augmented matrix named Ab; Use elementary row operations to reduced echelon form. Give the solution of the system. (If the system has no solution say that. Otherwise write the basic variables (Those corresponding to pivot columns) as function of numbers and free variables, if there are any).

```
% Consider the system of linear equations;
```



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```
%x1+2*x2-3*x3=-3
%-4*x1-5*x2+2*x3=-2
%2*x1+3*x2-x3=2
%Enter it into MATLAB as an augmented matrix named Ab;
%Use elementary row operations to reduced echelon form.
%Give the solution of the system.
clc
close all
clear all
echo on
format short
A=[1,2,-3;-4,-5,2;2,3,-1];
b=[-3;-2;2];
Ab=[A b]
Ab(2,:)=Ab(2,:)+4*Ab(1,:);
Ab(3,:)=Ab(3,:)-2*Ab(1,:);
Ab(2,:)=1/3*Ab(2,:);
Ab(3,:)=Ab(2,:)+Ab(3,:);
Ab(1,:)=2*Ab(2,:)-Ab(1,:);
Ab(1,:)=(-1)*Ab(1,:);
Ab(3,:)=(1/1.6667)*(Ab(3,:));
Ab(2,:)=(3.3333)*(Ab(3,:))+(Ab(2,:));
Ab(1,:)=(3.6667)*(Ab(3,:))-(Ab(1,:));
Ab(1,:)=(-1)*Ab(1,:);
X=Ab(:,4)
```

L11_Q37: Consider the system of linear equations;

$$x_1 + 3x_3 + x_5 = -1, \quad 4x_1 + x_2 + x_3 + 6x_5 = 1, \quad -3x_1 - 3x_2 - 3x_3 + x_4 - 19x_5 = 6, \\ 10x_1 - 4x_2 + 38x_3 + 2x_4 - 12x_5 = 0$$

Enter it into MATLAB as an augmented matrix named Ab; Use elementary row operations to reduced echelon form. Give the solution of the system. (If the system has no solution say that. Otherwise write the basic variables (Those corresponding to pivot columns) as function of numbers and free variables, if there are any).

```
% Consider the system of linear equations;
% x1+3*x3+x5=-1
% 4*x1+x2+x3+6*x5=1
% -3*x1-3*x2-3*x3+x4-19*x5=6
% 10*x1-4*x2+38*x3+2*x4-12*x5=0
%Enter it into MATLAB as an augmented matrix named Ab;
%Use elementary row operations to reduced echelon form.
%Give the solution of the system.
clc
close all; clear all
echo on
format short
A=[1,0,3,0,1;4 1 1 0 6;-3 -3 -3 1 -19;10 -4 38 2 -12];
b=[-1;1;6;0];
Ab=[A b]
Ab(2,:)=4*Ab(1,:)-Ab(2,:);
Ab(3,:)=3*Ab(1,:)+Ab(3,:);
Ab(4,:)=10*Ab(1,:)-Ab(4,:);
Ab(3,:)=3*Ab(2,:)-Ab(3,:);
Ab(4,:)=4*Ab(2,:)+Ab(4,:);
Ab(2,:)=(-1)*Ab(2,:);
Ab(3,:)=(1/27)*Ab(3,:);
Ab(4,:)=36*Ab(3,:)-Ab(4,:);
Ab(2,:)=11*Ab(3,:)+Ab(2,:);
Ab(1,:)=3*Ab(3,:)-Ab(1,:);
Ab(4,:)=(1/0.6667)*Ab(4,:);
Ab(1,:)=(0.1111)*Ab(4,:)+Ab(1,:);
```



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```
Ab(2,:)=(0.4074)*Ab(4,:)+Ab(2,:);
Ab(3,:)=(0.0370)*Ab(4,:)+Ab(3,:);
Ab(1,:)=(-1)*Ab(1,:);
Ab
disp('x5 is free variable - Let x5=1 then other values will be as under')
x=Ab(:,6)-Ab(:,5)
x1=1
x2=x(1,:)
x3=x(2,:)
x4=x(3,:)
x5=x(4,:)
```

L11_Q38: Show that $\begin{pmatrix} h \\ k \end{pmatrix}$ is in the span of $\begin{pmatrix} -3 & 2 \\ 4 & 5 \end{pmatrix}$.

```
% Show that [h;k] is in the span of [-3,2;4,5]
clc
close all
clear all
echo on
format short
syms h k
A=[-3,2;4,5];
b=[h;k];
Ab=[A b];
sol=rref(Ab)
disp('Possible values of weights');
X=sol(:,3)
```

L11_Q39: Solve the matrix equations of Sylvester type i.e. $AX+XB=C$. The matrices A,B and C are known and Matrix X to be determined.

```
% Solve the matrix equations of Sylvester type i.e. AX+XB=C.
% The matrices A,B and C are known and Matrix X to be determined.
clc
clear all
close all
echo on
A=[2,3,4;4,5,2;2,3,5]
B=[-3,3,4;-8,-3,2;0,3,5]
C=[-6,0,4;3,5,9;2,3,4]
X=sylvester(A,B,C)
echo off
```

L12&15_Q40: Compute the Riemann sum of the function $f(x) = e^{-x^2}$ for n=4, 6, 8, 10, 100 and 1000 by choosing C_k as the right end point of the interval [0, 2].

```
% Compute the Riemann sum of the function f(x)=e^(-x^2)
% for n=4, 6, 8, 10, 100 and 1000
% by choosing CK as the right end point of the interval [0, 2].
clc
clear all;
close all;
a=0;
b=2;
n=100;
%ALSO CHECK RESULTS BY PUTTING n=4, n=6, n=8, n=10 and n=1000
value=0;
f=inline('exp(-x^2)');
dx=(b-a)/n;
for k=1:n
    c=a+k*dx;
    value=value+f(c);
end
value=dx*value
```



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L12_Q41: Compute the Riemann sum of the function $f(x) = e^{-x^2}$ for $n=100$ by choosing C_K is randomly selected on the interval $[0, 2]$.

```
% Compute the Riemann sum of the function f(x)=e^(-x^2) for n=100
% by choosing CK is randomly selected on the interval [0, 2].
clear all;
close all;
clc;
a=0;
b=2;
n=100;
value=0;
f=inline('exp(-x^2)');
dx=(a-b)/n;
for k=1:n
    c=dx*rand+(a+(k-1)*dx)
    value=value+f(c);
end
value=dx*value;
```

L12_Q42: Find the Riemann sum of the function $f(x) = x^2$ for $n=100$ by choosing C_K is randomly selected on the interval $[-1, 3]$.

```
% Find the Riemann sum of the function f(x)=x^2 for n=100
% by choosing CK is randomly selected on the interval [-1, 3].
clear all;
close all;
clc;
a=-1;
b=3;
n=100;
value=0;
f=inline('x^2');
dx=(a-b)/n;
for k=1:n
    c=dx*rand+(a+(k-1)*dx)
    value=value+f(c);
end
value=dx*value;
```

L12&15_Q43: For the integral $\int_1^5 \sqrt{1+x^3} dx$ compute the Riemann sum approximation using 100 equally spaced sub-intervals and left end points.

```
% For the integral sqrt((1+x^3))dx [1, 5]
% compute the Riemann sum approximation
% using 100 equally spaced sub-intervals and left end points.
function value=riemannsum(f,a,b,n)
clear all;
close all;
clc;
a=1;
b=5;
n=100;
value=0;
f=@(x) (sqrt(1+x.^3));
dx=(b-a)/n;
for k=1:n
    c=a+(k-1)*dx;
    value=value+f(c);
end
value=dx*value;
```

L12&15_Q44: For the integral $\int_1^5 \sqrt{1+x^3} dx$ compute the Riemann sum approximation using 100 equally spaced sub-intervals and right end points.

```
% For the integral sqrt((1+x^3))dx [1, 5]
```



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```
% compute the Riemann sum approximation
% using 100 equally spaced sub-intervals and right end points.
function value=riemannsum(f,a,b,n)
clear all;
close all;
clc;
a=1;
b=5;
n=100;
value=0;
f=@(x) (sqrt(1+x.^3));
dx=(b-a)/n;
for k=1:n
    c=a+(k)*dx;
    value=value+f(c);
end
value=dx*value;
```

L12&15_Q45: For the integral $\int_1^5 \sqrt{1+x^3} dx$ compute the Riemann sum approximation using 100 equally spaced sub-intervals and mid points.

```
% For the integral sqrt((1+x^3))dx [1, 5]
% compute the Riemann sum approximation
% using 100 equally spaced sub-intervals and right end points.
function value=riemannsum(f,a,b,n)
clear all;
close all;
clc;
a=1;
b=5;
n=100;
value=0;
f=@(x) (sqrt(1+x.^3));
dx=(b-a)/n;
for k=1:n
    c=((a+(k)*dx)+(a+(k-1)*dx))/2;
    value=value+f(c);
end
value=dx*value;
```

L12&15_Q46: Compute the definite integral of the function $f(x) = e^{-x^2}$ using Trapezoid Rule considering 100 sub-intervals (that is, $n=100$) on the interval $[0, 2]$.

```
% Compute the definite integral of the function f(x)=e^(-x^2) using Trapezoid Rule
% considering 100 sub-intervals (that is, n=100) on the interval [0, 2].
clear all;
clc;
close all;
sum=0;
a=0;
b=2;
n=100;
f=inline('exp(-x^2)');
dx=(b-a)/n;
Averagevalue=(f(b)+f(a))/2;
for k=1:(n-1)
    c = a+k*dx;
    sum=sum+f(c);
end
Answer=(sum+Averagevalue)*dx
```

L12_Q47: Compute the definite integral of the function $f(x) = \sin(x)$ using Trapezoid Rule on the interval $[0, \pi]$ for $n=8, 12, 100$.

```
% Compute the definite integral of the function f(x)=sin(x)
% using Trapezoid Rule on the interval [0, pi] for n=8, 12, 100.
```



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```
close all
clear all
clc
a=0;
b=pi;
n=8;
%ALSO CHECK RESULTS BY PUTTING n=12 and n=100
dx=(b-a)/n;
f=@(x)(sin(x));
AW=(f(a)+f(b))/2;
for k=1:n-1
    x(k)=a+k*dx;
end
funvalue=f(x);
answer=(sum(funvalue)+AW)*dx
```

Imp by sultan

L12&15_Q48: Compute the following integral $\int_1^5 \sqrt{1+x^3} dx$ using Trapezoid Rule considering 10 equally spaced sub-intervals.

```
% Compute the following integral sqrt((1+x^3))dx [1, 5]
% using Trapezoid Rule considering 10 equally spaced sub-intervals.
close all
clear all
clc
a=1;
b=5;
n=10;
dx=(b-a)/n;
f=@(x)(sqrt(1+x.^3));
AW=(f(a)+f(b))/2;
for k=1:n-1
    x(k)=a+k*dx;
end
funvalue=f(x);
answer=(sum(funvalue)+AW)*dx
```

L12&15_Q49: Compute the following integral $\int_1^5 \sqrt{1+x^3} dx$ using Trapezoid Rule considering 100 equally spaced sub-intervals.

```
% Compute the following integral sqrt((1+x^3))dx [1, 5]
% using Trapezoid Rule considering 100 equally spaced sub-intervals.
close all
clear all
clc
a=1;
b=5;
n=100;
dx=(b-a)/n;
f=@(x)(sqrt(1+x.^3));
AW=(f(a)+f(b))/2;
for k=1:n-1
    x(k)=a+k*dx;
end
funvalue=f(x);
answer=(sum(funvalue)+AW)*dx
```

L12&15_Q50: Compute the following integral $\int_1^5 \sqrt{1+x^3} dx$ using Trapezoid Rule considering 1000 equally spaced sub-intervals.

```
% Compute the following integral sqrt((1+x^3))dx [1, 5]
% using Trapezoid Rule considering 1000 equally spaced sub-intervals.
close all
clear all
clc
a=1;
```



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```
b=5;  
n=1000;  
dx=(b-a)/n;  
f=@(x)(sqrt(1+x.^3));  
AW=(f(a)+f(b))/2;  
for k=1:n-1  
    x(k)=a+k*dx;  
end  
funvalue=f(x);  
answer=(sum(funvalue)+AW)*dx
```

L12&15_Q51: Compute the definite integral of the function $f(x) = e^{-x^2}$ on the interval $[0, 2]$ using Simpson's one-third Rule by dividing the interval $[0, 2]$ into 6 sub-intervals.

%Compute the definite integral of f(x)=e^-x2 on the interval [0,2] using
%Simpson's one Third Rule by dividing interval [0,2] into 6 sub-intervals.

```
close all  
clear all  
clc  
a=0;  
b=2;  
n=6;  
dx=(b-a)/n  
f=@(x)exp(-x.^2)  
value1=0;  
value2=0;  
for k=1:n-1  
    x(k)=a+k*dx;  
    if mod(k,2)==0  
        value1=value1+2*f(x(k));  
    else  
        value2=value2+4*f(x(k));  
    end  
end  
answer=(value1+value2+f(a)+f(b))*(dx/3)
```

L12&15_Q52: Compute the following integral $\int_1^5 \sqrt{1+x^3} dx$ using Simpson's One-Third Rule considering 6 equally spaced sub-intervals.

% Compute the following integral sqrt((1+x^3))dx [1, 5]
%Simpson's one Third Rule by considering 6 equally spaced sub-intervals.

```
close all  
clear all  
clc  
a=1;  
b=5;  
n=6;  
dx=(b-a)/n  
f=@(x)(sqrt(1+x.^3));  
value1=0;  
value2=0;  
for k=1:n-1  
    x(k)=a+k*dx;  
    if mod(k,2)==0  
        value1=value1+2*f(x(k));  
    else  
        value2=value2+4*f(x(k));  
    end  
end  
answer=(value1+value2+f(a)+f(b))*(dx/3)
```

L12&15_Q53: Compute the following integral $\int_1^5 \sqrt{1+x^3} dx$ using Simpson's One-Third Rule considering 30 equally spaced sub-intervals.



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```
% Compute the following integral sqrt((1+x^3))dx [1, 5]
%Simpson's one Third Rule by considering 30 equally spaced sub-intervals.
close all
clear all
clc
a=1;
b=5;
n=30;
dx=(b-a)/n
f=@(x) (sqrt(1+x.^3));
value1=0;
value2=0;
for k=1:n-1
    x(k)=a+k*dx;
    if mod(k,2)==0
        value1=value1+2*f(x(k));
    else
        value2=value2+4*f(x(k));
    end
end
answer=(value1+value2+f(a)+f(b))*(dx/3)
```

Imp by sultan

L12&15_Q54: Compute the following integral $\int_1^5 \sqrt{(1+x^3)} dx$ using Simpson's One-Third Rule considering 300 equally spaced sub-intervals.

```
% Compute the following integral sqrt((1+x^3))dx [1, 5]
%Simpson's one Third Rule by considering 300 equally spaced sub-intervals.
close all
clear all
clc
a=1;
b=5;
n=300;
dx=(b-a)/n
f=@(x) (sqrt(1+x.^3));
value1=0;
value2=0;
for k=1:n-1
    x(k)=a+k*dx;
    if mod(k,2)==0
        value1=value1+2*f(x(k));
    else
        value2=value2+4*f(x(k));
    end
end
answer=(value1+value2+f(a)+f(b))*(dx/3)
```

L12_Q55: Compute the definite integral of the function $f(x) = x^4$ on the interval $[-3, 3]$ using Simpson's one-third Rule by taking $n=6, 12, 100$.

```
% Compute the following integral of function f(x)=x^4 on interval [-3, 3]
% using Simpson's one Third Rule by taking n=6, 12, 100.
close all
clear all
clc
a=-3;
b=3;
n=6;
%ALSO CHECK RESULTS BY PUTTING n=12 and n=100
dx=(b-a)/n
f=@(x) (x^4);
value1=0;
value2=0;
for k=1:n-1
```



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```
x(k)=a+k*dx;  
if mod(k,2)==0  
    value1=value1+2*f(x(k));  
else  
    value2=value2+4*f(x(k));  
end  
end  
answer=(value1+value2+f(a)+f(b))*(dx/3)
```

L12&15_Q56: Compute the definite integral of the function $f(x) = e^{-x^2}$ on the interval $[0, 2]$ using Simpson's Three-Eight Rule by dividing the interval $[0, 2]$ into 6 sub-intervals.

```
% Compute the following integral f(x)=e^(-x^2) on interval [0, 2]  
% using Simpson's Three-Eight Rule by considering 6 equally spaced sub-intervals.  
clear all;  
clc;  
close all;  
sum1=0;  
sum2=0;  
a=0;  
b=2;  
n=6;  
f=@(x) exp(-x.^2)  
dx=(b-a)/n;  
value=f(b)+f(a);  
for k=1:n-1  
    c=a+k*dx;  
    if mod(k,3)==0  
        sum1=sum1+2*f(c);  
    else  
        sum2=sum2+3*f(c);  
    end  
end  
sum=sum1+sum2;  
Answer=(value+sum)*(3*dx/8)
```

L12&15_Q57: Compute the following integral $\int_1^5 \sqrt{1+x^3} dx$ using Simpson's Three-Eight Rule considering 6 equally spaced sub-intervals.

```
% Compute the following integral sqrt((1+x^3))dx [1, 5]  
% using Simpson's Three-Eight Rule by considering 6 equally spaced sub-intervals.  
clear all;  
clc;  
close all;  
sum1=0;  
sum2=0;  
a=1;  
b=5;  
n=6;  
f=@(x) sqrt(1+x^3)  
dx=(b-a)/n;  
value=f(b)+f(a);  
for k=1:n-1  
    c=a+k*dx;  
    if mod(k,3)==0  
        sum1=sum1+2*f(c);  
    else  
        sum2=sum2+3*f(c);  
    end  
end  
sum=sum1+sum2;  
Answer=(value+sum)*(3*dx/8)
```



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Imp by sultan
16march2022

L12&15_Q58: Compute the following integral $\int_1^5 \sqrt{(1+x^3)} dx$ using Simpson's Three-Eight Rule considering 30 equally spaced sub-intervals.

```
% Compute the following integral sqrt((1+x^3))dx [1, 5]
% using Simpson's Three-Eight Rule by considering 30 equally spaced sub-intervals.
clear all;
clc;
close all;
sum1=0;
sum2=0;
a=1;
b=5;
n=30;
f=@(x) sqrt(1+x^3)
dx=(b-a)/n;
value=f(b)+f(a);
for k=1:n-1
    c=a+k*dx;
    if mod(k,3)==0
        sum1=sum1+2*f(c);
    else
        sum2=sum2+3*f(c);
    end
end
sum=sum1+sum2;
Answer=(value+sum)*(3*dx/8)
```

16March2022

L12&15_Q59: Compute the following integral $\int_1^5 \sqrt{(1+x^3)} dx$ using Simpson's Three-Eight Rule considering 300 equally spaced sub-intervals.

```
% Compute the following integral sqrt((1+x^3))dx [1, 5]
% using Simpson's Three-Eight Rule by considering 300 equally spaced sub-intervals.
clear all;
clc;
close all;
sum1=0;
sum2=0;
a=1;
b=5;
n=300;
f=@(x) sqrt(1+x^3)
dx=(b-a)/n;
value=f(b)+f(a);
for k=1:n-1
    c=a+k*dx;
    if mod(k,3)==0
        sum1=sum1+2*f(c);
    else
        sum2=sum2+3*f(c);
    end
end
sum=sum1+sum2;
Answer=(value+sum)*(3*dx/8)
```

L12&15_Q60: Compute the Riemann sum of the function $f(x) = e^{-x^2}$ for $n=4, 6, 8, 10, 100$ and 1000 by choosing C_k as the left end point of the interval $[0, 2]$.

```
% Compute the Riemann sum of the function f(x)=e^(-x^2)
% for n=4, 6, 8, 10, 100 and 1000 by choosing CK as
% the left end point of the interval [0, 2].
clear all
close all
clc
```



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```
a=2;
b=0;
n=4;
%ALSO CHECK RESULTS BY PUTTING n=6, n=8, n=10, n=100 and n=1000
dx=(b-a)/n
f=@(x)exp(-x.^2)
for k=1:n
    c(k)=a+k*dx;
end
funcvalue=f(c);
summation=sum(funcvalue);
answer=summation*dx
```

Imp by sultan

L12&15_Q61: Compute the Riemann sum of the function $f(x) = e^{-x^2}$ for $n=4, 6, 8, 10, 100$ and 1000 by choosing C_k as the right end point of the interval $[0, 2]$.

```
% Compute the Riemann sum of the following function f(x)=e^-x^2 for
% n=4,6,8,10,100,1000 by choosing ck as the right point of interval[0,2]
clear all
close all
clc
a=0;
b=2;
n=4;
%ALSO CHECK RESULTS BY PUTTING n=6, n=8, n=10, n=100 and n=1000
dx=(b-a)/n
f=@(x)exp(-x.^2)
for k=1:n
    c(k)=a+k*dx;
end
funcvalue=f(c);
summation=sum(funcvalue);
answer=summation*dx
```

L12&15_Q62: Compute the Riemann sum of the function $f(x) = e^{-x^2}$ for $n=4, 6, 8, 10, 100$ and 1000 by choosing C_k as the right mid point of the interval $[0, 2]$.

```
% Compute the Riemann sum of the following function f(x)=e^-x^2 for
% n=4,6,8,10,100,1000 by choosing ck as the mid point of interval[0,2]
clear all
close all
clc
a=0;
b=2;
n=4;
%ALSO CHECK RESULTS BY PUTTING n=6, n=8, n=10, n=100 and n=1000
dx=(b-a)/n
f=@(x)exp(-x.^2)
for k=1:n
    c=dx*rand+(a+(k-1)*dx);
end
funcvalue=f(c);
summation=sum(funcvalue);
answer=summation*dx
```

L13_Q63: Construct the function vector $p_n^{(\alpha, \beta)}(x)$ (Orthogonal Shifted Jacobi Polynomials) defined on $[0, T]$ of degree 0, 1, 2, and 3 using equation

$$p_n^{(\alpha, \beta)}(x) = \sum_{k=0}^n \frac{(-1)^{(i-k)} \Gamma(i + \beta + 1) \Gamma(i + k + \alpha + \beta + 1)}{\Gamma(k + \beta + 1) \Gamma(i + \alpha + \beta + 1) \Gamma(i - k + 1) \Gamma(k + 1) T^k} x^k \text{ where } i = 0, 1, 2, 3, \dots$$

```
% Construct the function vector (Orthogonal Shifted Jacobi Polynomials)
% defined on [0,T] by alpha=0 and beta=0 and scale level M=4 taking using equation
function R=JacobFunVec(alpha,beta,M)
```



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```
clear all
close all
clc
syms x T k
M=4;
alpha=0;
beta=0;
for i=0:M-1
    a1=(-1)^(i-k);
    a2=gamma(i+beta+1);
    a3=gamma(i+k+alpha+beta+1);
    d1=gamma(k+beta+1);
    d2=gamma(i+alpha+beta+1);
    d3=gamma(i-k+1);
    d4=gamma(k+1);
    d5=T^k;
    aa=(a1*a2*a3)/(d1*d2*d3*d4*d5);
    P(i+1)=symsum(aa*x^k,k,0,i);
end
R=transpose(P)
```

Imp by sultan

L13_Q64: Construct the function vector $p_n^{(\alpha,\beta)}(x)$ (Orthogonal Shifted Jacobi Polynomials) defined on $[0,1]$ by $\alpha = 1$ and $\beta = 2$ and scale level $M=10$ taking using equation

$$p_n^{(\alpha,\beta)}(x) = \sum_{k=0}^n \frac{(-1)^{(i-k)} \Gamma(i+\beta+1) \Gamma(i+k+\alpha+\beta+1)}{\Gamma(k+\beta+1) \Gamma(i+\alpha+\beta+1) \Gamma(i-k+1) \Gamma(k+1) T^k} x^k \text{ where } i = 0, 1, 2, 3, \dots$$

% Construct the function vector (Orthogonal Shifted Jacobi Polynomials)
% defined on $[0,1]$ by $\alpha=1$ and $\beta=2$ and scale level $M=10$ taking using equation

function P=JacobFunVec(alpha,beta,M)

```
clear all
close all
clc
syms x T k
M=10;
T=1;
alpha=1;
beta=2;
for i=0:M-1
    a1=(-1)^(i-k);
    a2=gamma(i+beta+1);
    a3=gamma(i+k+alpha+beta+1);
    d1=gamma(k+beta+1);
    d2=gamma(i+alpha+beta+1);
    d3=gamma(i-k+1);
    d4=gamma(k+1);
    d5=T^k;
    aa=(a1*a2*a3)/(d1*d2*d3*d4*d5);
    P(i+1)=symsum(aa*x^k,k,0,i);
end
P=transpose(P);
```

L13_Q65: Write down a MATLAB code for weight function i.e. $W_T^{(\alpha,\beta)}(x) = (T-X)^\alpha x^\beta$

% Write down a MATLAB code for weight function

```
clc
clear all
close all
syms T x alpha beta
W=(T-x)^alpha*(x^beta)
```

L13_Q66: Construct the weight function vector $W_T^{(\alpha,\beta)}(x) = (T-X)^\alpha x^\beta$ on the interval $[0,1]$ by $\alpha = 1$ and $\beta = 2$.



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% Construct the weight function vector on the interval [0,1] by $\alpha=1$ and $\beta=2$.

```
clc
clear all
close all
syms T x alpha beta
alpha=1;
beta=2;
T=1;
W=(T-x)^alpha*(x^beta)
```

L13_Q67: Construct the weight function vector $W_T^{(\alpha,\beta)}(x) = (T-X)^\alpha x^\beta$ on the interval [0,1] by $\alpha = 0$ and $\beta = 0$.

% Construct the weight function vector on the interval [0,1] by $\alpha=0$ and $\beta=0$.

```
clc
clear all
close all
syms T x alpha beta
alpha=0;
beta=0;
T=1;
W=(T-x)^alpha*(x^beta)
```

L13_Q68: Check the orthogonality of orthogonal shifted Jacobi polynomial $p_n^{(\alpha,\beta)}(x)$ on [0,T] by choosing $\alpha = 1$ and $\beta = 1$ with respect to the weight function $W_T^{(\alpha,\beta)}(x)$.

SORRY

L13_Q69: Write down a MATLAB code for generating the constant factor

$$R_{T,j}^{(\alpha,\beta)} \delta_{(i,j)} = \frac{T^{\alpha+\beta+1} \Gamma(j+\alpha+1) \Gamma(j+\beta+1)}{(2j+\alpha+\beta+1) \Gamma(j+1) \Gamma(j+\alpha+\beta+1)}$$

% Write down a MATLAB code for generating the constant factor

```
function R=ConstantFactor(alpha,beta,T,M)
clear all
close all
clc
syms j alpha beta T
T=1;
alpha=1;
beta=1;
M=4;
for j=0:M-1
    a1=T^(alpha+beta+1);
    a2=gamma(j+alpha+1);
    a3=gamma(j+beta+1);
    d1=(2*j+alpha+beta+1);
    d2=gamma(j+1);
    d3=gamma(j+alpha+beta+1);
    R(j+1)=(a1*a2*a3)/(d1*d2*d3);
end
R=transpose(R)
```

L13_Q70: Compute the constant factor defined in $R_{T,j}^{(\alpha,\beta)} \delta_{(i,j)} = \frac{T^{\alpha+\beta+1} \Gamma(j+\alpha+1) \Gamma(j+\beta+1)}{(2j+\alpha+\beta+1) \Gamma(j+1) \Gamma(j+\alpha+\beta+1)}$ for $j=0:5$ and $\alpha = 2$ and $\beta = 3$.

% Compute the constant factor defined for $j=0:5$ and $\alpha=2$ and $\beta=3$.

```
function R=ConstantFactor(alpha,beta,T)
clear all
close all
clc
syms j alpha beta T
T=1;
```



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```
alpha=2;
beta=3;
for j=0:5
    a1=T^(alpha+beta+1);
    a2=gamma(j+alpha+1);
    a3=gamma(j+beta+1);
    d1=(2*j+alpha+beta+1);
    d2=gamma(j+1);
    d3=gamma(j+alpha+beta+1);
    R(j+1)=(a1*a2*a3)/(d1*d2*d3);
end
R=transpose(R)
```

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L13_Q71: Compute the constant factor defined in $R_{T,j}^{(\alpha,\beta)} \delta_{(i,j)} = \frac{T^{\alpha+\beta+1} \Gamma(j+\alpha+1) \Gamma(j+\beta+1)}{(2j+\alpha+\beta+1) \Gamma(j+1) \Gamma(j+\alpha+\beta+1)}$ for choosing the scale level $M=7$ and $\alpha = 3$ and $\beta = 1$.

% Compute the constant factor defined for choosing the scale level $M=7$ and $\alpha=3$ and $\beta=1$.

```
function R=ConstantFactor(alpha,beta,T,M)
clear all
close all
clc
syms j alpha beta T
T=1;
alpha=3;
beta=1;
M=7;
for j=0:M-1
    a1=T^(alpha+beta+1);
    a2=gamma(j+alpha+1);
    a3=gamma(j+beta+1);
    d1=(2*j+alpha+beta+1);
    d2=gamma(j+1);
    d3=gamma(j+alpha+beta+1);
    R(j+1)=(a1*a2*a3)/(d1*d2*d3);
end
R=transpose(R)
```

L13_Q72: Write down a MATLAB code for computing the series coefficients C_i , $i=0,1,2,3,4$.

$$C_i = \frac{1}{R_{T,j}^{(\alpha,\beta)}} \int_0^T f(x) W_T^{(\alpha,\beta)}(x) P_i^{(\alpha,\beta)}(x) dx$$

% Write down a MATLAB code for computing the series coefficients C_i , $i=0,1,2,3,4$.

```
function C=JacobiCoeffVector(f,x,M,alpha,beta,T)
close all;
clear all;
clc;
syms f x M alpha beta T k i j
T=1;
alpha=1;
beta=1;
M=4;
W = (T - x).^alpha * x.^beta;
for i=0:M-1
    a1 = (-1)^(i-k);
    a2 = gamma(i + beta+1);
    a3 = gamma(i + k+ alpha + beta + 1);
    d1 = gamma(k+beta + 1);
    d2 = gamma(i + alpha + beta + 1);
    d3 = gamma(i - k + 1);
    d4 = gamma(k+1);
    d5 = T^k;
    aa = (a1*a2*a3)/(d1*d2*d3*d4*d5);
```



```
P(i+1) = symsum(aa*x^k, k, 0, i);
end
P;
PW=f*P*W;
for j = 0:M-1
    a1 = T^(alpha + beta +1);
    a2 = gamma(j + alpha + 1);
    a3 = gamma(j + beta + 1);
    d1 = 2*j + alpha + beta + 1;
    d2 = gamma(j + 1);
    d3 = gamma(j + alpha + beta + 1);
    R(j + 1) = (a1*a2*a3)/(d1*d2*d3);
end
R ;
RR=1./R;
for i = 0:M-1
    C(i+1)=int(PW(i+1),x,0,i)*RR(i+1);
end
C=transpose(C);
```

L13&15_Q73: Compute the series coefficients C_i of Jacobi polynomials for $i=0:10$ and $\alpha = 1$ and $\beta =$

$$2. \quad C_i = \frac{1}{R_{T,j}^{(\alpha,\beta)}} \int_0^T f(x) W_T^{(\alpha,\beta)}(x) P_i^{(\alpha,\beta)}(x) dx$$

% Compute the series coefficients C_i of Jacobi polynomials
% for scale level $M=10$ and $\alpha=1$ and $\beta=2$.

function C=JacobiCoeffVector(f,x,M,alpha,beta,T)

```
close all;
clear all;
clc;
syms f x M alpha beta T k i j
T=1;
alpha=1;
beta=2;
M=10;
W = (T - x).^alpha * x^beta;
for i=0:M-1
    a1 = (-1)^(i-k);
    a2 = gamma(i + beta+1);
    a3 = gamma(i +k+ alpha + beta +1);
    d1 = gamma(k+beta +1);
    d2 = gamma(i + alpha + beta + 1);
    d3 = gamma(i - k + 1);
    d4 = gamma(k+1);
    d5 = T^k;
    aa = (a1*a2*a3)/(d1*d2*d3*d4*d5);
    P(i+1) = symsum(aa*x^k, k, 0, i);
end
P;
PW=f*P*W;
for j = 0:M-1
    a1 = T^(alpha + beta +1);
    a2 = gamma(j + alpha + 1);
    a3 = gamma(j + beta + 1);
    d1 = 2*j + alpha + beta + 1;
    d2 = gamma(j + 1);
    d3 = gamma(j + alpha + beta + 1);
    R(j + 1) = (a1*a2*a3)/(d1*d2*d3);
end
R ;
RR=1./R;
for i = 0:M-1
    C(i+1)=int(PW(i+1),x,0,i)*RR(i+1);
end
```



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C=transpose(C);

Imp by sultan

L13&15_Q74: Compute the series coefficients C_i of Jacobi polynomials for scale level $M=6$ and $\alpha = 2$ and $\beta = 1$. While

$$C_i = \frac{1}{R_{T,j}^{(\alpha,\beta)}} \int_0^T f(x) W_T^{(\alpha,\beta)}(x) P_i^{(\alpha,\beta)}(x) dx$$

% Compute the series coefficients C_i of Jacobi polynomials
% for scale level $M=6$ and $\alpha=2$ and $\beta=1$.

function C=JacobiCoeffVector(f,x,M,alpha,beta,T)

close all;

clear all;

clc;

syms f x M alpha beta T k i j

T=1;

alpha=2;

beta=1;

M=6;

W = (T - x).^alpha * x^beta;

for i=0:M-1

a1 = (-1)^(i-k);

a2 = gamma(i + beta+1);

a3 = gamma(i + k+ alpha + beta +1);

d1 = gamma(k+beta +1);

d2 = gamma(i + alpha + beta + 1);

d3 = gamma(i - k + 1);

d4 = gamma(k+1);

d5 = T^k;

aa = (a1*a2*a3)/(d1*d2*d3*d4*d5);

P(i+1) = symsum(aa*x^k, k, 0, i);

end

P;

PW=f*P*W;

for j = 0:M-1

a1 = T^(alpha + beta +1);

a2 = gamma(j + alpha + 1);

a3 = gamma(j + beta + 1);

d1 = 2*j + alpha + beta + 1;

d2 = gamma(j + 1);

d3 = gamma(j + alpha + beta + 1);

R(j + 1) = (a1*a2*a3)/(d1*d2*d3);

end

R ;

RR=1./R;

for i = 0:M-1

C(i+1)=int(PW(i+1),x,0,i)*RR(i+1);

end

C=transpose(C);

L14_Q75: Write MATLAB code to compute the Legendre Polynomials $P_0(z) = 1, P_1(z) = z, P_2(z) = \frac{1}{2}(3z^2 - 1), P_3(z) = \frac{1}{2}(5z^3 - 3z)$ and $P_4(z) = \frac{1}{8}(35z^4 - 30z^2 + 3)$ using the relation $L_{i+1}(Z) = \frac{2i+1}{i+1}zL_i(Z) - \frac{i}{i+1}L_{i-1}(Z)$.

% Write MATLAB code to compute the Legendre Polynomials using the relation

function P=LegenderFunctionVector(M,T,value1,value2)

clear all

close all

clc

syms z

format short

M=2;

value(1)=z;



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```
value(2)=sym(3/2)*z^2-sym(1/2);  
for i=1:M  
    value(i+2)=((2*i+3)/(i+2))*z*value(i+1)-((i+1)/(i+2))*value(i);  
end  
P=simplify(transpose(value));
```

L14_Q76: Write MATLAB code to compute the Legendre Polynomials using the relation $P_0(z) = 1$, $P_1(z) = z$, $P_2(z) = \frac{1}{2}(3z^2 - 1)$, $P_3(z) = \frac{1}{2}(5z^3 - 3z)$ and $P_4(z) = \frac{1}{8}(35z^4 - 30z^2 + 3)$ for $i=1:20$ and using the relation $L_{i+1}(Z) = \frac{2i+1}{i+1}zL_i(Z) - \frac{i}{i+1}L_{i-1}(Z)$.

```
% Write MATLAB code to compute the Legendre Polynomials using the relation  
% for i=1:20  
function P=LegenderFunctionVector(M,T,value1,value2)  
clear all  
close all  
clc  
syms z  
format short  
M=20;  
value(1)=z;  
value(2)=sym(3/2)*z^2-sym(1/2);  
for i=1:M  
    value(i+2)=((2*i+3)/(i+2))*z*value(i+1)-((i+1)/(i+2))*value(i);  
end  
P=simplify(transpose(value));
```

L14_Q77: Write MATLAB code to compute the Legendre Polynomials using the relation $P_0(z) = 1$, $P_1(z) = z$, $P_2(z) = \frac{1}{2}(3z^2 - 1)$, $P_3(z) = \frac{1}{2}(5z^3 - 3z)$ and $P_4(z) = \frac{1}{8}(35z^4 - 30z^2 + 3)$ at $z=0$, $z=1$ and $z=5$ and using the relation $L_{i+1}(Z) = \frac{2i+1}{i+1}zL_i(Z) - \frac{i}{i+1}L_{i-1}(Z)$.

```
% Write MATLAB code to compute the Legendre Polynomials using the relation  
% for i=1:20 and at z=0, z=1 and z=5  
function p=LegenderFunctionVector(M,T,value1,value2)  
clear all;  
close all;  
clc;  
syms z  
z=0;  
%ALSO FIND RESULTS BY PUTTING Z=1 AND Z=5  
format short  
M=20;  
value(1)=z;  
value(2)=sym(3/2)*z^2-sym(1/2);  
for i=1:M  
    value(i+2)=((2*i+3)/(i+2))*z*value(i+1)-((i+1)/(i+2))*value(i);  
end  
p=transpose(value);
```

L14_Q78: Construct the function vector $P_n(x)$ (Orthogonal Shifted Legendre Polynomials) defined on $[0,T]$ of degree 0,1,2 and 3 using the relation $p_i(x) = \sum_{k=0}^i (-1)^{i+k} \frac{\Gamma(i+k+1)}{\Gamma(i-k+1)\Gamma(k+1)^2}$ where $i = 0,1,2,3, \dots$

```
% Construct the function vector Orthogonal Shifted Legendre Polynomials  
% defined on [0,T] of degree 0,1,2 and 3  
function p=FunctionVectorOrthogonalShiftedLegendre(M,T)  
clear all; close all;  
clc;  
syms x T k i;  
M=4;  
for i=0:M-1  
    a1=(-1)^(i+k);  
    a2=gamma(i+k+1);  
    d1=gamma(i-k+1);
```



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```
d2=(gamma(k+1))^2;  
aa=(a1*a2)/(d1*d2);  
p(i+1)=symsum(aa*x^k,k,0,i);
```

```
end  
p=transpose(p);
```

L14_Q79: Construct the function vector $P_n(x)$ (Orthogonal Shifted Legendre Polynomials) defined on $[0,T]$ for $i=0:10$ using the relation $p_i(x) = \sum_{k=0}^i (-1)^{i+k} \frac{\Gamma(i+k+1)}{\Gamma(i-k+1)(\Gamma(k+1))^2}$ where $i = 0,1,2,3, \dots$

% Construct the function vector Orthogonal Shifted Legendre Polynomials
% defined on $[0,T]$ for $i=0:10$

```
function p=FunctionVectorOrthogonalShiftedLegendre(M,T)  
clear all;  
close all;  
clc;  
syms x T k i;  
for i=0:10  
    a1=(-1)^(i+k);  
    a2=gamma(i+k+1);  
    d1=gamma(i-k+1);  
    d2=(gamma(k+1))^2;  
    aa=(a1*a2)/(d1*d2);  
    p(i+1)=symsum(aa*x^k,k,0,i);  
end  
p=transpose(p);
```

L14_Q80: Construct the function vector $P_n(x)$ (Orthogonal Shifted Legendre Polynomials) defined on $[0,T]$ for the scale level $M=15$ using the relation $p_i(x) = \sum_{k=0}^i (-1)^{i+k} \frac{\Gamma(i+k+1)}{\Gamma(i-k+1)(\Gamma(k+1))^2}$ where $i = 0,1,2,3, \dots$

% Construct the function vector Orthogonal Shifted Legendre Polynomials
% defined on $[0,T]$ for $M=15$

```
function p=FunctionVectorOrthogonalShiftedLegendre(M,T)  
clear all;  
close all;  
clc;  
syms x T k i;  
M=15;  
for i=0:M-1  
    a1=(-1)^(i+k);  
    a2=gamma(i+k+1);  
    d1=gamma(i-k+1);  
    d2=(gamma(k+1))^2;  
    aa=(a1*a2)/(d1*d2);  
    p(i+1)=symsum(aa*x^k,k,0,i);  
end  
p=transpose(p);
```

L14&15_Q81: Construct the function vector $P_n(x)$ (Orthogonal Shifted Legendre Polynomials) defined on $[0,1]$ for $i=0:20$ using the relation $p_i(x) = \sum_{k=0}^i (-1)^{i+k} \frac{\Gamma(i+k+1)}{\Gamma(i-k+1)(\Gamma(k+1))^2}$ where $i = 0,1,2,3, \dots$
Moreover compute the values at of $P_n(x)$ at $x=2$.

% Construct the function vector Orthogonal Shifted Legendre Polynomials
% defined on $[0,1]$ for $i=0:20$ using the relation at $x=2$

```
function p=FunctionVectorOrthogonalShiftedLegendre(M,T)  
clear all;  
close all;  
clc;  
syms x T k i;  
M=20;  
T=1;  
x=2;  
for i=0:M  
    a1=(-1)^(i+k);
```



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```
a2=gamma(i+k+1);  
d1=gamma(i-k+1);  
d2=(gamma(k+1))^2;  
aa=(a1*a2)/(d1*d2);  
p(i+1)=symsum(aa*x^k,k,0,i);
```

```
end  
p=transpose(p);
```

L14&15_Q82: Construct the function vector $P_n(x)$ (Orthogonal Shifted Legendre Polynomials) defined on $[0,1]$ for the scale level $M=30$ using the relation $p_i(x) = \sum_{k=0}^i (-1)^{i+k} \frac{\Gamma(i+k+1)}{\Gamma(i-k+1)(\Gamma(k+1))^2}$ where $i = 0,1,2,3,\dots$. Moreover compute the values at of $P_n(x)$ at $x=0$.

% Construct the function vector Orthogonal Shifted Legendre Polynomials
% defined on $[0,1]$ for scale level $M=30$ using the relation at $x=0$;

```
function p=FunctionVectorOrthogonalShiftedLegendre(M,T)
```

```
clear all;  
close all;  
clc;  
syms x T k i;  
M=30;  
T=1;  
x=0;  
for i=0:M-1  
    a1=(-1)^(i+k);  
    a2=gamma(i+k+1);  
    d1=gamma(i-k+1);  
    d2=(gamma(k+1))^2;  
    aa=(a1*a2)/(d1*d2);  
    p(i+1)=symsum(aa*x^k,k,0,i);
```

```
end  
p=transpose(p);
```

L14_Q83: Write MATLAB code for generating the constant factor R_j .

% Write MATLAB code for generating the constant factor
% and using the relation $R_j=1/(2j+1)$

```
function p=ConstantFactor(j,M)
```

```
close all;  
clear all;  
clc;  
M=4;  
format short;  
syms j  
for j=0:M-1  
    a1=1;  
    a2=2*j+1;  
    R(j+1)=a1/a2;
```

```
end  
R
```

L14_Q84: Compute the constant factor defined in R_j for $j=0:6$ and using the relation $R_j = \frac{1}{2j+1}$

% Compute the constant factor defined in R_j for $j=0:6$
% and using the relation $R_j=1/(2j+1)$

```
function p=ConstantFactor(j)
```

```
close all;  
clear all;  
clc;  
format short;  
syms j  
for j=0:6  
    a1=1;  
    a2=2*j+1;  
    R(j+1)=a1/a2;
```

```
end
```



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R

L14&15_Q85: Compute the constant factor defined in R_j for $j=0:10$ and using the relation $R_j = \frac{1}{2j+1}$

% Compute the constant factor defined in R_j for $j=0:10$

% and using the relation $R_j=1/(2j+1)$

```
function p=ConstantFactor(j)
```

```
close all;
```

```
clear all;
```

```
clc;
```

```
format short;
```

```
syms j
```

```
for j=0:10
```

```
    a1=1;
```

```
    a2=2*j+1;
```

```
    R(j+1)=a1/a2;
```

```
end
```

R

L14_Q86: Compute the constant factor defined in R_j for choosing scale level $M=10$ and using the relation $R_j = \frac{1}{2j+1}$

% Write MATLAB code for generating the constant factor

% for choosing scale level $M=10$ and using the relation $R_j=1/(2j+1)$

```
function p=ConstantFactor(j,M)
```

```
close all;
```

```
clear all;
```

```
clc;
```

```
M=10;
```

```
format short;
```

```
syms j
```

```
for j=0:M-1
```

```
    a1=1;
```

```
    a2=2*j+1;
```

```
    R(j+1)=a1/a2;
```

```
end
```

R

L14&15_Q87: Compute the constant factor defined in R_j for choosing scale level $M=40$ and using the relation $R_j = \frac{1}{2j+1}$

% Write MATLAB code for generating the constant factor

% for choosing scale level $M=40$ and using the relation $R_j=1/(2j+1)$

```
function p=ConstantFactor(j,M)
```

```
close all;
```

```
clear all;
```

```
clc;
```

```
M=40;
```

```
format short;
```

```
syms j
```

```
for j=0:M-1
```

```
    a1=1;
```

```
    a2=2*j+1;
```

```
    R(j+1)=a1/a2;
```

```
end
```

R

L14_Q88: Write MATLAB code to compute the series coefficients C_i , $i=0, 1, 2, 3, 4$.

%Write MATLAB code to compute the series coefficients C_i , $i=0, 1, 2, 3, 4$.

```
function P=Lagdrfunvec(M,T)
```

```
clc; clear all; close all;
```

```
syms x T k
```

```
M=4;
```

```
for i=0:M
```

```
    a1=(-1)^(i+k);
```



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```
a2=gamma(i+k+1);
d1=gamma(i-k+1);
d2=(gamma(k+1))^2;
aa=(a1*a2)/(d1*d2);
P(i+1)=symsum(aa*x^k,k,0,i);
end
P=transpose(P);
function R=Lagendrorthogonal(i,M)
syms i
M=4;
for i=0:M-1
a1=1;
a2=2*i+1;
R(i+1)=a1/a2;
end
R
function C=Lagendrcoefvec(i,T,f)
syms x T i f
P=LagdrFunVec(T);
R=LagdrOrthogonal(i);
M=4;
Kw=f*P;
for i=0:M
aa=Kw(i+1);
C(i+1)=(1/(R(i+1)))*int(aa,x,0,T);
end
C=transpose(C);
```

L14_Q89: Compute the series coefficients C_i for $i=0:6$ and using the relation $C_i = \frac{1}{R_j} \int_0^1 f(x) P_i(x) dx$

%Write MATLAB code to compute the series coefficients for $i=0:6$.

```
function P=Lagdrfunvec(M,T)
clc;
clear all;
close all;
syms x T k
M=6;
for i=0:M
a1=(-1)^(i+k);
a2=gamma(i+k+1);
d1=gamma(i-k+1);
d2=(gamma(k+1))^2;
aa=(a1*a2)/(d1*d2);
P(i+1)=symsum(aa*x^k,k,0,i);
end
P=transpose(P);
function R=Lagendrorthogonal(i,M)
syms i
M=6;
for i=0:M-1
a1=1;
a2=2*i+1;
R(i+1)=a1/a2;
end
R
function C=Lagendrcoefvec(i,T,f)
syms x T i f
P=LagdrFunVec(T);
R=LagdrOrthogonal(i);
M=6;
Kw=f*P;
for i=0:M
aa=Kw(i+1);
```



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```
C(i+1)=(1/(R(i+1)))*int(aa,x,0,T);  
end  
C=transpose(C);
```

Imp by sultan **L14_Q90:** Compute the series coefficients C_i for choosing scale level $M=10$ and using the relation

$$C_i = \frac{1}{R_j} \int_0^1 f(x) P_i(x) dx$$

%Write MATLAB code to compute the series coefficients for scale level $M=10$.

```
function P=Lagdrfunvec(M,T)
```

```
clc;
```

```
clear all;
```

```
close all;
```

```
syms x T k
```

```
M=10;
```

```
for i=0:M-1
```

```
    a1=(-1)^(i+k);
```

```
    a2=gamma(i+k+1);
```

```
    d1=gamma(i-k+1);
```

```
    d2=(gamma(k+1))^2;
```

```
    aa=(a1*a2)/(d1*d2);
```

```
    P(i+1)=symsum(aa*x^k,k,0,i);
```

```
end
```

```
P=transpose(P);
```

```
function R=Lagendrorthogonal(i,M)
```

```
syms i
```

```
M=10;
```

```
for i=0:M-1
```

```
    a1=1;
```

```
    a2=2*i+1;
```

```
    R(i+1)=a1/a2;
```

```
end
```

```
R
```

```
function C=Lagendrcoefvec(i,T,f)
```

```
syms x T i f
```

```
P=LagdrFunVec(T);
```

```
R=LagdrOrthogonal(i);
```

```
M=10;
```

```
Kw=f*P;
```

```
for i=0:M
```

```
    aa=Kw(i+1);
```

```
    C(i+1)=(1/(R(i+1)))*int(aa,x,0,T);
```

```
end
```

```
C=transpose(C);
```

L14_Q91: Determined the Legendre Polynomials using the relation $L_{i+1}(Z) = \frac{2i+1}{i+1} zL_i(Z) - \frac{i}{i+1} L_{i-1}(Z)$

For $i=1:10$. That is we have to determined $P_3(z), P_4(z), P_5(z) \dots, P_{10}(z)$ using $P_1(z) = z$ and $P_2(z) =$

$$\frac{3z^2}{2} - \frac{1}{2}$$

% Write MATLAB code to compute the Legendre Polynomials using the relation

```
% For i=1:10
```

```
function p=LegenderFunctionVector(M,T,value1,value2)
```

```
clear all;
```

```
close all;
```

```
clc;
```

```
syms z
```

```
format short
```

```
M=10;
```

```
value(1)=z;
```

```
value(2)=sym(3/2)*z^2-sym(1/2);
```

```
for i=1:M
```

```
    value(i+2)=((2*i+3)/(i+2))*z*value(i+1)-((i+1)/(i+2))*value(i);
```

```
end
```

```
p=transpose(value);
```



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Imp by sultan

L14_Q92: Compute the values of the Legendre Polynomials using the relation $L_{i+1}(Z) = \frac{2i+1}{i+1} z L_i(Z) - \frac{i}{i+1} L_{i-1}(Z)$ at $z = 3, z = 4$ and $z = 6$

% Write MATLAB code to compute the Legendre Polynomials using the relation
% at $z=3, z=4$ and $z=6$

```
function p=LegenderFunctionVector(M,T,value1,value2)
clear all;
close all;
clc;
syms z
z=3;
%ALSO FIND RESULTS BY PUTTING Z=4 AND Z=6
format short
M=10;
value(1)=z;
value(2)=sym(3/2)*z^2-sym(1/2);
for i=1:M
    value(i+2)=((2*i+3)/(i+2))*z*value(i+1)-((i+1)/(i+2))*value(i);
end
p=transpose(value);
```

Imp by sultan

L15_Q93: Construct the one-dimensional Orthogonal Shifted Legendre function vector $P_i(x)$ defined on $[0,1]$ for $i=0:20$ using the relation $p_i(x) = \sum_{k=0}^i (-1)^{i+k} \frac{\Gamma(i+k+1)}{\Gamma(i-k+1)\Gamma(k+1)^2} x^k$ where $i = 0,1,2,3, \dots$

% Construct the function vector Orthogonal Shifted Legendre Polynomials
% defined on $[0,1]$ for $i=0:20$ using the relation;

```
function p=FunctionVectorOrthogonalShiftedLegendre(M,T)
clear all;
close all;
clc;
syms x T k i;
T=1;
M=20;
for i=0:M
    a1=(-1)^(i+k);
    a2=gamma(i+k+1);
    d1=gamma(i-k+1);
    d2=(gamma(k+1))^2;
    aa=(a1*a2)/(d1*d2);
    p(i+1)=symsum(aa*x^k,k,0,i);
end
p=transpose(p);
```

L15_Q94: Construct the one-dimensional Orthogonal Shifted Jacobi function vector $p_n^{(\alpha,\beta)}(x)$ defined on $[0,1]$ for $i=0:19$ and by choosing the values of parameters $\alpha = 0$ and $\beta = 0$ and using equation

$$p_n^{(\alpha,\beta)}(x) = \sum_{k=0}^n \frac{(-1)^{(i-k)} \Gamma(i+\beta+1) \Gamma(i+k+\alpha+\beta+1)}{\Gamma(k+\beta+1) \Gamma(i+\alpha+\beta+1) \Gamma(i-k+1) \Gamma(k+1) T^k} x^k \text{ where } i = 0,1,2,3, \dots$$

% Construct the one-dimensional Orthogonal Shifted Jacobi function vector
% defined on $[0,1]$ for $i=0:19$ and by choosing the values of parameters $\alpha=0$ and $\beta=0$

```
function P=JacobFunVec(alpha,beta,M)
clear all
close all
clc
syms x T k
M=19;
T=1;
alpha=0;
beta=0;
for i=0:M-1
    a1=(-1)^(i-k);
    a2=gamma(i+beta+1);
```



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```
a3=gamma(i+k+alpha+beta+1);
d1=gamma(k+beta+1);
d2=gamma(i+alpha+beta+1);
d3=gamma(i-k+1);
d4=gamma(k+1);
d5=T^k;
aa=(a1*a2*a3)/(d1*d2*d3*d4*d5);
P(i+1)=symsum(aa*x^k,k,0,i);
end
P=transpose(P);
```

L15_Q95: Compute the following relation for $j=0:20$ and choosing the values of $a=1$ and $b=2$:

$$\Omega_j^{(a,b)}(x) = \frac{(4)^{a+b+1} \Gamma(j+3a+4b+1)(j+9)!}{(2j+a+b+1) \Gamma(j+a+5)(j+10a+b+1)!}$$

% Compute the following relation for $j=0:20$ and choosing the values of $a=1$ and $b=2$:

```
function P=JacobFunVec(a,b,j)
clear all;
close all;
clc;
syms x k
i=20;
a=1;
b=2;
for j=0:i
    a1=(4)^(a+b+1);
    a2=gamma(j+3*a+4*b+1);
    a3=factorial(j+9);
    d1=2*j+a+b+1;
    d2=gamma(j+a+5);
    d3=factorial(j+10*a+b+1);
    aa=(a1*a2*a3)/(d1*d2*d3);
    P(j+1)=aa;
end
P=transpose(P);
```

L15_Q96: Compute the following relation for $i=0:10$ and choosing the values of $c=1$ and $d=2$:

$$\Omega_i^{(c,d)}(x) = \frac{(4)^{c+d+10} \Gamma(i+5c+d+10)(i+19)!}{(2i+c+d+12) \Gamma(i+c+5)(i+10c+d+15)!}$$

% Compute the following relation for $i=0:10$ and choosing the values of $c=1$ and $d=2$:

```
function P=JacobFunVec(c,d,i)
clear all;
close all;
clc;
syms x k
n=10;
c=1;
d=2;
for i=0:n
    a1=(4)^(c+d+10);
    a2=gamma(i+5*c+d+10);
    a3=factorial(i+19);
    d1=2*i+c+d+12;
    d2=gamma(i+c+5);
    d3=factorial(i+10*c+d+15);
    aa=(a1*a2*a3)/(d1*d2*d3);
    P(i+1)=aa;
end
P=transpose(P);
```



MTH643 - INTRODUCTION TO MATLAB
(BY ABU SULTAN)

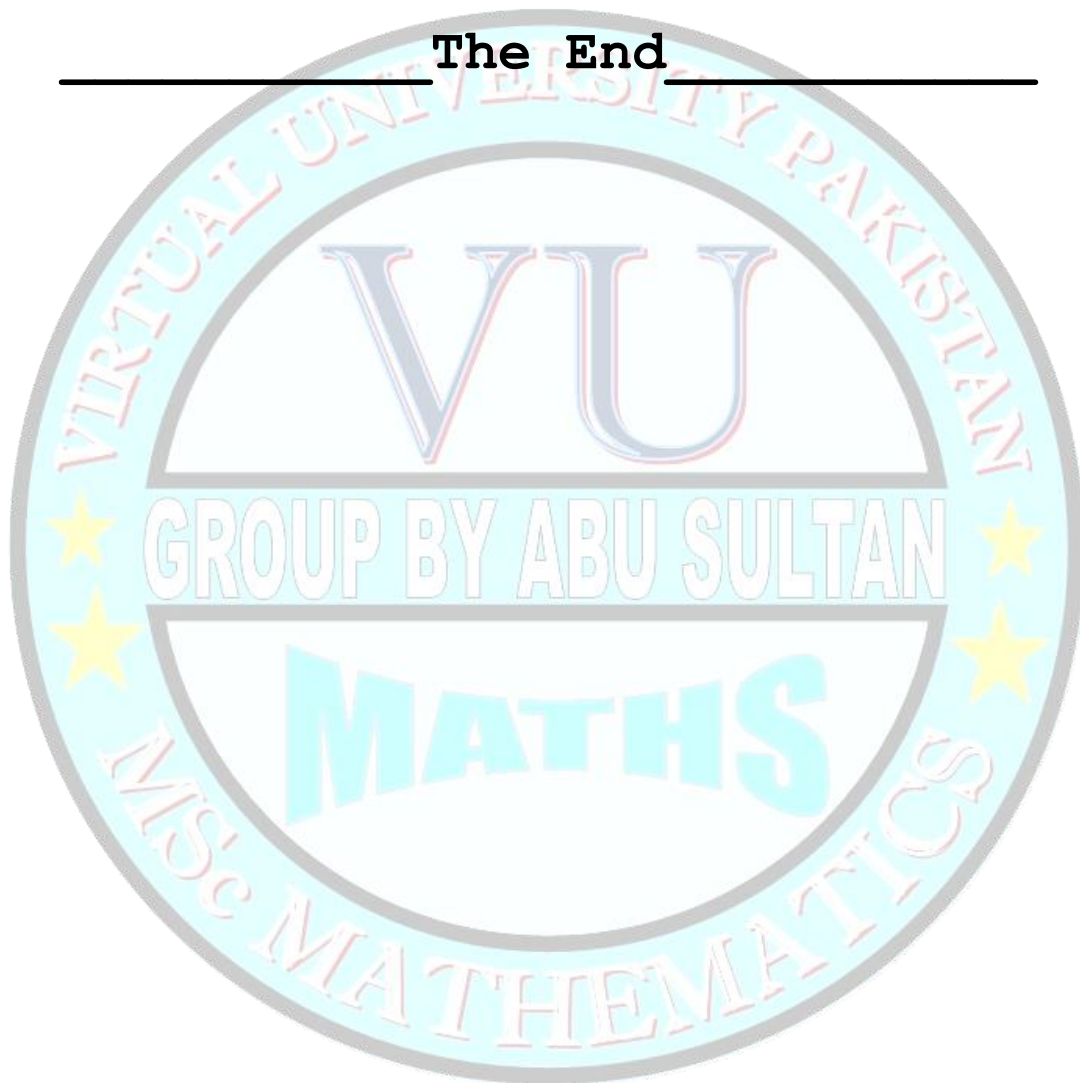
Page 33 of 33

SOLVED QUESTIONS FOR FINAL TERM EXAM [LECT 09 TO 15]



**DON'T LOOK FOR SOMEONE WHO CAN SOLVE YOUR PROBLEMS,
INSTEAD GO AND STAND IN FRONT OF THE MIRROR,
LOOK STRAIGHT INTO YOUR EYES,
AND YOU WILL SEE THE BEST PERSON WHO CAN SOLVE YOUR PROBLEMS!
ALWAYS TRUST YOURSELF.**

The End



MTH643

Introduction to MATLAB

Virtual University of Pakistan, Lahore

Practice Question for Final Term Lecture (8-15)

Solved by Mahar Afaq Safdar Muhammadi

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Lecture # 8

Question: Write the following matrices in MATLAB

$$A = \begin{bmatrix} 3 & 4 & 2 \\ 2 & 1 & 3 \\ 7 & 3 & 8 \end{bmatrix} \text{ \& } B = \begin{bmatrix} 1 & 3 & 9 \\ 4 & 2 & 7 \\ 3 & 3 & 9 \end{bmatrix}$$

- For the matrix equation $AX=B$, find the matrix X .
- Find the transpose of matrix A .
- Find the inverse of matrix B .
- Find the sum of third row of matrix A and sum of second column of matrix B using direct MATLAB command.
- Find the product of matrix A and B .
- Divide the matrix A by matrix B .

Solution:

`%Write the following matrices in MATLAB`

`A=[3,4,2;2,1,3;7,3,8]`

`B=[1,3,9;4,2,7;3,3,9]`

`%For the matrix equation  $AX=B$ , find the matrix  $X$ .`

`X=inv(A)*B`

`%Find the transpose of matrix A.`

`TransposeofA=transpose(A)`

`%Find the inverse of matrix B.`

`InverseofB=inv(B)`

`%Find the sum of third row of matrix A and sum of second column of matrix B`

`%using direct MATLAB command.`

`ThirddrowofA=sum(A(3,:))`

`SecondcolumnofB=sum(B(:,2))`

`%Find the product of matrix A and B.`

`ProductofAandB=A*B`

`%Divide the matrix A by matrix B.`

`DivideAbyB=A./B`

Question: Write the following matrices in MATLAB

$$A = \begin{bmatrix} \frac{1}{7} & \frac{2}{3} & 1 \\ 4 & \frac{8}{7} & 3 \\ \frac{1}{3} & \frac{1}{2} & \frac{1}{8} \end{bmatrix} \quad \& \quad B = \begin{bmatrix} \frac{1}{6} & \frac{3}{7} & \frac{9}{2} \\ \frac{4}{5} & \frac{2}{3} & \frac{7}{4} \\ \frac{3}{2} & \frac{3}{8} & \frac{9}{4} \end{bmatrix}$$

- For the matrix equation $AX=B$, find the matrix X .
- Find the transpose of matrix A .
- Find the inverse of matrix B .
- Find the sum of first row of matrix A and sum of third column of matrix B using direct MATLAB command.
- Find the product of matrix A and B .
- Divide the matrix A by matrix B .

Solution:

`%Write the following matrices in MATLAB`

`A=[1/7,2/3,1;4,8/7,3;1/3,1/2,1/8]`

`B=[1/6,3/7,9/2;4/5,2/3,7/4;3/2,3/8,9/4]`

`%For the matrix equation AX=B, find the matrix X.`

`X=inv(A)*B`

`%Find the transpose of matrix A.`

`TransposeofA=transpose(A)`

`%Find the inverse of matrix B.`

`InverseofB=inv(B)`

`%Find the sum of first row of matrix A and sum of third column of matrix B`

`%using direct MATLAB command.`

`FirstrowofA=sum(A(1,:))`

`ThirdcolumnofB=sum(B(:,3))`

`%Find the product of matrix A and B.`

`ProductofAandB=A*B`

`%Divide the matrix A by matrix B.`

`DivideAbyB=A./B`

Lecture # 9

Question

Compute the Eigen values and Eigen vectors for the following matrix using the MATLAB commands

$$\begin{bmatrix} 3 & 1 & 4 \\ 7 & 8 & 9 \\ 3 & 1 & 3 \end{bmatrix}$$

Solution:

```
%Compute the Eigen values and Eigen vectors for the following matrix using
%the MATLAB commands
%Let
A=[3,1,4;7,8,9;3,1,3]
Eigenvalues=eig(A)
[V,D]=eig(A)
```

Question

$$\begin{bmatrix} 3 & 1 & 4 \\ 7 & 8 & 9 \\ 3 & 1 & 3 \end{bmatrix}$$

Find the reduced echelon form of the following matrix using the MATLAB.

Note: Copy the code and also output from MATLAB to exams application.

Solution:

```
%Find the reduced echelon form of the following matrix using the MATLAB.
%Let
A=[3,1,4;7,8,9;3,1,3]
B=rref(A)
```

Output:

```
A =
     3     1     4
     7     8     9
     3     1     3

B =
     1     0     0
     0     1     0
     0     0     1
```

Lecture # 10

[Malik hafeez current papers](#)

Question: Write a *for loop* to add first 20 numbers which are divisible by 5.

Solution:

```
%Write a for loop to add first 20 numbers which are divisible by 5.
v=1:100;
sum=0;
for i=5:5:length(v)
    sum=sum+v(i);
end
disp(sum)
```

[Malik hafeez current papers](#)

Question: Write a program which takes a number as an input from the user and then using the *for loop* display all of its divisors.

Solution:

```
%Write a program which takes a number as an input from the user and then
%using the for loop display all of its divisors.
x=input('Enter a number:');
n=x;
for k=1:n
    if mod(x,k)==0
        disp(k)
    end
end
```

Malik hafeez current papers

Question: Write a program which compute the factorial of any number.

Solution:

```
%Calculate the factorial of any number.
number=input('Enter a number:');
fact=1;
if number<0
    fprintf('The number you have entered is negative');
else
    for i=1:number
        fact=fact*i;
    end
    disp(fact);
end
```

Question: Write a program in MATLAB that compute the following sum.

$$\sum_{i=1}^{10} 3x^i$$

Solution:

```
%Write a program in MATLAB that compute the following sum.
%[summation i=1:10 (3x^i)].
syms x
sum=0;
for i=1:10
    sum=sum+3*x^i;
end
disp(sum)
```

Question: Write a program in MATLAB that compute the following sum.

$$\sum_{j=1}^5 \sum_{i=1}^6 3^{(i+j)}$$

Solution:

```
%Write a program in MATLAB that compute the following sum.
%[summation j=1:6 summation i=1:5 (3^(i+j))].
sum=0;
for j=1:6
    for i=1:5
        sum=sum+3^(i+j);
    end
end
disp(sum)
```

Malik hafeez current papers

Question: Write a program which prints all the numbers divisible by 3 and 5 for a given number.

Solution:

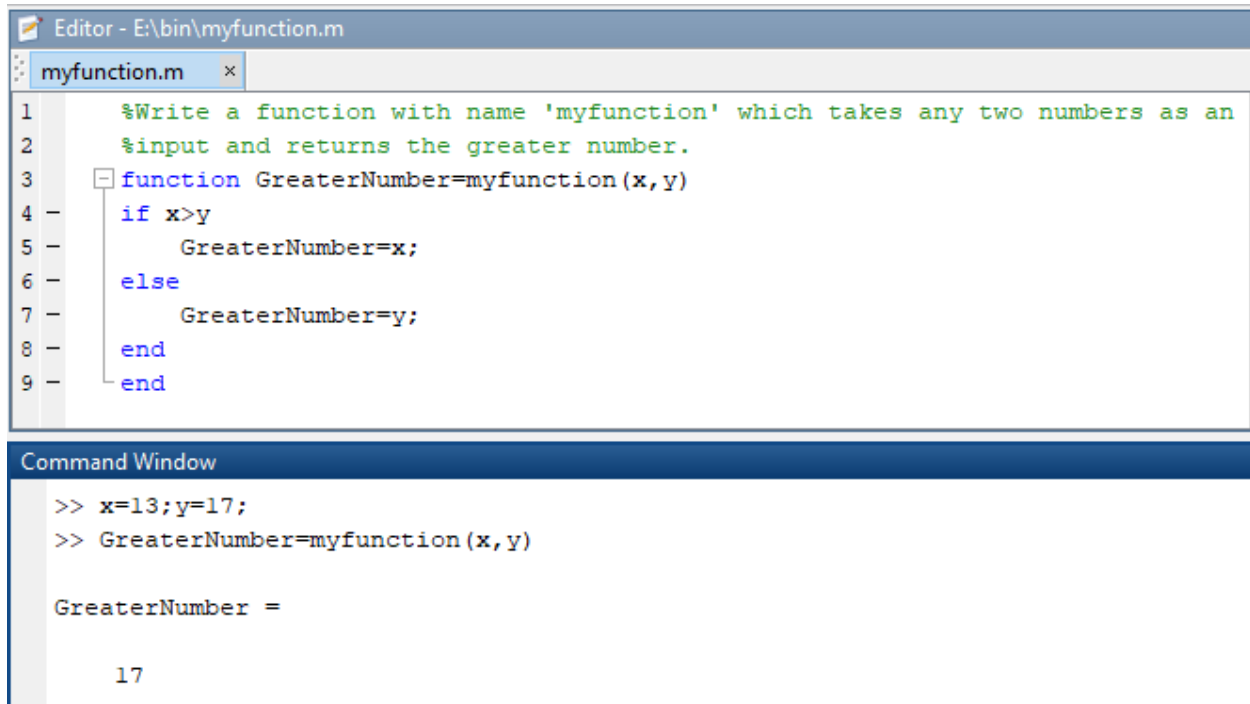
```
%Write a program which prints all the numbers divisible by 3 and 5 for a
given number.
x=input('Enter a number: ');
n=x;
for (k=1:n)
    if mod(k,3)==0 && mod(k,5)==0
        disp(k)
    end
end
```

Lecture # 11

Malik hafeez current papers

Question: Write a function with name 'myfunction' which takes any two numbers as an input and returns the greater number.

Solution:



The screenshot displays the MATLAB environment. The top window is the 'Editor' showing a file named 'myfunction.m'. The code inside is a function that takes two inputs, x and y, and returns the greater of the two. The code is as follows:

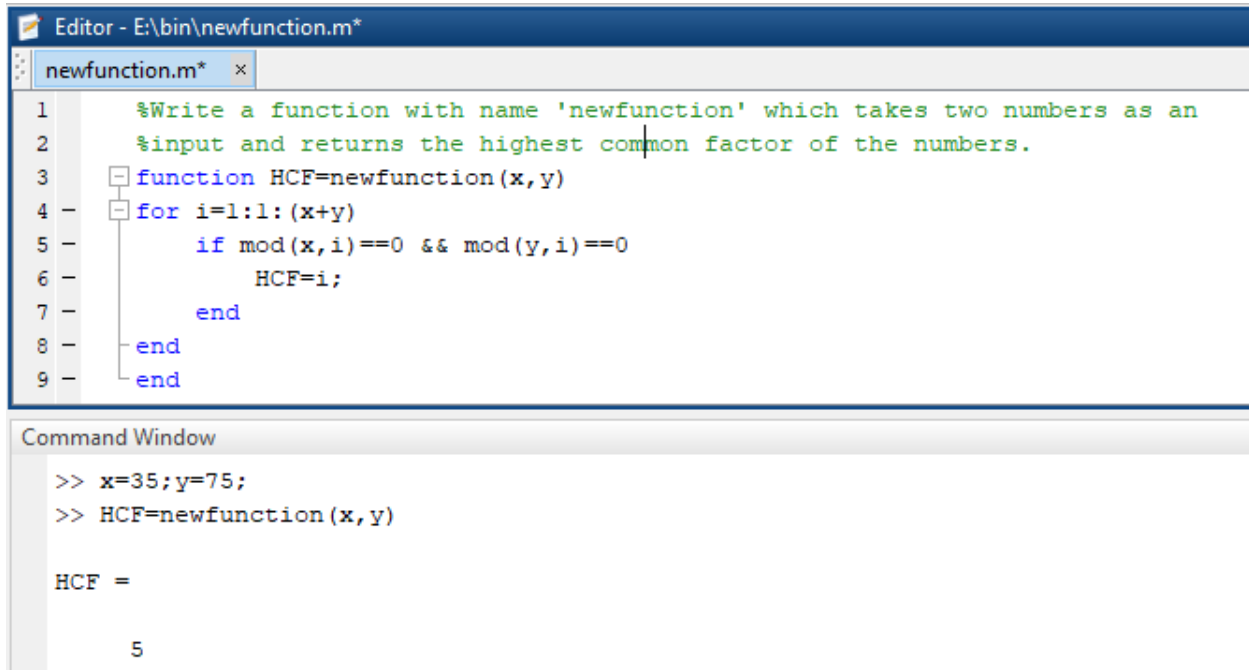
```
1 %Write a function with name 'myfunction' which takes any two numbers as an
2 %input and returns the greater number.
3 function GreaterNumber=myfunction(x,y)
4     if x>y
5         GreaterNumber=x;
6     else
7         GreaterNumber=y;
8     end
9 end
```

The bottom window is the 'Command Window'. It shows the execution of the function with the inputs x=13 and y=17. The command 'GreaterNumber=myfunction(x,y)' is entered, and the output 'GreaterNumber = 17' is displayed.

Malik hafeez current papers

Question: Write a function with name 'newfunction' which takes two numbers as an input and returns the highest common factor of the numbers.

Solution:



The image shows a MATLAB Editor window titled 'Editor - E:\bin\newfunction.m*' and a Command Window. The Editor contains the following code for 'newfunction.m':

```
1 %Write a function with name 'newfunction' which takes two numbers as an
2 %input and returns the highest common factor of the numbers.
3 function HCF=newfunction(x,y)
4 for i=1:1:(x+y)
5     if mod(x,i)==0 && mod(y,i)==0
6         HCF=i;
7     end
8 end
9 end
```

The Command Window shows the execution of the function:

```
>> x=35;y=75;
>> HCF=newfunction(x,y)

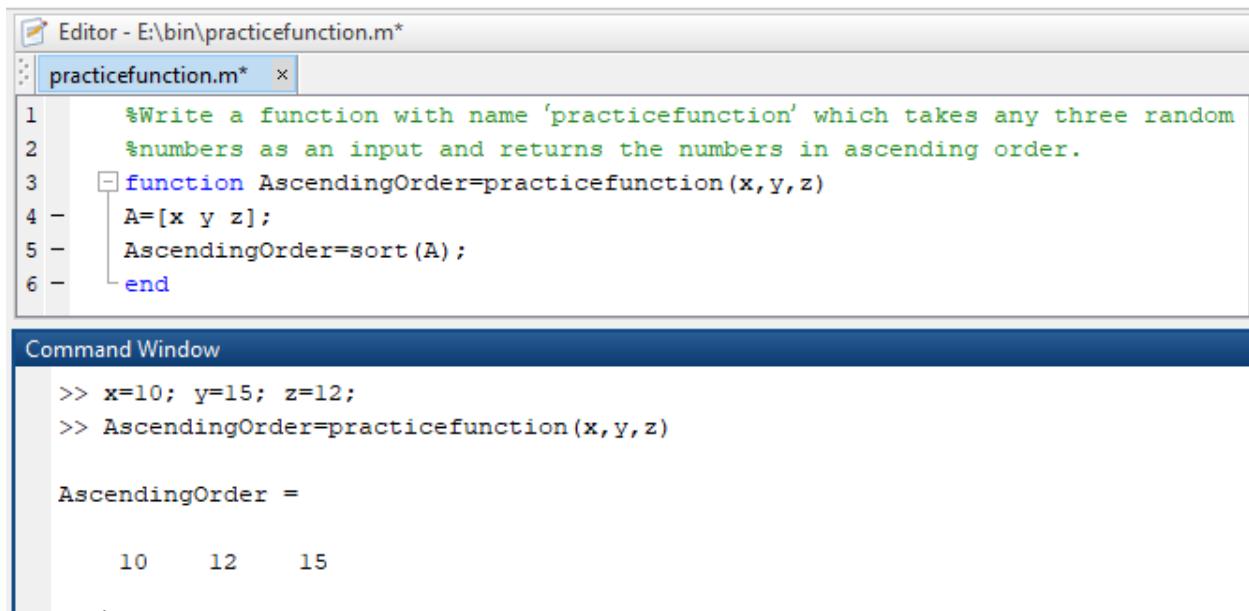
HCF =

     5
```

Malik hafeez current papers

Question: Write a function with name 'practicefunction' which takes any three random numbers as an input and returns the numbers in ascending order.

Solution:



The image shows a MATLAB Editor window titled 'Editor - E:\bin\practicefunction.m*' and a Command Window. The Editor contains the following code for 'practicefunction.m':

```
1 %Write a function with name 'practicefunction' which takes any three random
2 %numbers as an input and returns the numbers in ascending order.
3 function AscendingOrder=practicefunction(x,y,z)
4 A=[x y z];
5 AscendingOrder=sort(A);
6 end
```

The Command Window shows the execution of the function:

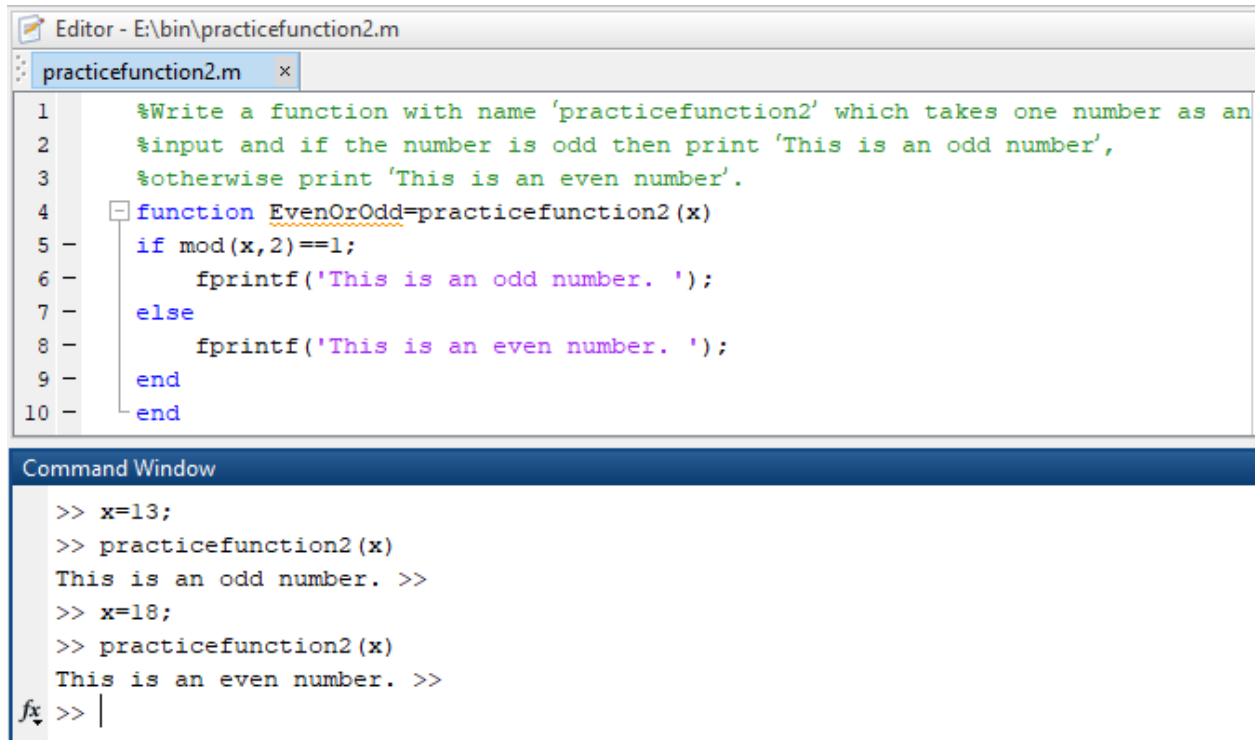
```
>> x=10; y=15; z=12;
>> AscendingOrder=practicefunction(x,y,z)

AscendingOrder =

     10     12     15
```

Question: Write a function with name 'practicefunction2' which takes one number as an input and if the number is odd then print 'This is an odd number', otherwise print 'This is an even number'.

Solution:



The image shows a MATLAB Editor window titled 'Editor - E:\bin\practicefunction2.m' and a Command Window below it. The Editor window contains the following code:

```

1 %Write a function with name 'practicefunction2' which takes one number as an
2 %input and if the number is odd then print 'This is an odd number',
3 %otherwise print 'This is an even number'.
4 function EvenOrOdd=practicefunction2(x)
5 - if mod(x,2)==1;
6 -     fprintf('This is an odd number. ');
7 - else
8 -     fprintf('This is an even number. ');
9 - end
10 - end

```

The Command Window shows the execution of the function:

```

>> x=13;
>> practicefunction2(x)
This is an odd number. >>
>> x=18;
>> practicefunction2(x)
This is an even number. >>
fx >> |

```

Lecture # 12

Question: Solve the differential equation $dy/dt=2y+t$ in MATLAB.

Solution:

```

% Solve the differential equation dy/dt=2y+t in MATLAB.
syms y(t)
ode=diff(y,t)==2*y+t;
soly(t)=dsolve(ode)

```

Question: Solve the differential equation $dy/dt=2y+t$ with the initial condition $y(0)=1$.

Solution:

```
% Solve the differential equation dy/dt=2y+t with the initial condition
y(0)=1.
syms y(t)
ode=diff(y,t)==2*y+t;
cond=y(0)==1;
soly(t)=dsolve(ode,cond)
```

Question: Solve the differential equation $dy/dx=2y+x^2$ with the initial condition $y(0)=1$.

Solution:

```
% Solve the differential equation dy/dx=2y+x^2 with the initial condition
y(0)=1.
syms y(x)
ode=diff(y,x)==2*y+x^2;
cond=y(0)==1;
soly(x)=dsolve(ode,cond)
```

16March 2022

Question: Solve the differential equation $d^2y/dx^2+2dy/dx=e^x$ with the initial conditions $y(0)=1, y'(0)=0$.

Solution:

```
% Solve the differential equation d^2y/dx^2+2dy/dx=e^x with the initial
conditions y(0)=1, y'(0)=0.
syms y(x)
Dy=diff(y);
ode=diff(y,x,2)+2*diff(y,x)==exp(x);
cond1=y(0)==1;
cond2=Dy(0)==0;
cond=[cond1 cond2];
soly(x)=dsolve(ode,cond)
```

Lecture # 13

Question: Find the approximate solutions of the following Initial Value Problem on the interval $[-3, 3]$ using ode45 command.

$$y'(x) = y - x^2 + 5, \quad y(0) = 1$$

Solution:

```
% Find the approximate solutions of the following Initial Value Problem on
the
% interval [-3,3] using ode45 command, y'(x)=y-x^2+5, y(0)=1.
yprime=@(x,y) y-x^2+5;
tspan=[-3 3];
y0=1;
[x,y]=ode45(yprime,tspan,y0)
plot(x,y)
```

Question: Numerically approximate the solution of the following ordinary differential equation using ode45

$$dx / dt = 3e^{-t}$$

Use a time interval of [0, 5] and the initial condition $x(0) = 0$.

Solution:

```
% Numerically approximate the solution of the following ordinary differential
% equation using ode45, dx/dt=3e^(-t).
% Use a time interval of [0,5] and the initial condition x(0)=0
xprime=@(t,x) 3*exp(-t);
tspan=[0 5];
x0=0;
[t,x]=ode45(xprime,tspan,x0)
plot(t,x)
```

Lecture # 14

Question:

Write the MATLAB program for approximating the following integral using Simpson's 1/3 rule with $n=4$

$$\int_1^2 \frac{1}{x} dx$$

Solution:

```
% Write the MATLAB program for approximating the following integral using
% Simpson's 1/3 rule with n =4
f=@(x) 1/x;
a=1;
b=2;
n=4;
h=(b-a)/n;
sumeven=0;
sumodd=0;
```

```

for k=1:n-1
    x(k)=a+k*h;
    if rem(k,2)==0
        sumeven=sumeven+f(x(k));
    else
        sumodd=sumodd+f(x(k));
    end
end
Area=h/3*(f(a)+f(b)+2*sumeven+4*sumodd)

```

Question:

Write the MATLAB program for approximating the following integral using Simpson's 1/3 rule with $n=8$

$$\int_1^4 x \sin(x) dx$$

Solution:

```

% Write the MATLAB program for approximating the following integral using
% Simpson's 1/3 rule with n =8
f=@(x) x*sin(x);
a=1;
b=4;
n=8;
h=(b-a)/n;
sumeven=0;
sumodd=0;
for k=1:n-1
    x(k)=a+k*h;
    if rem(k,2)==0
        sumeven=sumeven+f(x(k));
    else
        sumodd=sumodd+f(x(k));
    end
end
Area=h/3*(f(a)+f(b)+2*sumeven+4*sumodd)

```

Lecture # 15

Question: Compute the Riemann sum using 12 equally spaced sub-intervals for the following definite integral:

$$\int_0^4 \left(\frac{1}{4}x + 2 \right)$$

Solution:

```

f=@(x) x/4+2;
a=0;
b=4;
n=12;
h=(b-a)/n;
value=0;
for k=1:n
    c=a+k*h;
    value=value+f(c);
end
Answer=value*h

```

Question: Compute the Riemann sum using 9 equally spaced sub-intervals for the following definite integral:

$$\int_0^3 \frac{x^2}{2} dx$$

Solution:

```

f=@(x) x^2/2;
a=0;
b=3;
n=9;
h=(b-a)/n;
value=0;
for k=1:n
    c=a+k*h;
    value=value+f(c);
end
Answer=value*h

```

Question: Compute the Riemann sum using 5 equally spaced sub-intervals for the following definite integral:

$$\int_0^3 (2x^2 + 4) dx$$

Solution:

```

f=@(x) 2*x^2+4;
a=0;
b=3;
n=5;
h=(b-a)/n;
value=0;
for k=1:n
    c=a+k*h;
    value=value+f(c);
end
Answer=value*h

```

Question: Compute $\int_0^4 x^2 dx$ using Trapezoidal Rule considering 20 equally spaced sub-intervals.

Solution:

```
f=@(x) x^2;
a=0;
b=4;
n=20;
h=(b-a)/n;
sum=0;
for k=1:n-1
    x(k)=a+k*h;
    y(k)=f(x(k));
    sum=sum+y(k);
end
Area=h/2*(f(a)+f(b)+2*sum)
```

Question: Compute $\int_{-1}^3 2^x dx$ using Trapezoidal Rule considering 12 equally spaced sub-intervals.

Solution:

```
syms y
f1=y^2;
Area1=int(f1,a,b);

f=@(x) 2^x;
a=-1;
b=3;
n=12;
h=(b-a)/n;
sum=0;
for k=1:n-1
    x(k)=a+k*h;
    y(k)=f(x(k));
    sum=sum+y(k);
end
Area=h/2*(f(a)+f(b)+2*sum)
```

Question: Compute $\int_1^5 \frac{1}{x} dx$ using Trapezoidal Rule considering 16 equally spaced sub-intervals.

Solution:

```
f=@(x) 1/x;
a=1;
b=5;
n=16;
```

```

h=(b-a)/n;
sum=0;
for k=1:n-1
    x(k)=a+k*h;
    y(k)=f(x(k));
    sum=sum+y(k);
end
Area=h/2*(f(a)+f(b)+2*sum)

```

Question: Compute the integral $\int_0^5 x(x-2)(x-3)$ using Simpson's Three-Eight Rule by dividing the interval $[0, 5]$ into 10 sub-intervals of uniform length.

Solution:

```

f=@(x) x*(x-2)*(x-3);
a=0;
b=5;
n=10;
h=(b-a)/n;
sum1=0;
sum2=0;
for k=1:n-1
    x(k)=a+k*h;
    if rem(k,3)==0
        sum1=sum1+f(x(k));
    else
        sum2=sum2+f(x(k));
    end
end
Area=3*h/8*(f(a)+f(b)+2*sum1+3*sum2)

```

Question: Compute the integral $\int_{-1}^1 \tan(x) - 2x$ using Simpson's Three-Eight Rule by dividing the interval $[-1, 1]$ into 50 sub-intervals of uniform length.

Solution:

```

f=@(x) tan(x)-2*x;
a=-1;
b=1;
n=50;
h=(b-a)/n;
sum1=0;
sum2=0;
for k=1:n-1
    x(k)=a+k*h;
    if rem(k,3)==0
        sum1=sum1+f(x(k));
    end
end

```

```
        else
            sum2=sum2+f (x (k) ) ;
        end
    end
    Area=3*h/8*(f (a)+f (b)+2*sum1+3*sum2)
```

Mth-643 Final term lect8to15(yasir)

Matrix Algebra: <pre>clear all clc Rowvector=[1,2,3] Columnvector=[1;2;3] threeby3matrix=[1,2,3;3,4,5;7,6,8] transpose(threeby3matrix) %Built in Functions A=pascal(3) %symmetric matrix A^T=A B=magic(3) %antisymmetric F=ones(3) %matrix of ones G=eye(3) %Identity matrix H=zeros(2) % Zero matrix %diagonal matrix from a vector v=[2,3,4]; D=diag(v) E=diag(A) % diagonal entries elehda sy vector mn store %add scalar quantity to each element of vector J=[2,4,5;6,7,1;1,1,1]; K=3+J %Matrix Multiplication 1st n=2nd m syms x y T=[1,2;7,5]; X=[x;y] Z=T*X</pre>	Matrix Algebra: <u>%Matrix Multiplication using for Loop</u> <pre>matrix1=[1;2;3]; matrix2=[1,4,5]; m=3; n=3; for i=1:m for j=1:n c(i,j)=matrix1(i,:)*matrix2(:,j) end end</pre> <u>%Matrix Multiplication Simple method</u> <pre>A=[1;2;3]; %follow multiplication rule B=[1,2,3]; C=A*B</pre> <u>% Multiply Individual Entries</u> <pre>A=[1,2,3];B=[4,3,2]; C=A.*B</pre> <u>%divide Individual entries</u> <pre>A=[2,4,6]; B=[6,8,6]; C=A./B %A oper B nechy D=A.\B %B oper A nechy</pre> <u>%Eigen Values</u> <pre>A=[1,2,3;2,3,5;4,3,2]; eig(A); [V,D]=eig(A)</pre> <u>%Reduced Row Echelon Form</u> <pre>A=[1,2,3;1,3,4;2,5,7]; B=rref(A)</pre>
System of Linear Equations: <pre>%x+2y+4z=1,%3x+2y+4z=2,%2x+4y+5z=5 syms x y z A=[1,2,4;3,2,4;2,4,5]; X=[x;y;z]; B=[1;2;5]; X=inv(A)*B; %1st method X=vpa(A\B); %2nd method X=mldivide(A,B); %3rd method eqn1='x+2*y+4*z=1'; %4th method eqn2='3*x+2*y+4*z=2'; eqn3='2*x+4*y+5*z=5'; sol=solve(eqn1,eqn2,eqn3) X=double([sol.x,sol.y,sol.z])'</pre>	Matrix Equation of Sylvester Type: AX+BX=C <pre>A=[1,2,4;5,6,7;2,3,5]; B=[1,3,4;5,2,3;1,4,6]; C=[1,3,9;3,6,8;2,3,5]; X=sylvester(A,B,C)</pre>
For Loop: Example(1) <pre>%we want to add each element of vector v=1:10; sum=0; for i=1:length(v) sum=sum+i end fprintf('sum of all enteries of vector= %d\n',sum)</pre>	For Loop: Example(2) <pre>%we want to add 1st 30 odd numbers v=1:60; sum=0; for i=1:2:length(v) sum=sum+i end fprintf('sum of 1st 30 odd enteries of vector= %d\n',sum)</pre> Malik hafeez current papers
For Loop: Example(3) <pre>%we want to add 1st 30 even numbers v=1:60; sum=0; for i=1:length(v) if(rem(i,2)==0) sum=sum+i; end end fprintf('sum of 1st 30 even enteries of vector= %d\n',sum)</pre>	For Loop: Example(4) <pre>%Calculate factorial num=input('Enter a number= '); fact=1; while num<0 disp('Enter a positive Number') num=input('Enter a number= '); end if num>0 for i=1:num fact=fact*i; end end</pre>

	<pre> end fprintf('The factorial of %d is= %d\n',num,fact) end </pre>
Nested For Loop: Example(5) <pre> %print a pattern rows=input('How many rows do you want to print: '); for R=1:rows for S=1:R fprintf('*') end fprintf('\n') end </pre>	Differentiation and Integration: <pre> %y=x^3 syms x y z f=x^3; df=diff(f,x,2); %differentiation i=int(f,0,2); %Integration %sin(2x) g=sin(2*x); dg=diff(g,x); integ=int(g,x,0,pi/2); %x^2y^3z^2 h=x^2*y^3*z^2; dh=diff(h,z); Ih=int(int(int(h,0,pi),0,pi/2),0,1) </pre>
Solution Of ODES: Example(1) <pre> %dy/dt=ty %y(0)=1 syms y(t) ode=diff(y,t)==t*y; cond=y(0)==1; soly(t)=dsolve(ode,cond) </pre>	Solution Of ODES: Example(2) <pre> %dy/dt+4y(t)=exp(-t) %y(0)=1 syms y(t) ode=diff(y,t)+4*y(t)== exp(-t); cond=y(0)==1; soly(t)=dsolve(ode,cond) </pre>
Solution Of ODES: Example(3) <pre> %d^2y/dt^2=cos(2t)-y %y(0)=1 %y'(0)=0 syms y(t) Dy=diff(y); ode=diff(y,t,2)==cos(2*t)-y; cond1=y(0)==1; cond2=Dy(0)==0; cond=[cond1 cond2]; soly(t)=dsolve(ode,cond) simplsol=simplify(soly(t)) </pre>	Solution Of ODES: Example(4) <pre> %d^3u/dx^3=u %u(0)=1 %u'(0)=-1 %u''(0)=pi syms u(x) Du=diff(u); D2u=diff(u,2); ode=diff(u,x,3)==u; cond1=u(0)==1; cond2=Du(0)==-1; cond3=D2u(0)==pi; cond=[cond1 cond2 cond3]; solu(x)=dsolve(ode,cond) simplsolu(x)=simplify(solu(x)) </pre>
System Of ODES: Example(1) <pre> %du/dt=3u+4v %dv/dt=-4u+3v syms u(t) v(t) ode1=diff(u,t)==3*u+4*v; ode2=diff(v,t)==-4*u+3*v; ode=[ode1 ode2]; sol=dsolve(ode); sol.u; sol.v; %OR [usol vsol]=dsolve(ode) </pre>	Ode45:Example(1) <pre> %F=3exp(-t) %tspan=[0,5] %x0=0 %F=3exp(-t) %tspan=[0,5] %y0=0 syms t F=@(t,F) 3*exp(-t); tspan=[0,5]; f0=0; [t,F]=ode45(F,tspan,f0) plot(t,F) </pre>
Ode45:Example(2) <pre> %y'=2t %tspan=[0,5] %y0=0 yprime=@(t,y) 2*t; tspan=[0,5]; y0=0; [t y]=ode45(yprime,tspan,y0) plot(t,y) xlabel('t-axis'); ylabel('Y-axis'); title('Graph of yprime=2t') </pre>	Ode45:Example(3) <pre> %u'=2u+v+5w+exp(-2t) %v'=-3u-2v-8w+2exp(-2t)-cos(3t) %w'=3u+3v+2w+cos(3t) %tspan=[0,5] %u(0)=1 %v(0)=-1 %w(0)=0 clear all clc close all syms u v w t uprime=2*u+v+5*w+exp(-2*t); vprime=-3*u-2*v-8*w+2*exp(-2*t)-cos(3*t); wprime=3*u+3*v+2*w+cos(3*t); tspan=[0,5]; u0=1; v0=-1; w0=0; </pre>

	<pre>cond=[u0,v0,w0]; ode=@(t,x)[2*x(1)+x(2)+5*x(3)+exp(-2*t);- 3*x(1)-2*x(2)-8*x(3)+2*exp(-2*t)- cos(3*t);3*x(1)+3*x(2)+2*x(3)+cos(3*t)] [t,x]=ode45(ode,tspan,cond) plot(t,x) xlabel('X-axis') ylabel('Y-axis') title('Plot of Solution Curves')</pre>
Solution of differential equation using numerical method: Euler's Method: $y(x+h) = y(x) + hy'(x)$ $y(x+h) = y(x) + hf(x,y)$ <pre>%Euler Method %y(x+h)=y(x)+hy'(x) %y(x+h)=y(x)+hf(x,y) %f(x,y)=x/y %Euler Method %y(x+h)=y(x)+hf(x,y) %f(x,y)=x/y %a=0 %b=2 %y0=1 %x0=0 %n=10 clear all clc f=@(x,y)(x/y); a=0; b=2; y0=1; x0=0; n=10; h=(b-a)/n; x(1)=x0; y(1)=y0; for j=1:n y(j+1)=y(j)+h*f(x(j),y(j)); x(j+1)=x(j)+h; end plot(x,y) hold on syms Y(X) ode=diff(Y,X)==X/Y; cond=Y(0)==1; S=dsolve(ode,cond) F=matlabFunction(S); fplot(F,[0,2],'r',2) hold off</pre>	Trapezoidal Rule: $\int_a^b f(x)dx = \frac{\Delta x}{2} \left[f(x_0) + f(x_n) + 2 \sum_{j=1}^{n-1} f(x_j) \right]$ <pre>%Trapezoidal Rule %find area of curve x^2 %a=0,%b=2, %n=3 f=@(x)x^2; a=0; b=2; n=3; h=(b-a)/n; sum=0; x(1)=1; for i=1:n-1 x(i)=a+i*h; y(i)=f(x(i)); sum=sum+y(i); end Area=h/2*[f(a)+f(b)+2*sum] %find area of curve exp(x^2) f=@(x)exp(x^2); a=0; b=2; n=20; h=(b-a)/n; sum=0; x(1)=1; for i=1:n-1 x(i)=a+i*h; y(i)=f(x(i)); sum=sum+y(i); end Area=h/2*[f(a)+f(b)+2*sum]</pre>
Simpson's 1/3 Rule: $\int_a^b f(x)dx = \frac{h}{3} \left[f(x_0) + f(x_n) + 2 \sum_{j=1}^{\frac{n}{2}-1} f(x_{2j}) + 4 \sum_{j=1}^{\frac{n}{2}} f(x_{2j-1}) \right]$ <pre>%Simpson1by3rule %y=x^3 %a=0, %b=2, %n=10, clear all clc % f=@(x)x^3; a=0; b=2; n=10; % n must even h=(b-a)/n; if (rem(n,2)~=0) fprintf('\n Enter Valid n'); n=input('\n Enter n as Even'); end sum1=0;</pre>	Simpson's 3/8 Rule: $\int_a^b f(x)dx = \frac{3h}{8} \left[f(x_0) + f(x_n) + 2 \sum_{j=1}^{\frac{n}{3}-1} f(x_{3j}) + 3 \sum_{i \neq 3k}^{n-1} f(x_i) \right]$ <pre>%Simpson 3/8 rule %exp(2x)sin(6x) clear all clc %f=@(x)exp(2*x).*sin(6*x); f=@(x)1/(1+x); a=0; b=4; n=12; % n must be multiple of 3 if (rem(n,3)~=0)</pre>

<pre> sum2=0; for k=1:n-1 x(k)=a+k*h; if (rem(k,2)==0) sum1=sum1+f(x(k)); else sum2=sum2+f(x(k)); end end Area=(h/3)*(f(a)+f(b)+2*sum1+4*sum2); fprintf('Area by Simpson1/3 is=%f',Area) %comparison syms y f1=y^3; Area2=int(f1,a,b) </pre>	<pre> fprintf('\n Enter valid value of n'); n=input('\n Enter n as multiple of 3: ') end h=(b-a)/n; sum1=0; sum2=0; for k=1:n-1 x(k)=a+k*h; if (rem(k,3)==0) sum1=sum1+f(x(k)); else sum2=sum2+f(x(k)); end end Area=(3*h/8)*(f(a)+f(b)+2*sum1+3*sum2); fprintf('AreabySimpson 3/8 rule = %f',Area); %Comparison syms y f1=1/(1+y); Area2=int(f1,a,b) double(Area2) vpa(Area2,6) </pre>
Newton Raphson Method: $x_{i+1} = x_i - \frac{f(x_i)}{f'(x_i)}$ <pre> %Newton Raphson Method % f(x)=cos(x)-x^3, clear all clc syms x f=@(x)x^3-2*x-5; df=@(x)3*x^2-2; x0=2; tolerance=10^-4; n=5; if df(x0)~=0 for i=1:n x1=x0-f(x0)/df(x0); fprintf('x%d= %f\n',i,x1) if abs(x1-x0)<tolerance break end end end </pre>	Bisection Method: <pre> % x^3-x^2-2 %a=1 and b=2 %f(1)=-2 %f(2)=4 f=@(x)x^3-x-2; a=1; b=2; tol=10^-4; if f(a)*f(b)>0 disp('Bisection method not applicable'); return end disp('Iter No a b c') i=1; while (abs(a-b)>=tol) c=(a+b)/2; if f(c)==0 fprintf('Root of function is %f',c); return end fprintf('%2i \t %f \t %f \t %f\n',i, a, b, c); if f(a)*f(c)>0 a=c; else b=c; end i=i+1; end m=(a+b)/2 fprintf('Root lies at %f/',m) </pre>

Q1 find sum $= \sum_{k=1}^n \left(\frac{3}{x}\right)^k$

```
clear all
clc
close all
n=12;
k=1:n;
x=4;
for i=1:length(k);
    sum=(3/x)^k(i);
end
disp(sum)
```

OR

```
function sum=addtwo( x,n );
x=input('x');
n=input('n');
k=1:n;
for i=1:length(k);
    sum=(3/x)^k(i);
end
end
```

Q2 Newton question

```
function [x] = Newton(f,fd,x0,n);
f=@(x)x^3+x;
fd=@(x)3*x^2+1;
x0=2;
x=x0;
n=4;
for k=1:n;
    x=x-f(x)/fd(x)
end
end
```

Q3 simpson 1/3 rule

```
f=@(x) sqrt(x);
a=0;
b=5;
n=18;
h=(b-a)/n;
sum1=0;
sum2=0;
for k=1:n-1;
    x(k)=a+k*h;
    if (rem(k,2)==0);
        sum1=sum1+f(x(k));
    else
        sum2=sum2+f(x(k));
    end
end
```

```

    end
end
Area=h/3*(f(a)+f(b)+2*sum1+4*sum2)

```

Q4 simpson 3/8 rule

```

f=@(x) sqrt(x);
a=0;
b=5;
n=18;
h=(b-a)/n;
sum1=0;
sum2=0;
for k=1:n-1;
    x(k)=a+k*h;
    if (rem(k,3)==0);
        sum1=sum1+f(x(k));
    else
        sum2=sum2+f(x(k));
    end
end
Area=3*h/8*(f(a)+f(b)+2*sum1+3*sum2)

```

Q5 Trapezoidal rule

```

clear all
close all
clc
f=@(x) x^4;
a=0;
b=2;
n=6;
h=(b-a)/n;
sum=0;
for k=1:n-1;
    x(k)=a+k*h;
    y(k)=f(x(k));
    sum=sum+y(k);
end
Area=h/2*(f(a)+f(b)+2*sum)

```

Q6 factorial using for loop

```

a=input('Enter a number')
fact=1;
if a<0;
    fprintf('The numbe is negative')
else
    for i=1:a;
        fact=fact*i
    end
end

```

Q7 factorial using while loop

```
clear all
clc
close all
n=4;
f=n;
while n>1;
    n=n-1;
    f=f*n;
end
disp(f)
```

Q8 calculate Riemann sum $\int_0^2 e^{x^2} dx$ for n=20

```
clc
clear all
close all
f=@(x)exp(x^2);
a=0;
b=2;
n=20;
h=(b-a)/n;
value=0;
for k=1:n;
    x(k)=a+k*h;
    value=value+f(x(k));
end
R=value*h
```

Q9 Sum and Prod

```
function [ sum prod ] = examquestion( s,p )
clc
clear all
close all
s=input('s')
p=input('p')
sum=s+p
prod=s*p
end
```

Q10 Ode45 command

```
clc
clear all
close all
yprime=@(t,y)2*t;
tspan=[0 5];
y0=0;
[t,y]=ode45(yprime,tspan,y0)
```

Q11 Solve differential equation by dsolve command

```
clc
clear all
close all
syms y(t)
ode=diff(y,t)+5*y==12;
cond=y(0)==10;
solve=dsolve(ode,cond)
```

Q12 Solve differential equation when two condition given by

dsolve command. $\frac{d^2y}{dt^2} = \cos(2t) - y$ $y(0)=1$, $y'(0)=1$

```
clc
clear all
close all
syms y(t)
Dy=diff(y);
ode=diff(y,t,2)==cos(2*t)-y;
cond1=y(0)==1;
cond2=Dy(0)==1;
cond=[cond1 cond2];
sol=dsolve(ode,cond)
```

Q13 solve system of linear equation by solve command

```
clc
clear all
close all
equ1='2*x+y+z=2';
equ2='-x+y-z=3';
equ3='x+2*y+3*z=-10';
[x,y,z]=solve(equ1,equ2,equ3)
```

Q14 solve system of linear equation

```
clc
clear all
close all
A=[2 1 1;-1 1 -1;1 2 3];
B=[2;3;-10];
C=inv(A);
solve=C*B
```

Q15 Write argument matrix and find rref

```
clc
clear all
close all
```

```

A=[8 1 6;3 5 7;4 9 2]
b=[1;1;1]
Ab=[A b]
solve=rref(Ab)

```

Q16 Matrix multiplication

```

clc
clear all
close all
A=sym([3/11 2/5 4/7;2/3 4/5 6/7;7/9 8/6 9/4])
B=sym([1/3 8/9 4;2/9 3/7 9/6;6 7/4 5/7])
mult=A*B
iver=inv(A)

```

Q17 find sum of first 30 positive odd integer using for loop

```

clc
clear all
close all
k=1:30;
sum=0;
for i=1:2:length(k);
    sum=sum+k(i);
end
disp(sum)

```

Q18 Add A and B than store in C. Multiply A and B and store in D

```

clc
clear all
close all
A=[1 2 8;3 4 9;5 6 0];
B=[1 2 3;4 5 6;7 8 9];
C=A+B
D=A*B

```

Q19 Calculate rref and inverse of the given matrix

```

clc
clear all
close all
A=[1 3 4;9 5 6;1 1 2];
inv(A)
rref(A)

```

Q1

```
% simple differential equation with two condtion
syms y(t)
ode=diff(y,t,2)+2*diff(y,t)+5*y==7;
Du=diff(y,t);
cond1=y(0)==1;
cond2=Du(0)==0;
cond=[cond1 cond2];
s=dsolve(ode,cond)
```

Q2

```
%simple differential equation with one condtion
syms y(t)
ode=diff(y,t)==y+1;
cond=y(0)==1;
solve=dsolve(ode,cond)
```

Q3

```
%Fimd eign values and eigen victor and also reduced echlon form
A=[1 3 4;9 5 6;1 1 2];
eig(A);
[P D]=eig(A)
rref(A)
```

Q4

```
% find sumission
n=12;
k=1:n;
x=4;
for i=1:length(k)
    sum=(3/x)^k(i)
end
disp(sum)
```

Q5

```
%find factorial
a=input('input a number')
fact=1
if a<0
    fprintf('the number you enter is negatice')
else
    for i=1:a
        fact=fact*a
    end
end
```

Q6

```
%find sum and product
disp(fact)
function [sum prod] = examquestion(s,p)
s=input('s');
p=input('p');
sum=s+p
prod=s*p
end
```

Q7

```
%find argumented matrix and rref
A=[1 2 1;-1 1 -1;1 2 3];
b=[1;3;-10];
Ab=[A b]
rref(Ab)
```

Q8

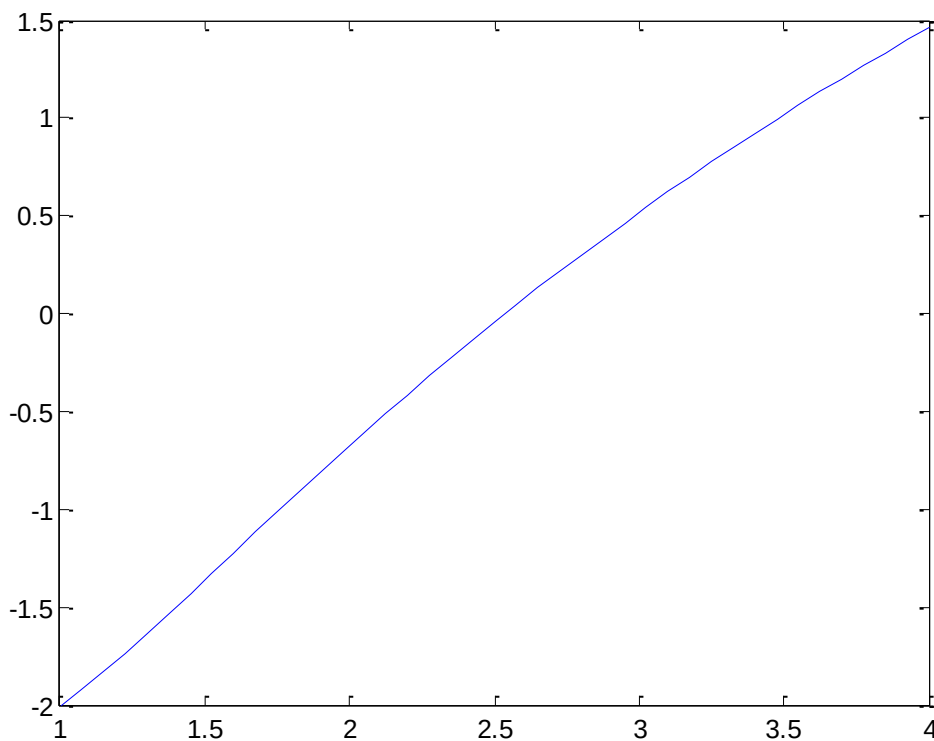
```
%ode45 command question
f=@(t,y)2*t;
tspan=[0 5];
y0=0;
[t,y]=ode45(f,tspan,y0)
```

MTH643 (final questions)

Question:1;

**%find approximate value of $t^2y'=y+3t$ on
%interval [1,4] initial condation
% $y(1)=-2$ and plot solution curve**

```
clear all;  
close all;  
clc  
f=@(t,y) (y+3*t)/t^2;  
tspan=[1,4];  
y1=-2;  
[t,y]=ode45(f,tspan,y1)  
plot(t,y)
```



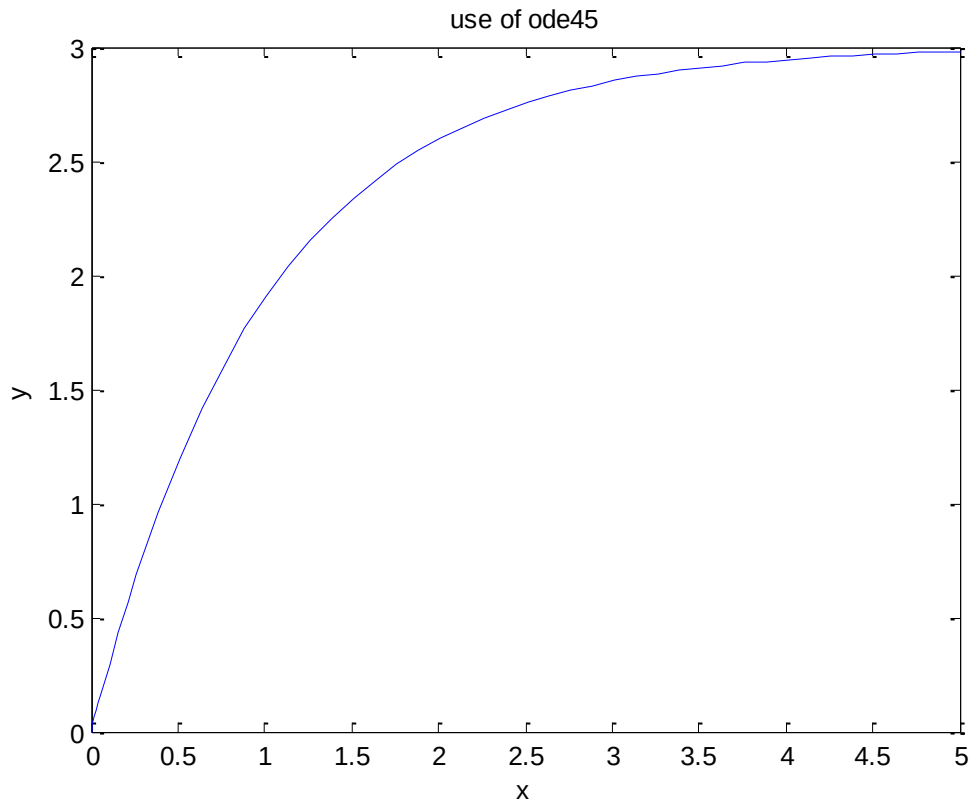
.....
//////////

//////////

Question:2;

**%find numerical solution using ode45command
%if $dx/dt=3e^{-t}$ time
%interval [0,5]initial condation $x(0)=0$ and
plot curve**

```
clear all;  
close all  
clc  
f=@(t,x) 3*exp(-t);  
tspan =[0,5];  
x0=0;  
[t,x]=ode45(f,tspan,x0)  
plot(t,x)  
xlabel('x')  
ylabel('y')  
title('use of ode45')
```



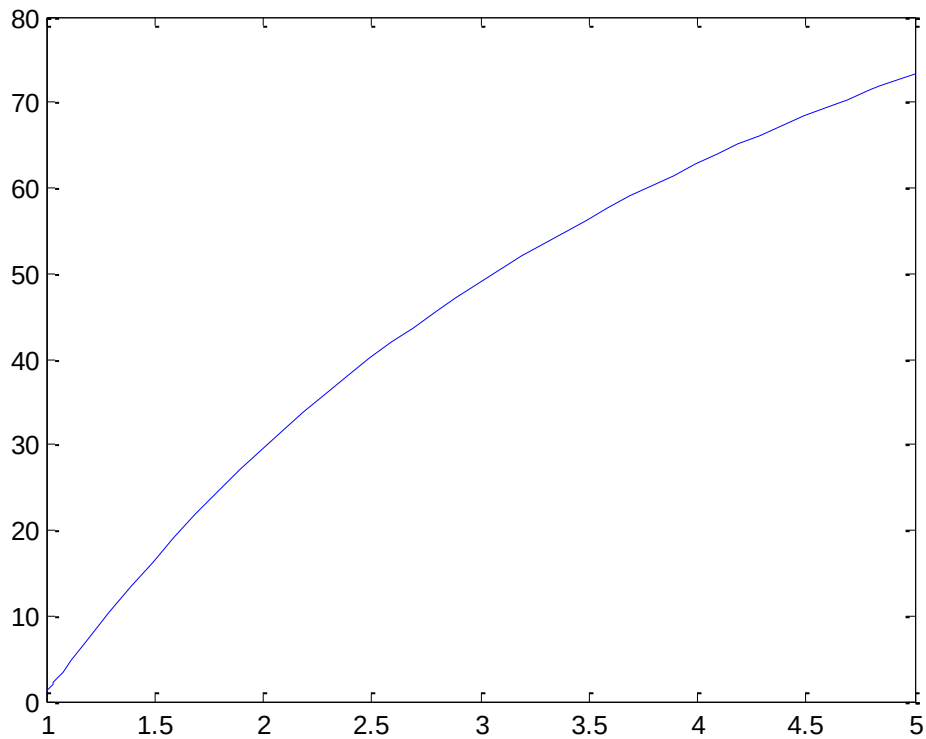
.....
 ////////////////

.....
 ////////////////

Question:3;

```
%find approximate solution if
%if  $dy/dt = y/t^2 + 32/t$   $y(0)=1$  interval
[1,5]plo
% curve
clear all;
close all
clc
f=@(t,y) y/t^2+32/t;
tspan =[1,5];
y0=1;
```

```
[t,y]=ode45(f,tspan,y0)
plot(t,y)
```



```
;;
```

```
.....
//////////
```

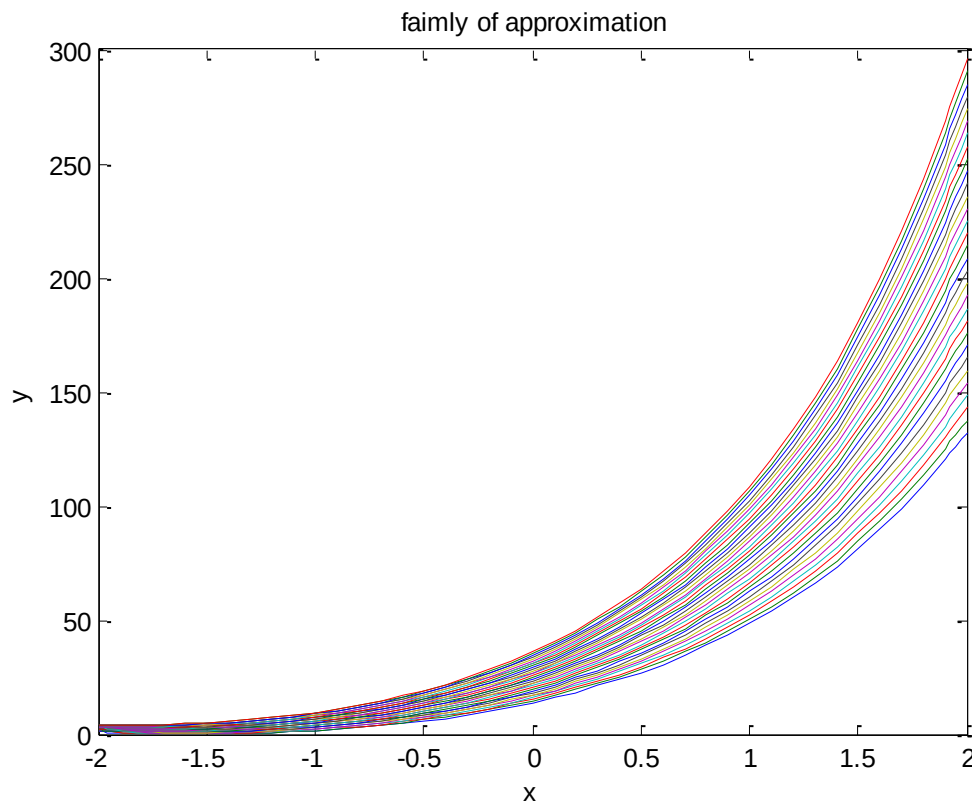
Qestion:4;

```
%plot the the faimly of approximation
solution of
%following initial value problem
% on the interval [-2,2] y'(x)1:0.1:4 %
f=y-3*x^2+7
clear all;
close all
clc
f=@(x,y) y-3*x^2+7;
```

```

xspan =[-2,2];
y1=1:0.1:4;
[x,y]=ode45(f,xspan,y1)
plot(x,y)
xlabel('x')
ylabel('y')
title('family of approximation')

```



Question:5;

```

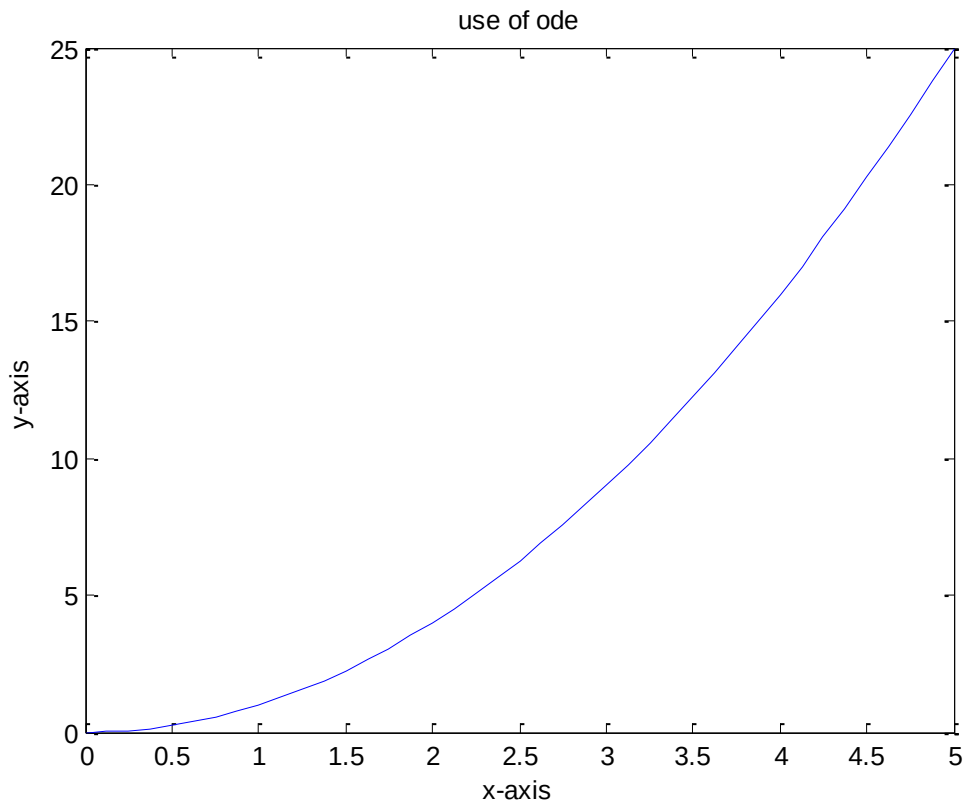
%find numerical solution of the following
%equation  $Y' = 2t$  using
%interval  $[0,5]$  and  $Y(0) = 0$ 
clear all
close all
clc
f=@(t,y) 2*t;

```

```

tspan=[0,5];
y0=0;
[t,y]=ode45(f,tspan,y0)
plot(t,y)
xlabel('x-axis')
ylabel('y-axis')
title('use of ode')

```



Question:6:

```

%creat matrix in matlab A[1 6 5'2 7 3;7 4
9]
%B=[2 8 4;1 5 9;6 7 3]
clear all
close all
clc

```

```

A=[1 6 5; 2 7 3;7 4 9]
B=[2 8 4;1 5 9;6 7 3]
%find
%1)find diagonal matrix of A
diagonalA=diag(A)
%2)sum of second row of matrix B
sum2ndrw=sum(B(2,:))
%3)sum of 3rd column of matrix A
sum3rdcln=sum(A(:,3))
,,,,,,,,,,,,,,,,,,,,,,,,,,,,,
,,,,,,,,,,,,,,,,,,,,,,,,,,,,,

```

A =

```

1  6  5
2  7  3
7  4  9

```

B =

```

2  8  4
1  5  9

```

6 7 3

diagonalA =

1

7

9

sum2ndrw =

15

sum3rdcln =

17

>> syms u v

.....
.....

Question:7;

```
%creat matrix in matlab
%A[3/11,2/5,4/7;2/3,4/5,6/5;7/9,8/6,9/4]and
%B[1/3,8/9,4;2/9,3/7,9/6;6,7/4,5/7]
clear all
close all
clc
A=sym([ [3/11,2/5,4/7;2/3,4/5,6/5;7/9,8/6,9/4] ])
B=sym([ [1/3,8/9,4;2/9,3/7,9/6;6,7/4,5/7] ])
%1)find inverse of matrix A
iverseofA=inv(A)
%2)A*B 3)find
C=A*B
%sum of element of last row of matrix B
sumlastr=sum(B(end,:))
```

OUTPUT:

A =

```
[ 3/11, 2/5, 4/7]
[ 2/3, 4/5, 6/5]
[ 7/9, 4/3, 9/4]
```

B =

```
[ 1/3, 8/9, 4]
[ 2/9, 3/7, 3/2]
[ 6, 7/4, 5/7]
```

inverseofA =

```
[ -385/38, 1595/228, -22/19]
[ 6545/228, -11725/1368, -155/57]
[ -770/57, 455/171, 140/57]
```

C =

```
[ 12503/3465, 1633/1155, 5657/2695]
[ 38/5, 5737/1890, 496/105]
[ 253/18, 47177/9072, 1693/252]
```

sumlastr =

237/28

>>

Question:8;

```
%create matrix in matlab
%A=[1 6 5;2 7 3;7 4 9]
%B=[2 8 4;1 5 9;7 4 9]
clear all
```

```

close all
clc
A=[1 6 5;2 7 3;7 4 9]
B=[2 8 4;1 5 9;7 4 9]
% 1)divide matrixA and B and its result
store in matrix c
C=A/B
%
```

```

% 2)find transpose of matrix c
D=transpose(C)
% 3)find invrerse of matrix B
G=inv(B)
```

Output:

A =

1	6	5
2	7	3
7	4	9

B =

2	8	4
1	5	9
7	4	9

C =

0.5460	0.3804	-0.0675
0.9294	-0.1166	0.0368
0	0	1.0000

D =

0.5460	0.9294	0
0.3804	-0.1166	0
-0.0675	0.0368	1.0000

G =

0.0276	-0.1718	0.1595
0.1656	-0.0307	-0.0429
-0.0951	0.1472	0.0061

>>

Question:9;

```
%create matrix in matlab A=[1 3 4;9 5 6;1 1 2]
```

```
clear all
```

```
close all
```

```
clc
```

```
A=[1 3 4;9 5 6;1 1 2]
```

```
%1) find eigen value eigenvector
```

```
[P D]=eig(A)
```

```
%2) find reduce echelon from A
reducofA=rref(A)
```

OUTPUT:

A =

1	3	4
9	5	6
1	1	2

P =

0.3820	0.6270	-0.0138
0.9095	-0.7783	-0.7993
0.1642	0.0335	0.6007

D =

9.8633	0	0
0	-2.5096	0
0	0	0.6464

reducofA =

1	0	0
0	1	0
0	0	1

>>

Question:10;

```
%create function with name  
"vectorsumproduct"  
%in matlab which take two  
%vector u=[1 4 5 7 9] and v=[3 1 9 5 8]  
%function must calculate sum and  
%product of two vector  
function [sum prod]=vectorsumproduct(v,u)  
clear all;  
close all  
clc  
u=[1 4 5 7 9]  
v=[3 1 9 5 8]  
sum=u+v  
prod=u.*v  
end
```

output:

u =

1 4 5 7 9

v =

3 1 9 5 8

sum =

4 5 14 12 17

prod =

3 4 45 35 72

ans =

4 5 14 12 17

>>

Question:11:

```
%write the function which compute the  
volume of one  
%function must take two +ve parameter as  
input height  
%and radius give volume as output formula  
%cone is  $v = \frac{1}{3} * (\pi * h * r^2)$   
function p=valumn(h,r)  
clear all  
close all  
clc  
h=3;  
r=2;  
v=1/3*(pi*h*r^2)  
end
```

output:

v =

12.5664

>>

Questin:12:

```
%solve system of linear equation
%2*x+y+z=2, -x+y-z=3, x+2*y+3*z=-10
clear all
close all
clc
eqn1='2*x+y+z=2'
eqn2='-x+y-z=3'
eqn3='x+2*y+3*z=-10'
[x,y,z]=solve(eqn1,eqn2,eqn3)
```

Output

eqn1 =

2*x+y+z=2

eqn2 =

-x+y-z=3

eqn3 =

$$\mathbf{x+2*y+3*z=-10}$$

x =

3

y =

1

z =

-5

>>

Question:13;

```
%compute Remain sum using 20 equally sub  
spaced of  
%following definite  
%integral f=exp(x^2) on tye interval [0,2]  
clc  
clear all  
close all  
n=20;  
a=0;  
b=2;  
dx=(b-a)/n;  
f=@(x)exp(x^2);  
value=0;  
for k=1:n  
    c=a+k*dx;  
    value =value+f(c);  
end  
R=value*dx
```

Output

R =

19.3139

>>

Question:14;

```
%compute definite integral of function
%f(x) = e^(-x^2) using trapezoidal rule
considering 100
%subinterval on the interval [0,2]
clc
clear all
close all
n=100;
a=0;
b=2;
dx=(b-a)/n;
f=@(x)exp(-x^2);
value=0;
avg=(f(b)+f(a))/2;
for k=1:(n-1)
    c=a+k*dx;
    value =value+f(c);
end
T=(value+avg)*dx
R=value*dx
```

Output:

T =

0.8821

R =

0.8719

>>

Question:15;

%find the area of the curve using simson's
one third rule

%if n=20 interval[0,2] and

%function (2+cos(2*sqrt(x)))

clear all

close all

clc

n=20;

a=0;

b=2;

f=@(x) (2+cos(2*sqrt(x)));

dx=(b-a)/n;

```
value1=0;
value2=0;
avg=f(a)+f(b)
for k=1:(n-1)
    x(k)=a+k*dx;
    if mod(k,2)==0;
        value1=value1+2*f(x(k));
    else
        value2=value2+4*f(x(k));
    end
end
area=(avg+value1+value2)*(dx/3)
```

OUTPUT:

avg =

4.0486

area =

3.4600

>>

Question:16;

```
%find area by using simson 3/8 rule of
%function sqrt(1+x^3) on interval [1,5] and
n=100
clear all
close all
clc
n=100;
a=1;
b=5;
dx=(b-a)/n;
f=@(x) sqrt(1+x^3);
avg=f(a)+f(b);
value1=0;
value2=0;
for k=1:(n-1)
    x(k)=a+k*dx;
    if mod(k,3)==0
        value1=value1+2*f(x(k));
    else
        value2=value2+3*f(x(k));
    end
end
Area=(avg+value1+value2)*(3/8*dx)
```

OUTPUT:

Area =

22.3732

>>

Question:17:

$$L_{i+2}(z) = \frac{i+3}{i+2} L_i(z) + \frac{i}{i+2} L_{i+1}(z) \text{ where } L_1(z) \text{ and } L_2(z) = z^2$$

Soluion:

```
function p=lengdp(value1,value2,M)
clc
clear all
close all
syms z
value(1)=z;
value(2)=z^2;
M=6;
for i=1:M;

value(i+2)=(sym(i+3)/(i+2))*value(i)+(sym(i)
)/(i+1)*value(i+1));
end
p=transpose(value)
end
```

output:

value =

[z, z^2, z^2/2 + (4*z)/3]

value =

[z, z^2, z^2/2 + (4*z)/3, (19*z^2)/12 + (8*z)/9]

value =

[z, z^2, z^2/2 + (4*z)/3, (19*z^2)/12 + (8*z)/9, (143*z^2)/80 + (34*z)/15]

value =

[z, z^2, z^2/2 + (4*z)/3, (19*z^2)/12 + (8*z)/9, (143*z^2)/80 + (34*z)/15, (5899*z^2)/1800 + (1924*z)/675]

value =

[z, z^2, z^2/2 + (4*z)/3, (19*z^2)/12 + (8*z)/9, (143*z^2)/80 + (34*z)/15, (5899*z^2)/1800 + (1924*z)/675, (72181*z^2)/15120 + (14078*z)/2835]

value =

[z, z^2, z^2/2 + (4*z)/3, (19*z^2)/12 + (8*z)/9, (143*z^2)/80 + (34*z)/15, (5899*z^2)/1800 + (1924*z)/675, (72181*z^2)/15120 + (14078*z)/2835, (5488699*z^2)/705600 + (493681*z)/66150]

p =

z

z^2

z^2/2 + (4*z)/3

$$(19*z^2)/12 + (8*z)/9$$

$$(143*z^2)/80 + (34*z)/15$$

$$(5899*z^2)/1800 + (1924*z)/675$$

$$(72181*z^2)/15120 + (14078*z)/2835$$

$$(5488699*z^2)/705600 + (493681*z)/66150$$

ans =

$$z$$

$$z^2$$

$$z^2/2 + (4*z)/3$$

$$(19*z^2)/12 + (8*z)/9$$

$$(143*z^2)/80 + (34*z)/15$$

$$(5899*z^2)/1800 + (1924*z)/675$$

$$(72181*z^2)/15120 + (14078*z)/2835$$

$$(5488699*z^2)/705600 + (493681*z)/66150$$

>>

Question:18;

$$L_{i+2}(z) = \frac{2i+1}{i+3} L_i(z) + \frac{i+3}{i+2} L_{i+1}(z) \text{ where } L_1(z) = \frac{z}{2} \text{ and } L_2(z) = \frac{2z^2}{3}$$

Solution:

```
clc
clear all
close all
syms z
L(1)=z/2;
L(2)=2*z^2/3;
M=4;
for i=1:M;

L(i+2)=(sym(2*i+1)/(i+3))*L(i)+(sym(i+3)/(i
+2))*L(i+1));
end
p=L'
```

OUTPUT:

p =

conj(z)/2

(2*conj(z)^2)/3

$$(3*\text{conj}(z))/8 + (8*\text{conj}(z)^2)/9$$

$$(15*\text{conj}(z))/32 + (16*\text{conj}(z)^2)/9$$

$$\text{conj}(z) + (428*\text{conj}(z)^2)/135$$

$$(1189*\text{conj}(z))/672 + (16966*\text{conj}(z)^2)/2835$$

>>

Question:19;

Using Simpson's one third rule to solve question in Matlab $\int_1^2 (\cos(x) - \ln(x) + e^x) dx$ $n = 10$

Solution:

```
clc
clear all
close all
n=10;
a=1;
b=2;
dx=(b-a)/n;
f=@(x) cos(x)-log(x)+exp(x);
value1=0;
value2=0;
avg=(f(a)+f(b));
for k=1:(n-1)
    c=a+k*dx;
    if mod(k,2)==0;
        value1=value1+2*f(c);
```

```

        else
            value2=value2+4*f(c);
        end
    end
    Answer=(avg+value1+value2)*(dx/3)

```

Output:

Answer =

4.3523

>>

Question:20;

```

clc
close all
clear all
syms x y
u=2*x+x*y^2+3*y;
ans1=subs(u,x,5)
f=sin(x);
ans2=subs(f,x,pi/2)
sol=solve('3*x^3+x^2+3*x+4=0',x)

```

Solution:

ans1 =

$$5*y^2 + 3*y + 10$$

ans2 =

1

sol =

$$\begin{aligned} & ((3571^{(1/2)} * 8748^{(1/2)}) / 8748 - \\ & 893/1458)^{(1/3)} - \\ & 26 / (81 * ((3571^{(1/2)} * 8748^{(1/2)}) / 8748 - \\ & 893/1458)^{(1/3)}) - 1/9 \end{aligned}$$

$$\begin{aligned} & (3^{(1/2)} * (26 / (81 * ((3571^{(1/2)} * 8748^{(1/2)}) / 8748 - \\ & 893/1458)^{(1/3)})) + \\ & ((3571^{(1/2)} * 8748^{(1/2)}) / 8748 - \\ & 893/1458)^{(1/3)}) * i) / 2 + \\ & 13 / (81 * ((3571^{(1/2)} * 8748^{(1/2)}) / 8748 - \\ & 893/1458)^{(1/3)}) - \\ & ((3571^{(1/2)} * 8748^{(1/2)}) / 8748 - \\ & 893/1458)^{(1/3)}) / 2 - 1/9 \\ & 13 / (81 * ((3571^{(1/2)} * 8748^{(1/2)}) / 8748 - \\ & 893/1458)^{(1/3)}) - \\ & (3^{(1/2)} * (26 / (81 * ((3571^{(1/2)} * 8748^{(1/2)}) / 8748 - \\ & 893/1458)^{(1/3)})) + \\ & ((3571^{(1/2)} * 8748^{(1/2)}) / 8748 - \end{aligned}$$

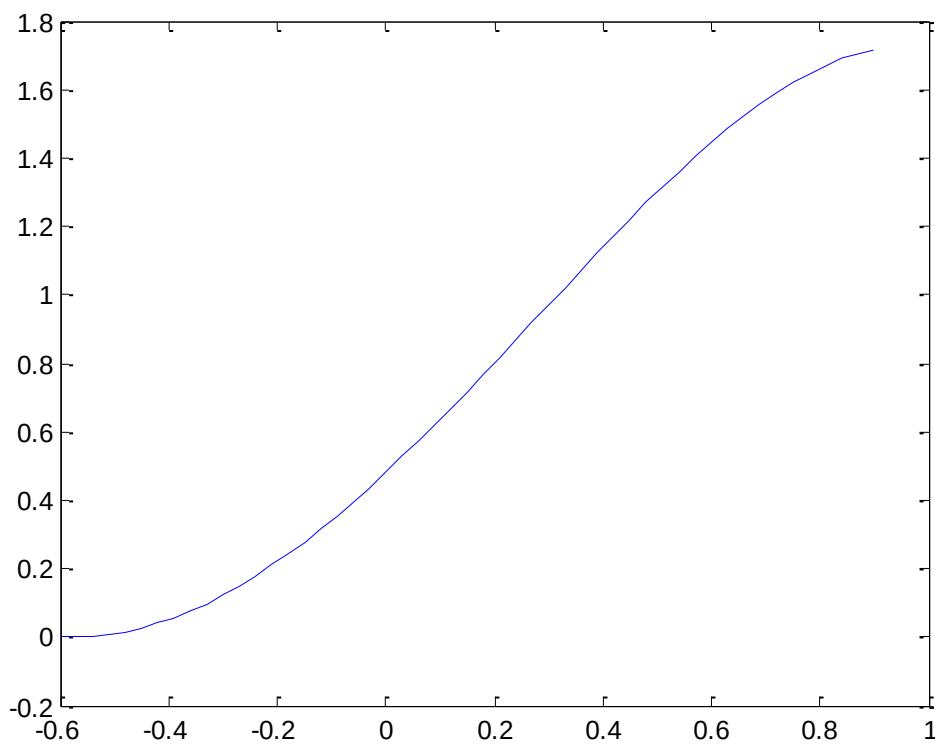
$$\frac{893}{1458} \left(\frac{1}{3} \right)^{\frac{1}{3}} i \Big/ 2 - \frac{\left((3571)^{\frac{1}{2}} * 8748^{\frac{1}{2}} \right)}{8748} - \frac{893}{1458} \left(\frac{1}{3} \right)^{\frac{1}{3}} \Big/ 2 - \frac{1}{9}$$

>>

Question:21;

```
clc
close all
clear all
syms x y
xspan=-0.6:0.03:0.9;
y0=0;
f=@(x,y) (y-3*x^2+1);
[x,y]=ode45(f,xspan,y0)
plot(x,y)
```

output:



Question:22;

$\alpha = 2, \beta = 2T = 1m = 4$ creat a function

$$R_{T,j}^{(\alpha,\beta)} = \sum_{j=1}^m \frac{T^{\alpha+\beta+1} (j+\alpha+1)! \Gamma(j+\alpha+\beta+1)}{(j+2\alpha+3) \Gamma(\alpha+\beta+1) \Gamma(\beta+1)} X^k$$

Solution:

```
function R=polynomial(alpha,beta,T,m)
clc
clear all
close all
syms k x
alpha=1;
beta=2;
T=1;
m=4;
for j=1:m
    a1=T^(alpha+beta+1);
    a2=factorial(j+alpha+1);
    a3=(j+alpha+beta+1);
    d1=(j+2*alpha+3);
    d2=gamma(alpha+beta+1);
    d3=gamma(beta+1);
    aa=(a1*a2*a3)/(d1*d2*d3);
    R(j+0)=symsum(aa*x^k,k,0,j);
end
R=R'
```

output:

R =

$$\begin{aligned} & (5*\text{conj}(x))/12 + 5/12 \\ & (12*\text{conj}(x))/7 + (12*\text{conj}(x)^2)/7 + \\ & 12/7 \\ & (35*\text{conj}(x))/4 + (35*\text{conj}(x)^2)/4 + \\ & (35*\text{conj}(x)^3)/4 + 35/4 \\ & (160*\text{conj}(x))/3 + (160*\text{conj}(x)^2)/3 + (160*\text{conj}(x)^3)/3 + \\ & (160*\text{conj}(x)^4)/3 + 160/3 \end{aligned}$$

ans =

$$\begin{aligned} & (5*\text{conj}(x))/12 + 5/12 \\ & (12*\text{conj}(x))/7 + (12*\text{conj}(x)^2)/7 + \\ & 12/7 \\ & (35*\text{conj}(x))/4 + (35*\text{conj}(x)^2)/4 + \\ & (35*\text{conj}(x)^3)/4 + 35/4 \\ & (160*\text{conj}(x))/3 + (160*\text{conj}(x)^2)/3 + (160*\text{conj}(x)^3)/3 + \\ & (160*\text{conj}(x)^4)/3 + 160/3 \end{aligned}$$

Abubakar (Solution😊)

question:24;

Khan solution

```
clc
clear all
close all
syms x k
value=0;
for j=0:4
    for i=0:5
        a1=(-1)^(i+k);
```

```

        a2=gamma(i+2*k+j+1);
        d1=gamma(i-k+1);
        d2=(3*k+2*j+1);
        aa=(a1*a2)/(d1*d2);
value=value+symsum(aa*x^k,k,0,i);
    end
end
R=(value) '

```

(((abubakar)00Solution

```

clc
clear all
close all
sum=0;
syms x
for j=0:4
    for i=0:5
        for k=0:5
            a1=(-1)^(i+k);
            a2=gamma(i+2*k+j+1);
            d1=gamma(i-k+1);
            d2=(3*k+2*j+1);
            aa=(a1*a2)/(d1*d2)
            sum=sum+aa*x^k;
        end
    end
end

```

end

p=sum

output

p =

$$5378591315260800x^5 -$$
$$(2288570712146424339929x^4)/134217728 +$$
$$34401699648x^3 -$$
$$(1291633305177407339317x^2)/21165598834688 +$$
$$112543x - 26069/105$$

Question:25:

%show that [a b] is span of [-1 1;1 6] for any a and b.
%rref is used to check that wheter vector can be
written as linear.

%combination of vector

clc

clear all

close all

syms a b

A=[-2 1;1 6];

b=[a;b];

Ab=[A b];

rref(Ab)

output:

ans =

[1, 0, b/13 - (6*a)/13]
[0, 1, a/13 + (2*b)/13]

MATLAB Drive > untitled21.m*

```
1 A=[1 1/3 2/3;4 2 1;3/7 7 1/2];  
2 %find transpose  
3 C=sym(A')  
4 %find sum of 2nd column  
5 D=sym(sum(A(:,2)))  
6 %find sum of third column  
7 E=sym(sum(A(3,:)))
```



>> untitled21

C =

[1, 4, 3/7]
[1/3, 2, 7]
[2/3, 1, 1/2]

D =

28/3

E =

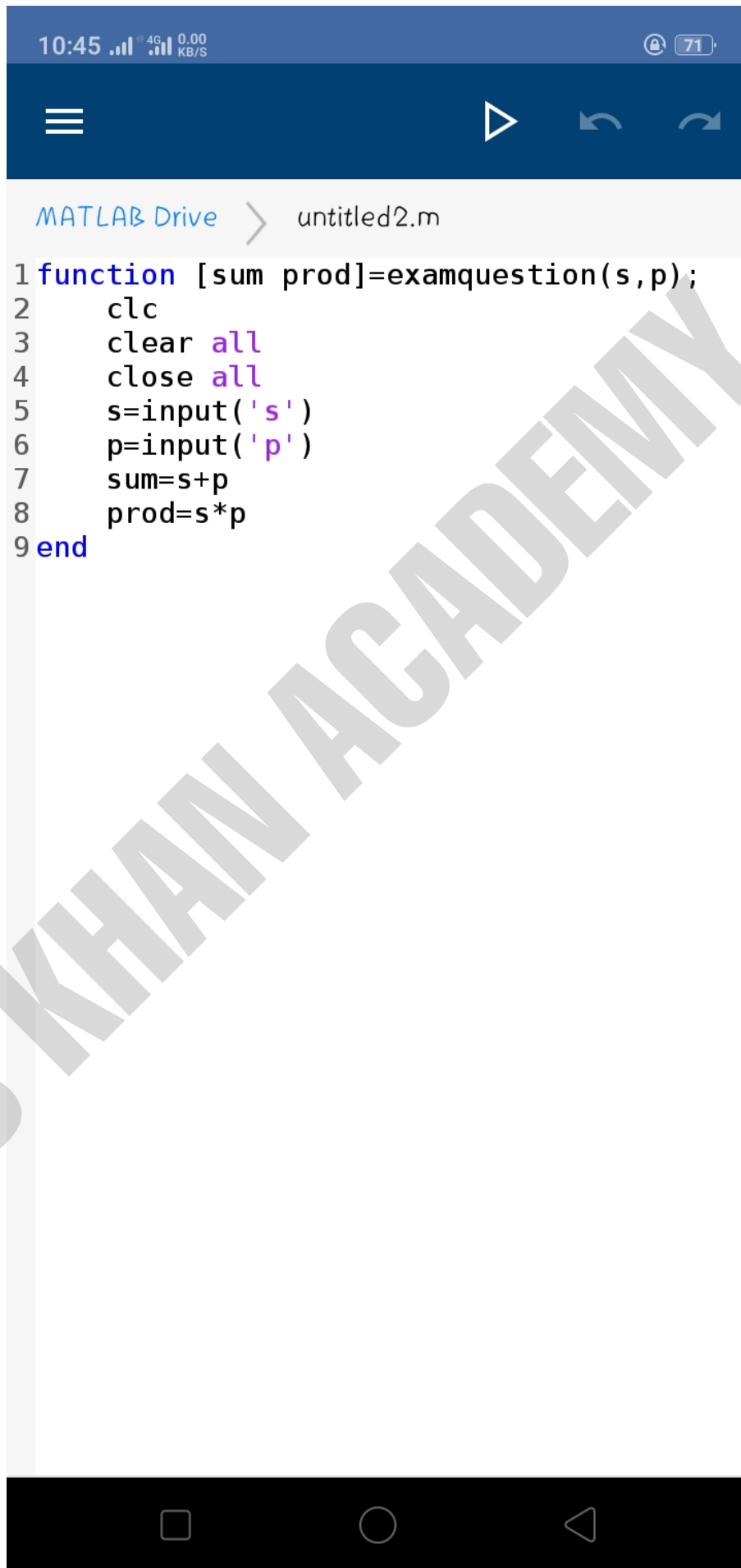
111/14

>>



Q5 Trapezoidal rule

```
clear all
close all
clc
f=@(x) x^4;
a=0;
b=2;
n=6;
h=(b-a)/n;
sum=0;
for k=1:n-1;
    x(k)=a+k*h;
    y(k)=f(x(k));
    sum=sum+f(y(k));
end
Area=h/2*(f(a)+f(b)+2*sum)
```

A screenshot of a mobile application interface for MATLAB Drive. The top status bar shows the time 10:45, signal strength, 4G network, and a speed of 0.00 KB/S. The app's header is dark blue with a hamburger menu icon on the left, a play button in the center, and back/forward navigation arrows on the right. Below the header, a light gray bar displays 'MATLAB Drive' and a file path '> untitled2.m'. The main area shows MATLAB code with line numbers 1 through 9. The code defines a function 'examquestion' that takes inputs 's' and 'p', calculates their sum and product, and returns them. A large, diagonal watermark 'S KHAN ACADEMY' is overlaid across the code. The bottom of the screen shows a black Android navigation bar with back, home, and recent apps icons.

```
1 function [sum prod]=examquestion(s,p);  
2     clc  
3     clear all  
4     close all  
5     s=input('s')  
6     p=input('p')  
7     sum=s+p  
8     prod=s*p  
9 end
```

Q6

Performed

% create matrix in MATLAB

$$\% A = \begin{bmatrix} 3/11 & 2/5 & 4/7 & 2/3 & 4/5 & 6/5 & 7/9 & 8/6 & 9/4 \end{bmatrix} \text{ and}$$

$$\% B = \begin{bmatrix} 1/3 & 8/9 & 4 & 2/9 & 3/7 & 9/6 & 6 & 7/4 & 5/7 \end{bmatrix}$$

% i) find inverse of matrix A directly using
% MATLAB command ii) Find $A*B$ iii) Find
% sum of elements of last row of matrix A.

clc;

clear all;

close all;

$$A = \text{sym}([3/11, 2/5, 4/7, 2/3, 4/5, 6/5, 7/9, 8/6, 9/4])$$

$$B = \text{sym}([1/3, 8/9, 4, 2/9, 3/7, 9/6, 6, 7/4, 5/7])$$

$$\text{Inverse } A = \text{inv}(A).$$

$$\text{multiply} = A*B.$$

$$\text{sumLast } A = \text{sum}(A(3,:))$$

Run

Sym $\rightarrow$ Command used b/c of fraction
eg $3/11$

(Final 2020
month 7)

Q Consider the system of linear eqs.

$$8x + y + 6z = 1$$

$$3x + 5y + 7z = 1$$

$$4x + 9y + 2z = 1$$

Write the system in MATLAB as an (augmented) matrix B.

Use elementary row operations to reduce it to reduced echelon form.

code

clc;

clear all;

close all;

A = sym([8 16; 3 5 7; 4 9 2]);

b = sym([1; 1; 1]);

B = [A, b];

$$B(1,i) = \frac{1}{8} * B(1,i);$$

$$B(2,i) = B(2,i) - 3 * B(1,i);$$

$$B(3,i) = B(3,i) - 4 * B(1,i);$$

$$B(2,i) = \frac{8}{37} * B(2,i);$$

$$B(1,i) = B(1,i) - \frac{1}{8} * B(2,i);$$

$$B(3,i) = B(3,i) - \frac{17}{2} * B(2,i);$$

$$B(3,i) = -\frac{37}{360} * B(3,i);$$

$$B(2,i) = B(2,i) - \frac{38}{37} * B(3,i);$$

$$B(1,i) = B(1,i) - \frac{23}{37} * B(3,i);$$

- Run

Final result
March

$$Q = \sum_{i=0}^{10} \sum_{k=0}^i \frac{(-1)^{i+k} \Gamma(i+k+1) x^k}{\Gamma(i-k+1) (\Gamma(k+1))^2}$$

function p = polynomial(M, K)

clc;

clear all;

close all;

syms x K

M=10;

for i=0 : M-1

a1 = (-1)^(i+k);

a2 = gamma(i+k+1);

d1 = gamma(i-k+1);

d2 = (gamma(k+1))^2;

aa = (a1*a2)/(d1*d2);

P(i+1) = symsum(aa*x^K, K, 0, i);

end

p = transpose(p).

end.

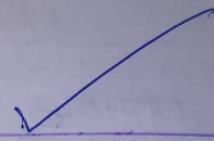


2020

Binet

math

Q2



Find numerical solution using ode45
command if $\frac{dx}{dt} = 3e^{-t}$ time interval
[0 5] initial condition $x(0)=0$
and plot curve

Final 2020
March

clc;

clear all;

close all;

f = @(t,x)(3*exp(-t));

tspan = [0 5]

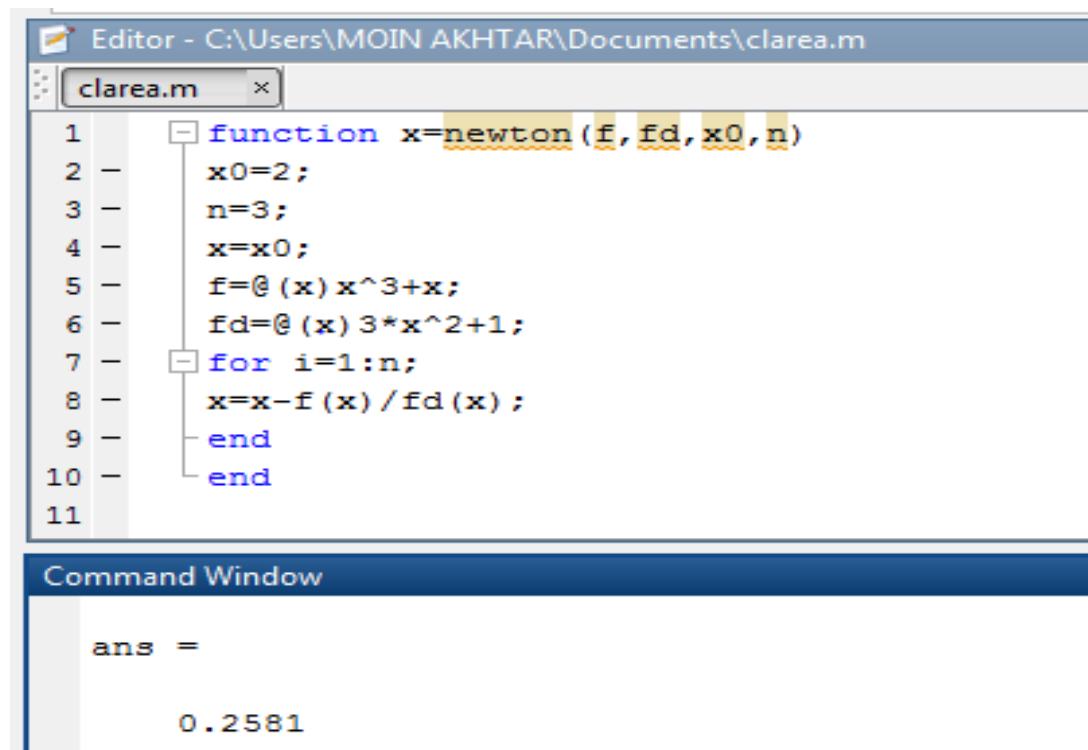
x0 = 0;

[t,x] = ode45(f, tspan, x0)

16 March 2022

Q1. Find Newton's Equation $x^3 + x$ if the value of $n=3$ and $x_0=2$?

```
function x=newton(f,fd,x0,n)
x0=2;
n=3;
x=x0;
f=@(x) x^3+x;
fd=@(x) 3*x^2+1;
for i=1:n;
x=x-f(x)/fd(x);
end
end
```



The screenshot shows the MATLAB Editor window with the file 'clarea.m' open. The code is as follows:

```
1 function x=newton(f,fd,x0,n)
2     x0=2;
3     n=3;
4     x=x0;
5     f=@(x) x^3+x;
6     fd=@(x) 3*x^2+1;
7     for i=1:n;
8         x=x-f(x)/fd(x);
9     end
10 end
11
```

Below the editor is the Command Window, which displays the result of the function call:

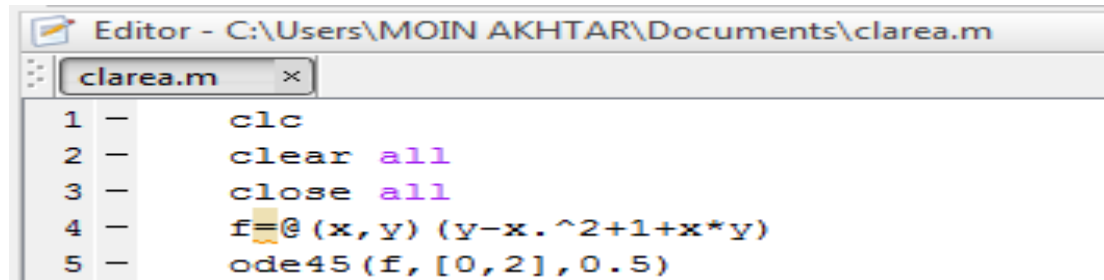
```
ans =

    0.2581
```

Q2. 16March 2022

Find initial value problem on $[0,2]$: % $y'(x) = y - x^2 + 1$, $y(0) = 0.5$ by using Ode 45 command?

```
clc
clear all
close all
f=@(x,y) (y-x.^2+1+x*y)
ode45(f,[0,2],0.5)
```

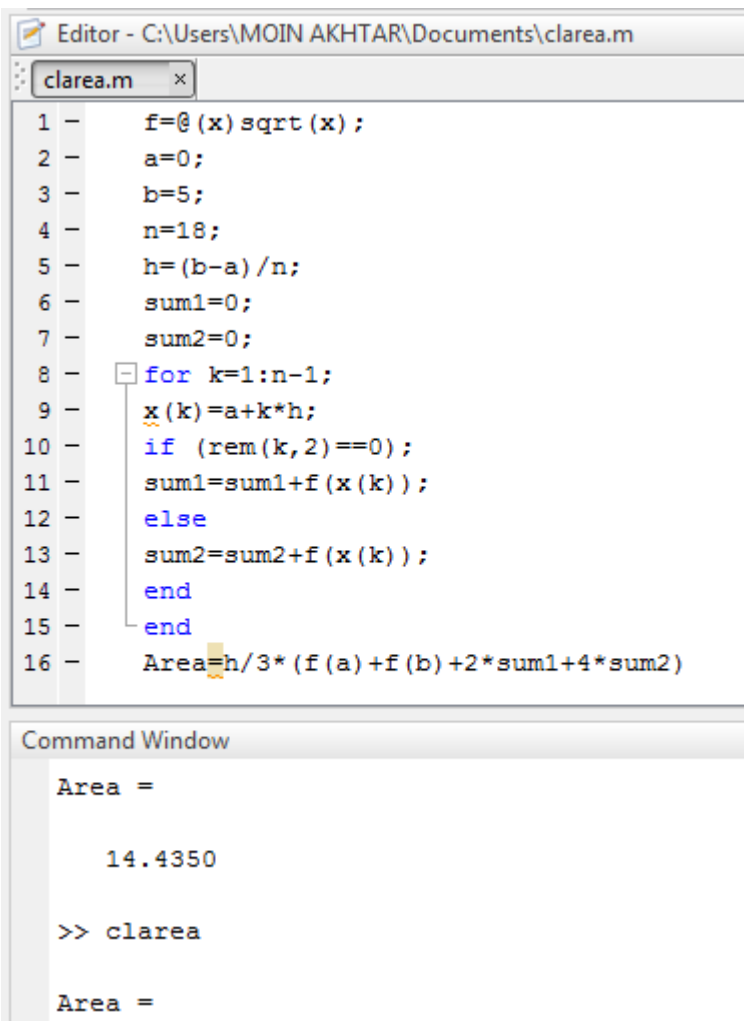


3.Question:

Write the MATLAB program for approximating the following integral

$$\int_0^5 \sqrt{x} \, dx \text{ using Simpson's 1/3 rule with } n=4$$

```
f=@(x) sqrt(x);  
a=0;  
b=5;  
n=18;  
h=(b-a)/n;  
sum1=0;  
sum2=0;  
for k=1:n-1;  
    x(k)=a+k*h;  
    if (rem(k,2)==0);  
        sum1=sum1+f(x(k));  
    else  
        sum2=sum2+f(x(k));  
    end  
end  
Area=h/3*(f(a)+f(b)+2*sum1+4*sum2)
```



The image shows a MATLAB environment with an Editor window and a Command Window. The Editor window displays a script named `clarea.m` with the following code:

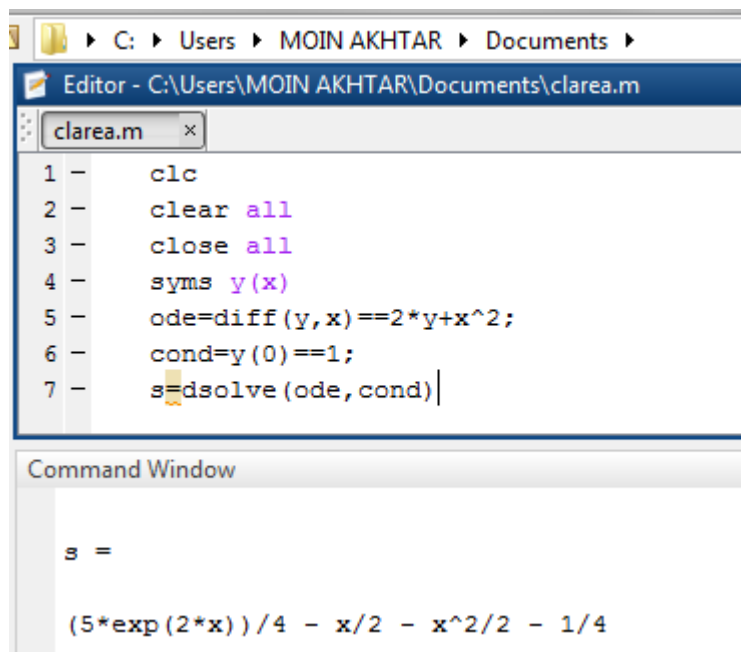
```
1 - f=@(x) sqrt(x);  
2 - a=0;  
3 - b=5;  
4 - n=18;  
5 - h=(b-a)/n;  
6 - sum1=0;  
7 - sum2=0;  
8 - for k=1:n-1;  
9 -     x(k)=a+k*h;  
10 -    if (rem(k,2)==0);  
11 -        sum1=sum1+f(x(k));  
12 -    else  
13 -        sum2=sum2+f(x(k));  
14 -    end  
15 - end  
16 - Area=h/3*(f(a)+f(b)+2*sum1+4*sum2)
```

The Command Window shows the output of the script:

```
Area =  
  
    14.4350  
  
>> clarea  
  
Area =
```

4.Question: Solve the differential equation $y'=2y+x^2$ with the initial condition $y(0)=1$

```
clc
clear all
close all
syms y(x)
ode=diff(y,x)==2*y+x^2;
cond=y(0)==1;
s=dsolve(ode,cond)
```



The image shows a MATLAB Editor window with the file 'clarea.m' open. The code in the editor is as follows:

```
1 - clc
2 - clear all
3 - close all
4 - syms y(x)
5 - ode=diff(y,x)==2*y+x^2;
6 - cond=y(0)==1;
7 - s=dsolve(ode,cond)
```

Below the editor is the Command Window, which displays the result of the execution:

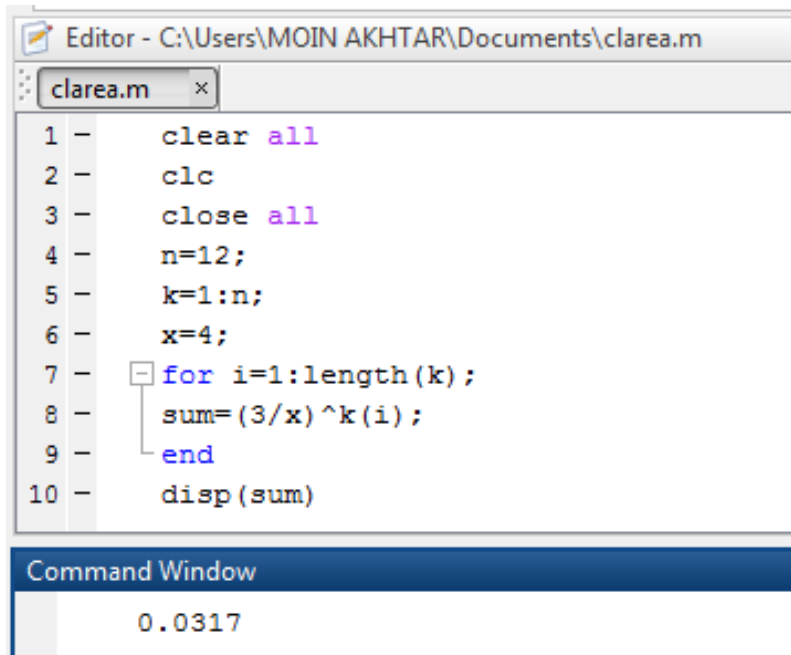
```
s =
(5*exp(2*x))/4 - x/2 - x^2/2 - 1/4
```

Q.5

$$\text{find sum} = \sum_{k=1}^n \left(\frac{3}{x}\right)^k$$

When the value of $n=12$
And the value of $x=4$?

```
clear all
clc
close all
n=12;
k=1:n;
x=4;
for i=1:length(k);
sum=(3/x)^k(i);
end
disp(sum)
```



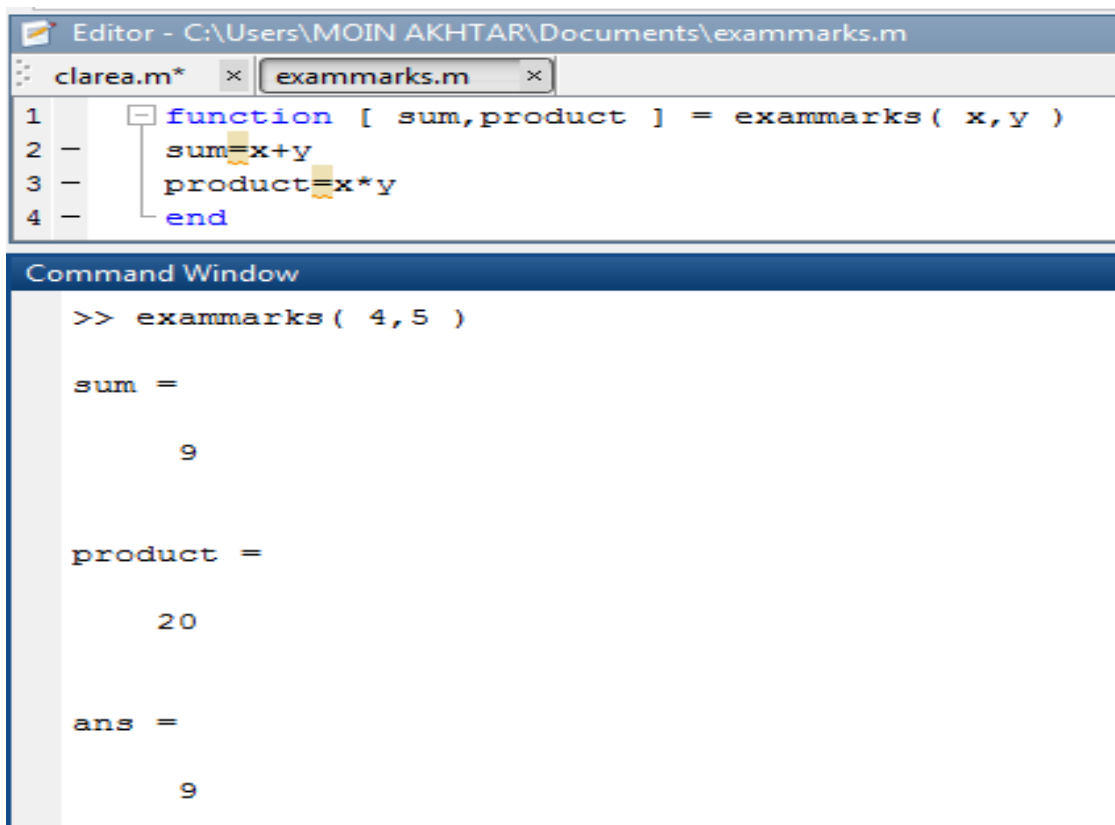
The screenshot shows a MATLAB Editor window titled 'Editor - C:\Users\MOIN AKHTAR\Documents\clarea.m' with a single tab 'clarea.m'. The script contains the following code:

```
1 - clear all
2 - clc
3 - close all
4 - n=12;
5 - k=1:n;
6 - x=4;
7 - for i=1:length(k);
8 -     sum=(3/x)^k(i);
9 - end
10 - disp(sum)
```

Below the editor is the Command Window, which displays the output '0.0317'.

6. Question: Write a function with name 'exammarks' which takes any two numbers as an input their sum and product as an output?

```
function [ sum,product ] = exammarks( x,y )  
sum=x+y  
product=x*y  
end
```



The image shows a MATLAB Editor window with the file 'exammarks.m' open. The code in the editor is as follows:

```
1 function [ sum,product ] = exammarks( x,y )  
2     sum=x+y  
3     product=x*y  
4 end
```

Below the editor is the Command Window, which shows the execution of the function with inputs 4 and 5:

```
>> exammarks( 4,5 )  
  
sum =  
     9  
  
product =  
     20  
  
ans =  
     9
```

Q.7 Find

1. Eigen values of the following matrix using the MATLAB.
 2. Reduced echelon form of the following matrix using the MATLAB
- Note: Copy the code and also output from MATLAB to exams application.

$$\begin{bmatrix} 3 & 1 & 4 \\ 7 & 8 & 9 \\ 3 & 1 & 3 \end{bmatrix}$$

```
A=sym([3,1,4;7,8,9;3,1,3])
E=eig(A)
R=rref(A)
```

The screenshot shows the MATLAB Editor with a file named 'exammarks.m' containing the following code:

```
1 - A=sym([3,1,4;7,8,9;3,1,3])
2 - E=eig(A)
3 - R=rref(A)
4
```

Below the editor is the Command Window showing the output:

```
A =
[ 3, 1, 4]
[ 7, 8, 9]
[ 3, 1, 3]

E =

14/3 - 109/(18*(12^(1/2)*13537^(1/2)*(i/12) + 1375/54)^(1/3)) -
(3^(1/2)*(109/(9*(12^(1/2)*13537^(1/2)*(i/12) + 1375/54)^(1/3))

R =

[ 1, 0, 0]
[ 0, 1, 0]
[ 0, 0, 1]
```

8.Question: Write the following matrices in MATLAB

Find the product of matrix A and B store in C.

Find the sum of matrix A and B store in C.

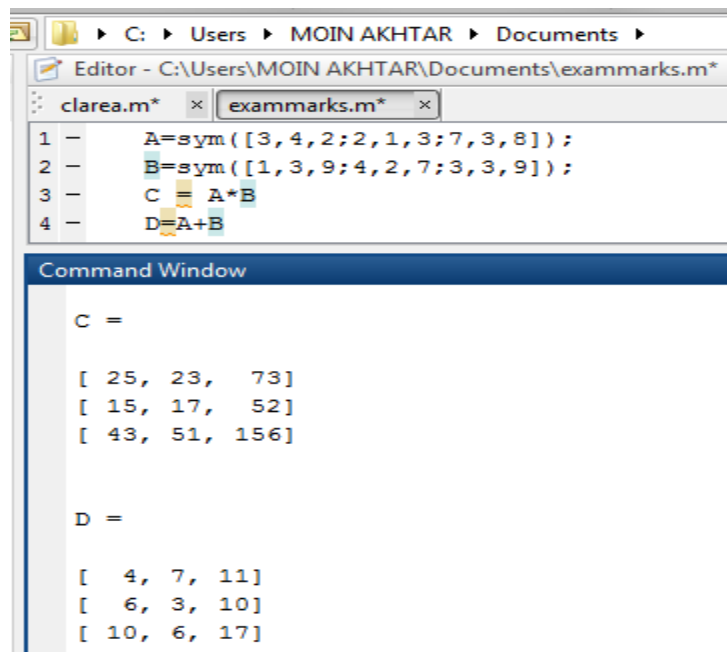
$$A = \begin{bmatrix} 3 & 4 & 2 \\ 2 & 1 & 3 \\ 7 & 3 & 8 \end{bmatrix} \quad \& \quad B = \begin{bmatrix} 1 & 3 & 9 \\ 4 & 2 & 7 \\ 3 & 3 & 9 \end{bmatrix}$$

```
A=sym([3,4,2;2,1,3;7,3,8]);
```

```
B=sym([1,3,9;4,2,7;3,3,9]);
```

```
C=A*B
```

```
D=A+B
```



The screenshot shows the MATLAB Editor with a file named 'exammarks.m' open. The code in the editor is as follows:

```
1 - A=sym([3,4,2;2,1,3;7,3,8]);
2 - B=sym([1,3,9;4,2,7;3,3,9]);
3 - C = A*B
4 - D=A+B
```

Below the editor, the Command Window displays the results of the execution:

```
C =

[ 25, 23, 73]
[ 15, 17, 52]
[ 43, 51, 156]

D =

[ 4, 7, 11]
[ 6, 3, 10]
[ 10, 6, 17]
```

end

Question No.8

Write a function with name 'newfunction' which takes any two number as input and returns the highest common factor of the number.

Solution

```
function [HCF]=newfunction(n1,n2)
for i=1:1:(n1+n2);
    if mod(n1,i)==0 && mod(n2,i)==0
        HCF=i;
    end
end
```

Question No.9

Write a program which prints all the numbers divisible by 3 and 5 for a given number.

Solution

```
clc
clear all
close all
x=input('enter a number:')
n=x;
for i=1:n;
    if mod(i,3)==0 && mod(i,5)==0
        disp(i)
    end
end
```

Question No.10

Write a for loop which adds first 30 odd numbers.

Solution

```
clc
```

```

clear all
close all
k=1:60;
sum=0;
for i=1:2:length(k);
    sum=sum+i;
end
disp(sum)

```

Question No.11

Write a function name cube takes a number as an input if the number is even return cube if odd then return square.

Solution

```

function [cubes square]=cube(n)
if mod(n,2)==1
    fprintf('square')
else
    fprintf('cube')
end
end

```

Question No.12

Find sum and write program

$$\sum_{k=1}^n \left(\frac{3}{x}\right)^k$$

and input x=4 and n=12.

Solution

```

clc
clear all
close all
n=1:12;
x=4;
sum=0;
for k=1:length(n);
    sum=sum+(3/x)^k;
end

```

```
end  
disp(sum)
```

Question No.13

Solve the newton equation x^3+x by using for loop when $x_0=2$ and $n=3$.

Solution

```
clc  
clear all  
close all  
f=@(x)x^3+x  
df=@(x)3*x^2+1  
x0=2;  
n=3;  
x=x0;  
for i=1:n;  
    x=x-f(x)/df(x)  
end
```

Question No.14

Solve the newton equation x^3+x by using while loop when $x_0=2$ and $n=3$.

Solution

```
clc  
clear all  
close all  
f=@(x)x^3+x  
df=@(x)3*x^2+1  
x0=2;  
n=3;  
x=x0;  
tol=10^-4  
while abs(f(x))>tol  
    x=x-f(x)/df(x)  
end  
fprintf('Root: %0.15 f\n',x)
```

Question No.15

Write a function with the name 'practisefunction' which takes any three random variables as an input and returns the number in ascending order.

Solution

```
function [Ascending]=practisefunction(n1,n2,n3)
n1=input('enter the 1st number:')
n2=input('enter the 2nd number:')
n3=input('enter the 3rd number:')
A=[n1,n2,n3]
Ascendingorder=sort(A)
end
```

Question No.16

Find factorial of a number by using while loop.

Solution

```
clc
clear all
close all
n=input('enter a number:')
i=n;
fact=1;
if i==0
    fact=1;
elseif i<0
    fprintf('the number you are entered is nagative')
end
while i>0
    fact=fact*i;
    i=i-1;
end
disp(fact)
```

Question No.17

Find factorial of a number by using for loop.

Solution

```
clc
clear all
close all
n=input('enter a number:')
fact=1;
for i=1:n;
    fact=fact*i;
end
disp(fact)
```

Question No.18

write a function with name examquestions which take any two number as an input and return the sum and product of those number as output.

Solution

```
function [x y]=examquestions(x,y)
sum=x+y
product=x*y
end
```

Question No.19

Use while loop to calculate the factorial of 10.

Solution

```
clc
clear all
close all
n=10;
i=n;
fact=1;
while i>0
    fact=fact*i;
    i=i-1;
end
disp(fact)
```

Question No.20

Numerically solve the following equation by using ode45 command

$$\frac{dy}{dx} = \frac{y}{t^2} + \frac{2}{y} \quad \text{when } y(0)=1$$

Solution

```
clc
clear all
close all
f=@(t,y)t/y^2+2/t
tspan=[2 -2];
y0=1;
[t y]=ode45(f,tspan,y0)
plot(t,y)
```

Question No.21

$$A = \begin{bmatrix} 3/11 & 2/5 & 4/7 \\ 2/3 & 4/5 & 6/5 \end{bmatrix} \text{ and } B = \begin{bmatrix} 1/3 & 8/4 & 4 \\ 2/9 & 3/7 & 9/6 \\ 6 & 7/4 & 5/7 \end{bmatrix}$$

Then find

- i) $\text{inv}A$
- ii) $A*B$

Solution

```
clc
clear all
close all
A=sym([3/11 2/5 4/7;2/3 4/5 6/5])
B=sym([1/3 8/4 4;2/9 3/7 9/6;6 7/4 5/7])
C=inv(B)
D=sym(A*B)
```

Question No.22

$$2x+y+z=2$$

$$-x+y-z=3$$

$$x+2y+3z=-10$$

- i) Write system in matlab as an augmented matrix
- ii) Make reduced echelon form

Solution

```
clc
clear all
close all
syms x y z
A=[2,1,1;-1,1,-1;1,2,3]
B=[2;3;-10]
X=[x;y;z]
%AX=B%
C=rref(A,B)
```

Question No.23

$y(x)=\sqrt{1+x^3}$ solve the equation using simpson's 3/8 rule interval [1 5] and keep step size 12.

Solution

```
clc
clear all
close all
f=@(x)sqrt(1+x^3)
a=1;
b=5;
n=12;
h=(b-a)/n;
if rem(n,3)~=0
    fprintf('enter valid n')
    input('enter n as the multiple of 3')
end
sum1=0;
sum2=0;
```

```

for i=1:n-1;
    x(i)=a+i*h;
    if rem(i,3)==0
        sum1=sum1+f(x(i));
    else
        sum2=sum2+f(x(i));
    end
end
Area=3*h/8*(f(a)+f(b)+2*sum1+3*sum2)

```

Question No.24

$$\frac{d^2y}{dt^2} + 2\frac{dy}{dt} + 5y = 7 \quad \text{and} \quad y(0)=1 \text{ and } y'(0)=0$$

Solve the differential equation.

Solution

```

clc
clear all
close all
syms y(t)
Dy=diff(y,t)
ode=diff(y,t,2)+2*diff(y,t)+5*y==7
cond1=y(0)==1
cond2=Dy(0)==0
cond=[cond1,cond2]
sol=dsolve(ode,cond)

```

Question No.25

Solve $x-2\sin(x^2)=0$ by using bisection method perform 10 iterations to find the root between 0.4 and 0.6.

Solution

```

clc
clear all
close all

```

```

f=@(x)x-2*sin(x^2)
a=0.4;
b=0.6;
n=10;
if f(a)*f(b)>0
    fprintf('there is no change of sign:')
    return
end
tol=10^-4
disp('iteration number a b c')
i=1;
while (abs(a-b)>=tol)
    c=(a+b)/2;
    if f(c)==0
        fprintf('root of the function is %f:',c)
        return
    end
    fprintf('%2i \t %f \t %f \t %f \n',i,a,b,c)
    if f(a)*f(c)>0
        a=c;
    else
        b=c;
        i=i+1;
    end
end
m=(a+b)/2
fprintf('root lies at c=%f \n',m)

```

Question No.26

Write a function with name 'circlecalculation' which take the circle of radius as input and circf as output.

Solution

```

function [circf]=circlecalculation(radius)
radius=input('enter the radius of circle:')
circf=2*pi*radius
end

```

Question No.27

$y(x)=\sqrt{1+x^3}$ solve the equation using simpson's 1/3rule interval [1 5] and keep step size 10.

Solution

```
clc
clear all
close all
f=@(x)sqrt(1+x^3)
a=1;
b=5;
n=12;
h=(b-a)/n;
if rem(n,2)~=0
    fprintf('enter valid n')
    input('enter n as the even multiple')
end
sum1=0;
sum2=0;
for i=1:n-1;
    x(i)=a+i*h;
    if rem(i,2)==0
        sum1=sum1+f(x(i));
    else
        sum2=sum2+f(x(i));
    end
end
Area=h/3*(f(a)+f(b)+2*sum1+4*sum2)
```

Question No.28

$$A = \begin{bmatrix} 3/11 & 2/5 & 4/7 \\ 2/3 & 4/5 & 6/5 \end{bmatrix} \text{ and } B = \begin{bmatrix} 1/3 & 8/4 & 4 \\ 2/9 & 3/7 & 9/6 \\ 6 & 7/4 & 5/7 \end{bmatrix}$$

Then find

- i) Sum of 3rd row of B
- ii) Sum of 2nd column of A

Solution

```

clc
clear all
close all
A=sym([3/11 2/5 4/7;2/3 4/5 6/5])
B=sym([1/3 8/4 4;2/9 3/7 9/6;6 7/4 5/7])
SumA=sum(A(:,2))
SumB=sum(B(3,:))

```

Question No.29

Solve the following equation $x^2/2$ by using trapezoidal rule in the interval [4 6] by using step size 10.

Solution

```

clc
clear all
close all
f=@(x)x^2/2
a=4;
b=6;
n=10;
h=(b-a)/n;
sum=0;
for i=1:n-1;
    x(i)=a+i*h;
    y(i)=f(x(i));
    sum=sum+y(i);
end
Area=h/2*(f(a)+f(b)+2*sum)

```

Question No.30

Solve the following equation $x^2/2$ by using reimann sum in the interval [4 6] by using step size 10.

Solution

```

clc
clear all
close all

```

```

f=@(x)x^2/2
a=4;
b=6;
n=10;
dx=(b-a)/n;
value=0;
for i=1:n;
    c=a+i*dx;
    value=value+f(c);
end
Area=value*dx

```

Question No.31

Find the value of X if

$$A = \begin{bmatrix} 1 & 3 \\ 2 & 4 \end{bmatrix} \quad \text{and} \quad B = \begin{bmatrix} -2 \\ 3 \end{bmatrix}$$

Solution

```

clc
clear all
close all
A=[1,3;2,4]
B=[-2;3]
% As we know that
% AX=B
% X=inv(A)*B
C=inv(A)
X=C*B

```

16March 2022

Question No.32

Solve the system of linear equation by using solve command.

$$3x+2y+z=1$$

$$y=2$$

$$x+2y=3$$

Solution

```

clc
clear all
close all
A='3*x+2*y+z=1'
B='y=2'
C='x+2*y=3'
sol=solve(A,B,C)
Answer=double([sol.x,sol.y,sol.z])

```

Question No.33

Find the eigen values and eigen vector of the following matrix.

$$A = \begin{bmatrix} 3 & 1 & 4 \\ 7 & 8 & 9 \\ 3 & 1 & 3 \end{bmatrix}$$

Solution

```

clc
clear all
close all
A=[3,1,4;7,8,9;3,1,3]
V=eig(A)
[u v]=eig(A)

```

Remember Me in your Prayers

REIMMAN SUM	TRAPEZOIDAL
<pre>clc clear all close all a=6; b=4; n=6; f=@(x)x.^2/2; h = (b-a)/n; for k=1:n; c=a+k*h; end Sum=f(c)*h</pre>	<pre>clc clear all close all a=6; b=4; n=6; f=@(x)x.^2/2; h = (b-a)/2; sum=0; for k=1:n-1; x(k)=a+h*k; y(k)=f(x(k)); sum=sum+y(k); end area=h/2*(f(a)+f(b)+2*sum)</pre>

SIMPSON 1/3RD	SIMPSON 3/8 RULE
<pre>clc clear all close all a=6; b=4; n=6; f=@(x)x.^2/2; h = (b-a)/n; sum1=0; sum2=0; for k=1:n-1; x(k)=a+h*k; y(k)=f(x(k)); if mod(k,2)==0 sum1=sum1+y(k); else sum2=sum2+y(k); end end area=h/3*(f(a)+f(b)+2*sum1+4*sum2)</pre>	<pre>clc clear all close all a=6; b=4; n=6; f=@(x)x.^2/2; h = (b-a)/n; sum1=0; sum2=0; for k=1:n-1; x(k)=a+h*k; y(k)=f(x(k)); if mod(k,3)==0 sum1=sum1+y(k); else sum2=sum2+y(k); end end area=3*h/8*(f(a)+f(b)+2*sum1+3*sum2)</pre>

MATH=643 Introduction to MATLAB

by Naeem shehzad & shehzad mumtaz

Q.1 Write MATLAB code to Legendre Polynomials

using the relation $P_0(z) = 0.1$, $P_1(z) = z$,

$P_2(z) = \frac{1}{2}(3z^2 - 1)$, $P_3(z) = \frac{1}{2}(5z^3 - 3z)$ and

$P_4(z) = \frac{1}{8}(35z^4 - 30z^2 + 3)$ for $i = 1:20$ and

using the relation $L_{i+1}(z) = \frac{2i+1}{i+1}zL_i(z) - \frac{i}{i+1}L_{i-1}(z)$

function $P = \text{LegendreFunctionVectors}(M, T, \text{value1}, \text{value2})$

clear all;

clc;

close all;

syms z

M = 20;

value(1) = z;

value(2) = sym(3/2)*z^2 - sym(1/2);

for i = 1:M

value(i+2) = ((2*i+3)/(i+2))*z*value(i+1) - (i/(i+2))*value(i);

end

P = simplify(transpose(value));

Put $L_i(z) = \text{value}(i+1)$



MATH 643 Introduction to MATLAB

by: Name shehzad 8 shehzad Mumtaz

Q.1 compute the constant factor defined in

R_j for $j = 0:10$ and using the relation

$$R_j = \frac{1}{2j+1}$$

function $p = \text{Constant Factor}(j)$

```
close all;
```

```
clear all;
```

```
clc;
```

```
format short;
```

```
syms j;
```

```
for j = 0:10
```

```
    a1 = 1;
```

```
    a2 = 2*j + 1;
```

```
    R(j+1) = a1/a2;
```

```
end
```

```
R
```

MTH643 (MATLAB)

By: Naeem; Shahzad Mumtaz

Q:01:

Write down a MATLAB code for computing the series coefficients

$$C_i = 0, 1, 2, 3, 4.$$

$$C_i = \frac{1}{R_{T,j}^{(\alpha,\beta)}} \int_0^T f(x) W_T^{(\alpha,\beta)}(x) P_i^{(\alpha,\beta)}(x) dx$$

function C = Jacobi Coef Vector (f, x, M, Alpha, Beta, T)

clc;

close all;

clear all;

T = 9;

Alpha = 1;

Beta = 1;

M = 4;

$$W = (T-x)^{\alpha} \cdot x^{\beta};$$

for i = 0 : M-1

$$a1 = (-1)^i (i-k);$$

$$a2 = \text{gamma}(i + \text{beta} + 1);$$

$$a3 = \text{gamma}(i + k + \alpha + \text{beta} + 1);$$

$$d1 = \text{gamma}(k + \text{beta} + 1);$$

$$d2 = \text{gamma}(i + \alpha + \text{beta} + 1);$$

$$d3 = \text{gamma}(i - k + 1);$$

$$W_T^{(\alpha,\beta)} = (T-x)^{\alpha} x^{\beta}$$

$$P_i^{(\alpha,\beta)}(x) = \sum_{k=0}^i \frac{(-1)^k \Gamma(i+1) \Gamma(i-k+1) \Gamma(i+k+\alpha+\beta+1)}{\Gamma(k+1) \Gamma(i-k+1) \Gamma(i+k+\alpha+\beta+1)} x^k$$

$$R_{T,j}^{(\alpha,\beta)} = \frac{T^{\alpha+\beta+1} \Gamma(k+1) T^k}{\Gamma(j+\alpha+1) \Gamma(j+\beta+1) (2j+\alpha+\beta+1) \Gamma(j+1) \Gamma(j+\alpha+\beta+1)}$$

$$d4 = \text{gamma}(k+1);$$

$$d5 = T^k;$$

$$aa = (a1 \cdot a2 \cdot a3) / (d1 \cdot d2 \cdot d3 \cdot d4 \cdot d5);$$

$$P(i+1) = \text{syssum}(aa \cdot x^k, k, 0, i);$$

end

P;

$$PW = f \cdot P^W;$$

for $j = 0 : M-1$

$$a1 = T^j (\alpha + \beta + 1);$$

$$a2 = \text{gamma}(j + \alpha + 1);$$

$$a3 = \text{gamma}(j + \beta + 1);$$

$$d1 = 2 \cdot j + \alpha + \beta + 1;$$

$$d2 = \text{gamma}(j+1);$$

$$d3 = \text{gamma}(j + \alpha + \beta + 1);$$

$$R(j+1) = (a1 \cdot a2 \cdot a3) / (d1 \cdot d2 \cdot d3);$$

end

R;

$$RR = 1 ./ R;$$

for $i = 0 : M-1$

$$C(i+1) = \text{int}(PW(i+1), x, 0, i) \cdot RR(i+1);$$

end

$$C = \text{transpose}(C);$$



Rough Sheet

FALL/SPRING MID/FINAL TERM 20__ (Year)

EXAMS YJPWOL

Date: _____

Superintendent Signature: _____

Campus Code: _____

Student ID: _____

Student Signature: _____

Course Code: _____

Subject: _____

Student ID: _____

Date: _____

1) Find the solution (root) of following function
 $f(x) = x^3 - 5$ using Newton's method with
 initial guess at $x_0 = 2$ and $n = 3$.

2) Numerically

ode45

$$\frac{dy}{dt} = \frac{y}{t^2} + \frac{2}{t}, y(0) = 1$$

$$3) A = \begin{bmatrix} 3/11 & 2/5 & 4/7 \\ 2/3 & 4/5 & 6/5 \end{bmatrix}$$

$$B = \begin{bmatrix} 1/3 & 8/4 & 4 \\ 2/9 & 3/7 & 9/6 \\ 6 & 7/4 & 5/7 \end{bmatrix}$$

i) inv A (ii) $A^* B$

$$4) \begin{aligned} 2x + y + z &= 2 \\ -x + y - z &= 3 \\ x + 2y + 3z &= -10 \end{aligned}$$

i) Write system in Matlab as an augmented matrix
 (ii) reduced echelon form

$$5) y(x) = \sqrt{(1+x^3)} \quad \text{interval } [1, 5]$$

Note: Submit this sheet to Superintendent, before leaving the Examination Center.

Simpson's 3/8

6) Write a programme which takes a number as an input from the user using for loop, compute factorial;

7) function examsquestion which takes 2 no. input and return sum and product.

$$8) \frac{d^2 y}{dt^2} + 2 \frac{dy}{dt} + 5y = 7$$

$$y(0) = 1, \quad y'(0) = 0$$

solve differential equation

Q2: Compute the Riemann sum using 20 equally spaced sub-intervals for the following definite integral $\int_0^2 e^{x^2} dx$.

Write also the code.

Q3: $A = \begin{bmatrix} 2 & 3 & 4 & 7 \\ 3 & 2 & 1 & 8 \\ 7 & 8 & 9 & 10 \\ 4 & 5 & 6 & 2 \end{bmatrix}$

- Determine square matrix whose columns represent the Eigenvectors of the matrix A .
- Determine the diagonal matrix having the Eigenvalues of the matrix A on its main diagonal.

Q4:- Compute the following relation for $i = 0 : 10$, and choosing the values of the constants $c = 1$ and $d = 2$.

$$\Lambda_{i,c,d}^{(c,d)} = \frac{4^{c+d+10} \Gamma(i+5c+d+10) (i+19)!}{(2i+c+d+12) \Gamma(i+c+5) (i+10c+d+15)!}$$

Q5:- Compute the following relation for $k = 0 : 10$, and choosing the values of the constants $a = 1$ and $b = 9$.

$$\Lambda_k^{(a,b)} = \frac{2^{(a+b+15)} \Gamma(k+3a+10b+10) (k+4+a+b)! \Gamma(a+b+5)}{(3k+a+b+4) \Gamma(k+a+4b+4) (k+10a+15b+12)!}$$

➡ *Forwarded*

- 1) Use ode45 to plot the problem
 - 2) Euler improved formula code also plot
 - 3) Trapezoidal rule question
 - 4) Legendre polynomial function code
 - 5) Omega polynomial function 14
- lecture s
- Had question 10 marks ka tha

8:20 pm

Solve the equations with Solve Command

① $2x + 2y = 3, 3x + 2y = 4$

Also plot the graph of $3x + 2y = 4$

② If $A = \begin{pmatrix} 2 & 3 & 4 & 7 \\ 3 & 2 & 1 & 8 \\ 7 & 8 & 2 & 10 \\ 4 & 5 & 6 & 2 \end{pmatrix}$

• To find the Square and Eigen Vector of A

• To determine the diagonal matrix of A with Eigen Values.

③

Using Simpson to Solve $Y(x) = \sqrt{1+x^2}$
Three-point Method

Range Interval $[1, 5]$, Sub Interval 30

④ if $i = 0:10$ and $c = 1, d = 2$

Then find the value of

$$\sum_{i=1}^{c,d} \frac{(i+d+10)!}{(2i+c+d+12)! (i+c+5)! (i+10+c+d+15)!}$$

⑤ if $k = 0:10, a = 1, b = 1$

Then Compute the value of

$$\Delta_{k=0}^{(a,b)} \frac{2^{a+b+15} \sqrt{(k+3a+10b+10)} (k+11+a+b)}{(3k+a+b+11) \sqrt{(k+a+b+11)(k+10+a+b)}}$$

MTH - 643 - Final - Paper

Q1= Find the numerical solution of following differential equation on the interval $[0, 2]$ using Taylor's method of the second interval for $n = 10$.

$$\frac{dy}{dx} = \cos(xy), \quad y(0) = \pi$$

Note: Iteration relaxation of Taylor's method is;

$$y_{k+1} \approx y_k + f(x_k, y_k)\Delta x + \left(\frac{\partial f}{\partial x}(x_k, y_k) + \frac{\partial f}{\partial y}(x_k, y_k) \right)$$

Write code in script file with m-extension in MATLAB.

Construct the one-dimensional Orthogonal Shifted Jacobi function vector, $P_n^{(\alpha, \beta)}(x)$ defined on $[0, 1]$ for $i = 0 : 19$, and by choosing the values of the parameters $\alpha = 0$, and $\beta = 0$ using the following relation:

$$P_n^{(\alpha, \beta)}(x) = \sum_{k=0}^i \frac{(-1)^{(i-k)} \Gamma(i + \beta + 1) \Gamma(i + k + \alpha + \beta + 1)}{\Gamma(k + \beta + 1) \Gamma(i + \alpha + \beta + 1) \Gamma(i - k + 1) \Gamma(k + 1) 1^k} x^k,$$

Copied to clipboard.

Compute the following relation for $j=0:20$, and choosing the values of the constants $a = 1$, and $b = 2$:

$$A_j^{(a,b)} = \frac{4^{a+b+1} \Gamma(j+3a+4b+1)(j+9)!}{(2j+a+b+1) \Gamma(j+a+5)(j+10a+b+1)!}.$$

- Compute the definite integral of $y(x) = \sqrt{1+x^3}$ defined on the interval $[1, 5]$ using Simpson's ~~One-Third~~ Rule by dividing the interval $[1, 5]$ into ~~100~~ sub-intervals of uniform length.

Note:

The general form of Simpson's ~~One-Third~~ Rule is given as under:

$$\int_{x_0}^{x_{n+h}} y(x) dx \approx \frac{\Delta}{3} \left[(y(x_0) + y(x_n)) + 4(y(x_1) + y(x_3) + \dots + y(x_{n-1})) + 2(y(x_2) + y(x_4) + \dots + y(x_{n-2})) \right].$$

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- 1) solve system of ordinary differential equations + plot graph (lec#7)
- 2) trapezoidal rule (lec#12)
- 3) solve eq using ode45 command (lec#9)
- 4) Orthogonal Shifted Jacobi Polynomials (lec#13)
- 5) question similar to lec#15 lastq

3:22 pm

Malla B. (2019)

৫।

on $[-2, 2]$

plot family of curve by ode45



$$Y'(t) = e^{\frac{1}{2}t^2}$$



Exels improved formula

Lecture #8

$$\begin{array}{r} 8-1 \\ 1-8 \\ \hline 8+1 \end{array}$$

Q

Trapezoidal Rule (Lecture #12)

Q4

Lecture # 15 (pg NO 17)

$\Rightarrow$ (One-dimensional orthogonal matrix Jacobi)

Q5

Lecture # 14

orthogonal shifted legendre

MATLAB 7.10.0 (R2010a)

```
File Edit Text Go Cell Tools Debug Parallel Desktop Window Help
Current Folder: F:\vu\4rt semester\mth643\practice\final part
Shortcuts How to Add What's New
Editor - C:\Users\mianw\AppData\Local\Temp\Rar$DIa15880.4250\onedimensionalOrthogonalShiftedJacobi.m
Stack: Base fx

%parameters ? = 0, and ? = 0 using the following relation:
function P=onedimensionalOrthogonalShiftedJacobi(M,T,alpha,beta)
- close all;
- clear all;
- clc;
- syms M T k x
- M=20;
- T=1;
- alpha=0;
- beta=0;
- for i=0:M-1
-     a1=(-1)^(i-k);
-     a2=gamma(i+beta+1);
-     a3=gamma(i+k+alpha+beta+1);
-     d1=gamma(k+beta+1);
-     d2=gamma(i+alpha+beta+1);
-     d3=gamma(i-k+1);
-     d4=gamma(k+1);
-     d5=T^k;
-     aa=(a1*a2*a3)/(d1*d2*d3*d4*d5);
-     P(i+1)=symsum(aa*x^k,k,0,i);
- end
- P=transpose(P)
```

sample.m x lec_13_4th_Example.m x orthogonal1.m x orthogonal2.m x orthogonal3.m x orthogonal4.m x lec1

Start

Type here to search

Taskbar icons: File Explorer, Google Chrome, Microsoft Store, VLC media player, Adobe Reader, and a multi-colored application icon.

- Consider the following example.

Example:

- Compute the eigen values and eigen vectors for the following matrix:

$$B = \begin{pmatrix} 0 & 1 & 3 \\ 2 & 4 & 1 \\ 6 & 1 & 8 \end{pmatrix}$$

Imran Talib VU

Lecture NO.11

Eigen Values and Eigen Vectors
Reduced row echelon form
Solution of system of linear equations
Elementary row operations
Spanning set
Exercise

- The recipe of the solution is as under:

$$B = [0, 1, 3; 2, 4, 1; 6, 1, 8];$$

$$\text{eig}(B)$$

$$[P, D] = \text{eig}(B)$$

Note:

- The columns of the matrix P denotes the eigen vectors of the matrix B .
- The matrix D denotes the diagonal matrix having eigen values on the main diagonal.

Imran Talib VU

Lecture NO.11

Eigen Values and Eigen Vectors
Reduced row echelon form
Solution of system of linear equations
Elementary row operations
Spanning set
Exercise

- Computation of the eigen values and eigen vectors.

```

1 = clear all;
2 = close all;
3 = clc;
4 = B=[0,1,3;2,4,1;6,1,8]; % Given matrix
5 = eig(B) % Determine eigen values
6 = [P,D]=eig(B) % Determine eigen values and eigen vectors
7 % The columns of the matrix P denotes the eigen vectors of the matrix B
8 % And the matrix D denotes the diagonal matrix with eigen values
9 % on the main diagonal
10

```

Workspace:

Name	Value
B	[0,1,3;2,4,1;6,1,8]
D	[-1.8716, 0, 0]
P	[-0.4480, 0.295, 1.4771]
ans	[-1.8716, 0, 0]

Command History:

```

> B=[0,1,3;2,4,1;6,1,8];
> clc
> D=eig(B)
> latex(B)
> latex(P)
> latex([P,D])=eig(B)

```

Lec11ExQ02 - Notepad

File Edit Format View Help

```
% Lecture # 11, Exercise Q.2
% Consider the system of equations  $x_1+3x_3+x_5=-1$ ,  $4x_1+x_2+x_3+6x_5=1$ ,
%  $-3x_1-3x_2-3x_3+x_4-19x_5=6$ ,  $10x_1-4x_2+38x_3+2x_4-12x_5=0$ 
% Enter into MatLab as an augmented matrix named Ab
% Use elementary row operations to reduce it to reduced echelon form
% Give the solution of the system
clear all
clc
A = [1 0 3 0 1; 4 1 1 0 6; -3 -3 -3 1 -19; 10 -4 38 2 -12]
b = [-1; 1; 6; 0]
Ab = [A b]
Ab(2,:) = Ab(2,:) - 4*Ab(1,:);
Ab(3,:) = Ab(3,:) + 3*Ab(1,:);
Ab(4,:) = Ab(4,:) - 10*Ab(1,:);
Ab(3,:) = Ab(3,:) + 3*Ab(2,:);
Ab(4,:) = Ab(4,:) + 4*Ab(2,:);
Ab(3,:) = (-1/27)*Ab(3,:);
Ab(1,:) = Ab(1,:) - 3*Ab(3,:);
Ab(2,:) = Ab(2,:) + 11*Ab(3,:);
Ab(4,:) = Ab(4,:) + 36*Ab(3,:);
Ab(4,:) = (1/0.6667)*Ab(4,:);
Ab(1,:) = Ab(1,:) - (0.1111)*Ab(4,:);
Ab(2,:) = Ab(2,:) + (0.4074)*Ab(4,:);
Ab(3,:) = Ab(3,:) + (0.0370)*Ab(4,:);
Ab
disp('x5 is free variable, let x5=1 then other values are as under');
X = Ab(:,6)-Ab(:,5);
x1 = 1
x2 = X(1,:)
x3 = X(2,:)
x4 = X(3,:)
x5 = X(4,:)
```



Lec11ExQ02 - Notepad

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```
% Lecture # 11, Exercise Q.2
% Consider the system of equations  $x_1+3x_3+x_5=-1$ ,  $4x_1+x_2+x_3+6x_5=1$ ,
%  $-3x_1-3x_2-3x_3+x_4-19x_5=6$ ,  $10x_1-4x_2+38x_3+2x_4-12x_5=0$ 
% Enter into MatLab as an augmented matrix named Ab
% Use elementary row operations to reduce it to reduced echelon form
% Give the solution of the system
clear all
clc
A=[1 0 3 0 1;4 1 1 0 6;-3 -3 -3 1 -19;10 -4 38 2 -12]
b = [-1;1;6;0]
Ab = [A b]
Ab(2,:)=Ab(2,)-4*Ab(1,:);
Ab(3,:)=Ab(3,)+3*Ab(1,:);
Ab(4,:)=Ab(4,)-10*Ab(1,:);
Ab(3,:)=Ab(3,)+3*Ab(2,:);
Ab(4,:)=Ab(4,)+4*Ab(2,:);
Ab(3,:)=(-1/27)*Ab(3,:);
Ab(1,:)=Ab(1,)-3*Ab(3,:);
Ab(2,:)=Ab(2,)+11*Ab(3,:);
Ab(4,:)=Ab(4,)+36*Ab(3,:);
Ab(4,:)=(1/0.6667)*Ab(4,:);
Ab(1,:)=Ab(1,)-(0.1111)*Ab(4,:);
Ab(2,:)=Ab(2,)+(0.4074)*Ab(4,:);
Ab(3,:)=Ab(3,)+(0.0370)*Ab(4,:);
Ab
disp('x5 is free variable, let x5=1 then other values are as under');
X = Ab(:,6)-Ab(:,5);
x1 =1
x2 =X(1,:)
x3 = X(2,:)
x4 = X(3,:)
x5 = X(4,:)
```



end

output:

v = 12.5664

>>

Questin:12:

```
%solve system of linear equation  
%2*x+y+z=2, -x+y-z=3, x+2*y+3*z=-10  
clear all  
close all  
clc  
eqn1='2*x+y+z=2'  
eqn2='-x+y-z=3'  
eqn3='x+2*y+3*z=-10'  
[x,y,z]=solve(eqn1,eqn2,eqn3)
```

Output

eqn1 =

2*x+y+z=2

eqn2 =

-x+y-z=3

eqn3 =

x+2*y+3*z=-10

x = 3

y = 1

z = -5

>>**Question:13;**

```
%compute Remain sum using 20 equally s  
%following definite  
%integral f=exp(x^2) on tye interval [0  
clc  
clear all  
close all  
n=20;
```



MTH643 S KHAN A...

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pages)

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9:38 pm

Today

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~yasir qbal

Today matlab paper :

Question 1.

Ode 45

Question no 2 .

Linear equations was given and write
argumend metrics and find rref.

Question no 3.

 $Y' = y + t$ $Y(0) = 1$

Solve differential equation.

4:33 pm



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~Rana @£!~1

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Today matlab paper :

Question 1.

Ode 45 ...

Yasir bhi kia Bata saktay An In 24



Type a message



Bujo 

52 minutes ago



Q-3): Linear equations was given. write augmented matrix and find rref

sol

$$2x + 3y + z = 2$$

$$3x + 2y + 3z = 4$$

$$y + z = 5$$

∴ we will write augmented matrix

$$A = [2, 3, 1; 3, 2, 3; 0, 1, 1];$$

$$b = [2; 4; 5];$$

$$Ab = [A, b]$$

∴ To find reduced row echelon form we apply direct rref command

$$\text{rref}(Ab)$$

Q-4) Given $y' = y + t$; $y(0) = 1$. solve differential eq.

sol

$$\text{syms } y(t)$$

$$\longrightarrow \text{ode} = \text{diff}(y) == y + t;$$

$$\text{cond} = y(0) == 1;$$

$$y_{\text{sol}}(t) = \text{solve}(\text{ode}, \text{cond})$$



MTH632 S KHAN A...

Asia, Baano, Bujo 🐼, Heer, Jee...



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Paper pattern bta da math632 ka

3:53 pm



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~بیک یا رسول اللہ~

MTH(643)

Question no (1)

Use of ode45

 $F=3e^{-t}$

Interval=[0,5]

Initial condition $x_0=0$;

Question No 2;

2(I) Create Matix in MatLab.A and B
given

2(ii)...add Matix A and B in Matlab

2(III)... multiply Matix A and B.

Question no 3;

Write a program in Matlab smition $(x/n)^k$ And run the program given the value
x, as 4 and n as 12Ye function create krna tha or
command widow m X or N Value ko
likh KR output nukalnii thii

Best of luck

4:13 pm



+92 318 7502167

~Aun Raza



Type a message



ode 45 [0,3];

$$y' = 3y - x^2 + 7, y(0) = 1$$

Numerically approximal
solution curve.

$$A = \begin{bmatrix} 1 & 3 & 4 \\ 1 & 5 & 6 \\ 2 & 1 & 2 \end{bmatrix}$$

eigen value eigen factor
reduced echelon

$$\frac{d^2 y}{dt^2} + 2 \frac{dy}{dt} + 5y = 7$$

$$y(0) = 1, y'(0) = 0$$

clc

clear all

close all

$$x = 4$$

$$n = 12$$

$$K = 1:n$$

for i = 1:length(K)

$$\text{sum} = (3/x)^{K(i)}$$

end

disp(sum)

Q. 3): Linear equations was given. write augmented matrix and find rref.

sol

$$2x + 3y + z = 2$$

$$3x + 2y + 3z = 4$$

$$y + z = 5$$

∴ we will write augmented matrix

$$A = [2, 3, 1; 3, 2, 3; 0, 1, 1];$$

$$b = [2; 4; 5];$$

$$Ab = [A, b]$$

∴ To find reduced row echelon form we apply direct rref command

$$\text{rref}(Ab)$$

Q. 4) Given $y' = y + t$; $y(0) = 1$. solve differential eq.

sol

$$\text{syms } y(t)$$

$$\rightarrow \text{ode} = \text{diff}(y) == y + t;$$

$$\text{cond} = y(0) == 1;$$

$$y_{\text{sol}}(t) = \text{dsolve}(\text{ode}, \text{cond})$$

QNo1

MTh643

write a program in Matlab that
Compute the following sum

$$\sum_{k=1}^n \left(\frac{3}{x}\right)^k$$

take the of x and n as and
input from user. The run the program
by giving value of x as 4
and value of n as 12.

QNo2 consider the linear system.

$$2x + y + z = 2$$

$$-x + y - z = 3$$

$$x + 2y + 3z = -10$$

$$\begin{aligned} \textcircled{1} \quad & 8x + y + 6z = 1 \\ & 3x + 5y + 7z = 1 \\ & 4x + 9y + 2z = 1 \end{aligned}$$

$\textcircled{1}$ write augmented matrix
~~and~~ $\textcircled{11}$ solve using rref

$\textcircled{2}$ compute using trapezoidal rule $\int_0^2 e^{x^2}$
 20 equally sub interval

$\textcircled{3}$ write a program which takes a number
 from the user and then using for loop
 compute its factorial.

MTH 643

Q: 1) Use ODE 45 command.

$$f = 3e^t - t, \quad [0, 5]. \quad t(0) = 0.$$

sol:-

```
clc
close all
clear all
f = @(t) (3*e^t - t);
tspan = [0, 5];
t(0) = 0;
t = ode45(f, tspan, t0)
plot (t)
```

~~***~~

Q: 2) Create Matrix A and B in MATLAB.

- i) Add A and B
- ii) Multiply A and B

sol:-

$$A = [1, 3, 4; 2, 3, 4; 4, 5, 6];$$

$$B = [2, 4, 3; 4, 5, 9; 6, 7, 8];$$

% Add A and B and stored Answer in C.

$$C = A + B$$

% Multiply A and B and stored Ans. in D.

$$D = A * B$$

Given $y = 0$ diff. eq.

MTH643 11:00 am

→ program which take a number as an input from user and then using the for loop compute its factorial.

→ solve linear equation

$$2x + y + z = 2$$

$$-x + y - z = 3$$

$$x + 2y + 3z = -10$$

→ Numerically approximate the solution of the following ordinary diff. equation using ode 45.

$$\frac{dx}{dt} = 3e^{-t}$$

time interval $[0, 5]$

initial condition $x(0) = 0$

MTH 643

1/9/2021 ; 3:00

Q.1 $A = \begin{bmatrix} 1 & 2 & 8 \\ 3 & 4 & 9 \\ 5 & 6 & 0 \end{bmatrix}$, $B = \begin{bmatrix} 1 & 2 & 3 \\ 4 & 5 & 6 \\ 7 & 8 & 9 \end{bmatrix} \rightarrow$ (5 marks)

creat matrix A and B

i) Add A and B Then store result in C.

ii) multiply A and B and store in D.

Q.2 Solve diff equation $y' = y + t \rightarrow$ (5 mark)
with conditions $y(1) = -2$.

Q.3 Solve $\int_1^5 \sqrt{1+x^3} dx$ $n=30 \rightarrow$ (5 marks)
' using simpson's $3/8$ rule.



Learning with Facts



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