Questions Bank

Computational Mathematics II

Exercises

1- Write a program to draw the graph of $f(x) = \begin{cases} x^2 + 1 \quad if \;\; x \geq 2 \\ 1 \quad if \quad 0 \leq x < 2 \\ |x - 3| \quad x < 0 \end{cases}$.

2- Write a program to draw the graph of $f(x) = \ln(x^2 - 4)$ on interval [-10, 10].

3- Write a program to draw the graph of $f(x) = \sqrt{x - 2} + \sqrt{1 - x^2}$ on interval [-10, 10].

4- Write a program to input a polynomial then draw its graph and plot its max. and min. points if exist on his graph.

5- Write a program to draw the surface of $f(x, y) = \ln(\mathrm{x}^2 - \mathrm{y}^2) + \sqrt{\mathrm{xy} - 1}$ on region $C = \{(x, y) \in \mathbb{R}^2;\ -2 \leq x \leq 2 \; and \; -1 \leq y \leq 1\}$

6- Write a program to draw the surface of $f(x, y) = \mathrm{y}e^{\mathrm{x}^2 + \mathrm{y}^2}$ on region $C = \{(x, y) \in \mathbb{R}^2;\ x^2 + y^2 \leq 4\}$

7- Write a program to draw the surface of $f(x, y) = \mathrm{x}\sin(\mathrm{y}) + \mathrm{y}\cos(\mathrm{x})$ on region $C = \{(x, y) \in \mathbb{R}^2; 1 \leq x^2 + y^2 \leq 4\}$

8- Write a program to draw the surface of $f(x, y) = \mathrm{x}^2 + \mathrm{y}^2 - 6$ on region $C = \{(x, y) \in \mathbb{R}^2; x \in [-4, -2\,] \cup [\,2\,, 4\,] \; and \; y \in [-4, -2] \cup [\,2\,, 4\,]\}$

9- Write a program to draw the surface of $f(x, y) = \mathrm{x}^2 + \mathrm{y}^2 - 6$ on region $C = \{(x, y) \in \mathbb{R}^2; (x, y) \in \Delta ABC : A = (1\,, 1), B = (6\,, 2\,), C = (3\,,\ 5)\}$

10-Write a program to draw the surface of $f(x, y) = \mathrm{x}^2 - \mathrm{y}^2$ on region $C = \{(x, y) \in \mathbb{R}^2;\ -2 \leq x \leq 2 \; and - 1 \leq y \leq 1 \; and \; x^2 + y^2 - xy \geq 1\}$

Exercises

1- Write a program to find the tangent line of polynomial $p(x)$ at the point x_0 then draw the graph of polynomial ant its tangent line.
2- Write a program to find all local maximum and minimum pints of polynomial $p(x)$ then draw polynomial and (max., min.) points.
3- Write a program to find the area under polynomial $p(x)$ if its bounded.
4- Write a program to find the area under polynomial $p(x)$ on interval $[a, b]$.
5- Write a function to add two polynomial $p(x)$ and $q(x)$.
6- Write a function to subtract two polynomial $p(x)$ and $q(x)$.
7- Write a program to find the area between two polynomials $p(x)$ and $q(x)$ if its bounded.

Q1) Write a program to draw the graph of input function.

Q2) Write a program to draw the surface of input function.

Q3) Write a program to check if the input function is odd or even.

Q4) Write a program to find all asymptotic line of input function if exist.

Q5) Write a program to find the area between three line if they are not co-linear and then draw the triangle of intersection.

Q6) Write a program to find out if the input function is onto one or not then find it inverse if exist the draw the graphs.

Q7) Write a program to find all singular point of input equation.

Q8) Write a program to find the equation of line from two points.

Q9) Mixing MATLAB built-in functions to do the following by one-line statement in command window

a) Find the number of imaginary roots of polynomial.

b) Find the sum of real roots of polynomial.

c) Find the maximum coefficient in polynomial.

d) Find the degree of polynomial.

Exercises

Q1) Write a program to find derivative of input function by definition.

Q2) Write a program to find the area under function $f(x)$ on interval $[a, b]$ by Riemann integral.

Q3) Write a program to find tangent line of function $f(x)$ at x_0 and draw the graphs.

Q4) Write a program to find local maximum, Local minimum and Inflection point of function $f(x)$ then draw its graph.

Q5) Write a program to find the area between two input functions.

Q6) Write a program to find the area under function $f(x)$ on interval $[a, b]$.

Q7) Write a program to find the area under function $f(x)$ if exist.

Q8) Write a program to find local maximum, local minimum and saddle point of function $f(x, y)$ then draw its graph.

Q9) Write a program to find the parametric equation of line in R^3 that pass through the two points and plot of its graph.

Q10) Write a program to find the equation of plane pass through the three points and plot of its graph.

Q11) Write a program to find the eq. of tangent plane of the surface $f(x, y, z)$ at the point (x_0, y_0, z_0).

Q1) Mixing MATLAB built-in functions to do the following by one-line statement in command window

a) Check whether the matrix $\mathbf{A_{n\times m}}$ is zero matrix or not.

b) Check whether the matrix $\mathbf{A_{n\times n}}$ is identity matrix or not.

c) Check whether the matrix $\mathbf{A_{n\times n}}$ is diagonal matrix or not.

d) Check whether the matrix $\mathbf{A_{n\times n}}$ is Symmetric matrices or not.

e) Check whether the matrix $\mathbf{A_{n\times n}}$ is Singular matrix or not.

f) Check whether the matrix $\mathbf{A_{n\times n}}$ is Hermitian matrix or not.

g) Check whether the matrix $\mathbf{A_{n\times n}}$ is Orthogonal matrix or not.

h) Check whether the matrix $\mathbf{A_{n\times n}}$ is Idempotent matrix or not.

i) Check whether the matrix $\mathbf{A_{n\times n}}$ is Involuntary matrix or not.

j) Check whether the matrix $\mathbf{A_{n\times n}}$ is Nilpotent matrix of power *p* or not.

k) Check whether the all eigenvalue of matrix $\mathbf{A_{n\times n}}$ is real or not.

l) Check whether two vectors in R^3 are parallel or not.

m) Find the angle between two vectors in R^3.

Q2) Write a program to input three vectors in R^3 then find out are independent or not.

Q3) Write a program to solve linear system by using Cramer's rule.

Q4) Write a program input three vectors V_1, V_2 and V_3in R^3 then find the area of triangle $V_1V_2V_3$.

Calculus Application

Q) Write a Matlab function to checks that either the input function is even or odd.

```
function k=e(f)
syms x
if subs(f,-x)==f
    k='even';
elseif subs(f,-x)==-f
    k='odd';
else
    k='is not even and not odd';
end
```

```
end
```

H.w) Write a program to fine the area between two functions.

```
syms x real
f=input('f(x)=');
g=input('g(x)=');
r=solve(f-g);
r=sort(r);
if length(r)>1
    s=0;
    for i=1:length(r)-1
        s=s+abs(int(f-g,x,r(i),r(i+1)));
    end
    s
else
    disp('the area is not bounded')
end
```

Q) Write a program to input the function then find the area under the curve.

```
syms x
f=input('f=');
a=input('a=');
b=input('b=');
c=double(solve(f));
c=c(c>a&c<b);
c=c(real(c)==c);
c=sort([c a b]);
s=0;
 for i=1:length(c)-1
    s=s+abs(int(f,x,c(i),c(i+1)));
end
s
```

H.W) Write a program to find the local maximum and local minimum points of input function if exists then

draw the graph of function and view the local maximum and local minimum points on the graph.

Sol)

```
syms x
f=input('f(x)=');
df=diff(f,x);
d2f=diff(df,x);
xc=double(solve(df));
xc=sort(xc);
n=length(xc);
if n>0
    for i=1:n
        if subs(d2f,xc(i))>0
            disp([num2str(xc(i)) ' is min.'])
        elseif subs(d2f,xc(i))<0
            disp([num2str(xc(i)) ' is max.'])
        else
            disp('test fail')
        end
    end
end
x1=xc(1)-1:0.1:xc(n)+1;
y1=double(subs(f,x1));
plot(x1,y1)
yc=subs(f,xc);
hold on
plot(xc,yc,'or')
```

Q) Write a program to find the critical point and check it which is max., min. or saddle point.

```
syms x y
f=input('f(x,y)=');
fx=diff(f,x);
fxx=diff(fx,x);
fxy=diff(fx,y);
fy=diff(f,y);
```

```
fyy=diff(fy,y);
d=fxx*fyy-(fxy)^2;
[xc,yc]=solve(fx,fy);
xc=double(xc)
yc=double(yc)
for i=1:length(xc)
    if subs(d,[x,y],[xc(i),yc(i)])>0
      if subs(fxx,[x,y],[xc(i),yc(i)]) >0
          disp(['(' num2str(xc(i)) ',' num2str(yc(i))
') is min.'])
      else
         disp(['(' num2str(xc(i)) ',' num2str(yc(i)) ')
is max.'])
      end
    elseif subs(d,[x,y],[xc(i),yc(i)])<0
       disp(['(' num2str(xc(i)) ',' num2str(yc(i)) ')
is saddle.'])
    else
        disp('the method fails')
    end
end
```

Q) Write a program to find the Taylor series.

```
syms x
f=input('f(x)=');
x0=input('x0=');
n=input('n=');
s=0;
for i=0:n
    s=s+(subs(diff(f,x,i),x,x0)/factorial(i))*(x-x0)^i;
end
s
```

Q) Write a program to input then find the derivative by definition.

```
syms x h
f=input('input the function f(x)=')
g=simplify((subs(f,x,x+h)-f)/h);
```

```
limit(g,h,0)
```

Q) Write a program to input the function $f(x)$ and the point x_0 then find the equation tangent line of input function.

```
syms x y
f=input('f(x)= ');
x0=input('x0=');
y0=subs(f,x,x0);
m=diff(f,x);
y=m*(x-x0)+y0
```

Q) Write a program to find the slop and the equation of tangent line of the points (x_0, x_1) and (y_0, y_1).

```
syms x y
x0=input('x0=');
y0=input('y0=');
x1=input('x1=');
y1=input('y1=');
m=(y1-y0)/(x1-x0);
y=simplify(m*(x-x0)+y0)
```

Q) Write a program to find the eq. of tangent plane of the surface $f(x,y,z)$ at the point(x_0, y_0, z_0).

```
syms x y z
f=input('f(x,y,z)=');
x0=input('x0=');
y0=input('y0=');
z0=input('z0=');
fx=diff(f,x);
fy=diff(f,y);
fz=diff(f,z);
subs(fx,[x y z],[x0 y0 z0])*(x-x0)+subs(fy,[x y z],[x0
y0 z0])*(y-y0)+subs(fz,[x y z],[x0 y0 z0])*(z-z0)
```

Q) Write a program to find the parametric eq. pass through the two points and plot of it.

```
syms t
a=input('a=');
b=input('b=');
v=b-a;
x=a(1)+t*v(1);
y=a(2)+t*v(2);
z=a(3)+t*v(3);
t1=-10:10;
x1=subs(x,t1);
y1=subs(y,t1);
z1=subs(z,t1);
plot3(x1,y1,z1)
```

Q) Write a program to input the polynomial and the discreet set then check that is the polynomial is one to one or not.

```
syms x
f=input('f(x)=');
a=input('input the start range of the function=');
b=input('input the end range of the function=');
c=a:b;
for i=1:length(c)-1
    for j=i+1:length(c)
        if subs(f,x,c(i))==subs(f,x,c(j))&&c(i)~=c(j)
         disp('the function is not one to one')
         return
        end
    end
end
     disp('the fuction is one to one')
```

Exam) Write a program to input two vectors in $\mathbb{R}^3$ then if they are not parallel then find the angle between them and plane that contains them.

Sol)

```
v1=input(v1);
v2=input(v1);
if norm(cross(v1,v2))==0
    disp('They are parallel')
else
    th=acosd((dot(v1,v2))/(norm(v1)*norm(v2)))
    n=cross(v1,v2);
    syms x y z
    P=n(1)*(x-v1(1))+n(2)*(y-v1(2))+n(3)*(z-v1(3))
end
```