EXPT.NO.2

Title: Finding angle between polar curves and Radius of curvature.

This expt. deals with finding angle between polar curves, curvature and radius of curvature of a given curve. Given a pair of polar curves angle between radius vector and tangent for each curve are obtained so that the difference is the desired angle. Simple checking for orthogonality (angle 90^0) isalso given at the intermediate step. Radius of curvature program for all Cartesian, polar and parametric curves are given.

Formula: Angle between radius vector and tangent for curve

$$tan\varphi = r\left(\frac{d\theta}{dr}\right)$$

Formula: Angle between two polar curves

i)$\varphi = |\varphi_{1-}\ \varphi_2|=\frac{\pi}{2}$ [Two curves intersect orthogonally]

ii)$\varphi = |\varphi_{1-}\ \varphi_2|$

Ex.1 Find the angle between two polar curves

$r_1=5[1+cos\ t]\ \ and\ \ \ r_2=5[1-cos\ t]$

Program:

```
%% MATLAB:02
%% "Angle between two polar curves "
syms r  t
r1=5*(1+cos ( t ) );
r2=5*(1-cos ( t ) );
dr1 = diff ( r1 , t );
dr2 = diff ( r2 , t );
t1=r1/dr1;
t2=r2/dr2;
p = simplify(t1*t2);
if p==-1
    disp('Curves are orthogonal');
else
    q= solve ( r1-r2 , t );
    w1 = subs(t1, t, q);
    w2 = subs(t2, t, q);
    y1= atan (w1);
    y2= atan (w2);
    w = abs(y1-y2);
    fprintf('Angle between polar curves in radians is = %f',w);
end
```

Ex.2 Find the angle between two polar curves

r1=5*(1-sin (2*t)); r2=5*(1-cos (4*t))

Program:

```
%% MATLAB:02
%%"Angle between two polar curves " syms r t
Clear
clc
r1=2*(1-sin (2*t));
r2=3*(1-cos (4*t));
dr1 = diff (r1, t);
dr2 = diff (r2, t);
t1=r1/dr1;
t2=r2/dr2;
p = simplify(t1*t2);
if p==-1
    disp ('Curves are orthogonal');
else
    q= solve (r1-r2, t);
     w1 = subs (t1, t, q);
    w2 = subs (t2, t,q);
    y1= atan (w1);
    y2= atan (w2);
    w = abs(y1-y2);
 fprintf('Angle between polar curves in radians is = %f',w);
end
```

Ex.3 Find the Radius of curvature program in Cartesian curves,

y=sqrt(2*x)

Program:

```
%% Matlab 02: Radius of Curvature    NAME:
%% Radius of Curvature for Cartesian Curve
clear
clc
syms x y y1 y2
a=1;
y=sqrt(2*x);
y1=diff (y, x);
y2=diff (y1, x);
y1=simplify(y1);
y2=simplify(y2);
rho=abs((1+y1^2) ^(3/2)/y2);
rho=subs (rho, x, a);
rho=simplify(rho)
```

Ex.4 Find the Radius of curvature program for parametric curves.

x= t + sin(t); y=1 + cos(t);

Program:

```
%% Matlab 02 : Radius of Curvature    NAME:
%% Radius of Curvature for Parametric Curves
clear
clc
```

```
syms t x y
a=1;
x= t + sin(t);
y=1 + cos(t);
y1=diff(y,t)/diff(x,t);
y1=simplify(y1);
y2=diff(y1,t)/diff(x,t);
y2=simplify(y2);
rho = abs((1+y1^2)^(3/2)/y2);
rho = subs(rho,x,a);
rho = simplify(rho)
```

Ex.5 Find the Radius of curvature program polar curves,

r=1-cos(θ)

Program:

```
%% Matlab 02: Radius of Curvature    NAME:
%% Radius of Curvature for Polar Curves
clear
clc
syms theta r r1 r2
a=pi/2;
r=1-cos(theta);
r1=diff(r,theta);
r2=diff(r1,theta);
r1=simplify(r1);
r2=simplify(r2);
rho=abs((r^2+r1^2)^(3/2)/(r^2+2*r1^2-r*r2));
rho=subs(rho, theta, a);
rho = simplify(rho)
```