UNIVERSITY OF ANBAR

كلية : التربية للعلوم الصرفة

القسم او الفرع :الرياضيات

المرحلة: الثانية

أستاذ المادة : ميمون ابراهيم اسماعيل

اسم المادة بالغة العربية :التفاضل المتقدم

اسم المادة باللغة الإنكليزية : Advance Calculus

اسم المحاضرة الحادية عشر باللغة العربية: الرسم في الاحداثيات القطبية (الاشكال الورد)

اسم المحاضرة الحادية عشر باللغة الإنكليزية: Graphing in Polar Coordinates (*Rose curve*)

Rose curve if the polar equation has form as

• $r = a\ cosn\theta$ or $r = a\ sinn\theta\ where\ a \in R - \{0\}, n \neq 1, and\ n \in N$

Note that: if n is an odd number then the number of leaves equal n.

If n is an even number then the number of leaves equal $2n$.

Examples:

1) Graph the Curve $r = \cos 2\theta$

Solution:

●The curve is symmetric about the x-axis because (r, θ) on the graph then

$r = \cos(-2\theta) \rightarrow r = \cos 2\theta$, So $(r, -\theta)$ on the graph

●The curve is symmetric about the y-axis because (r, θ) on the graph then

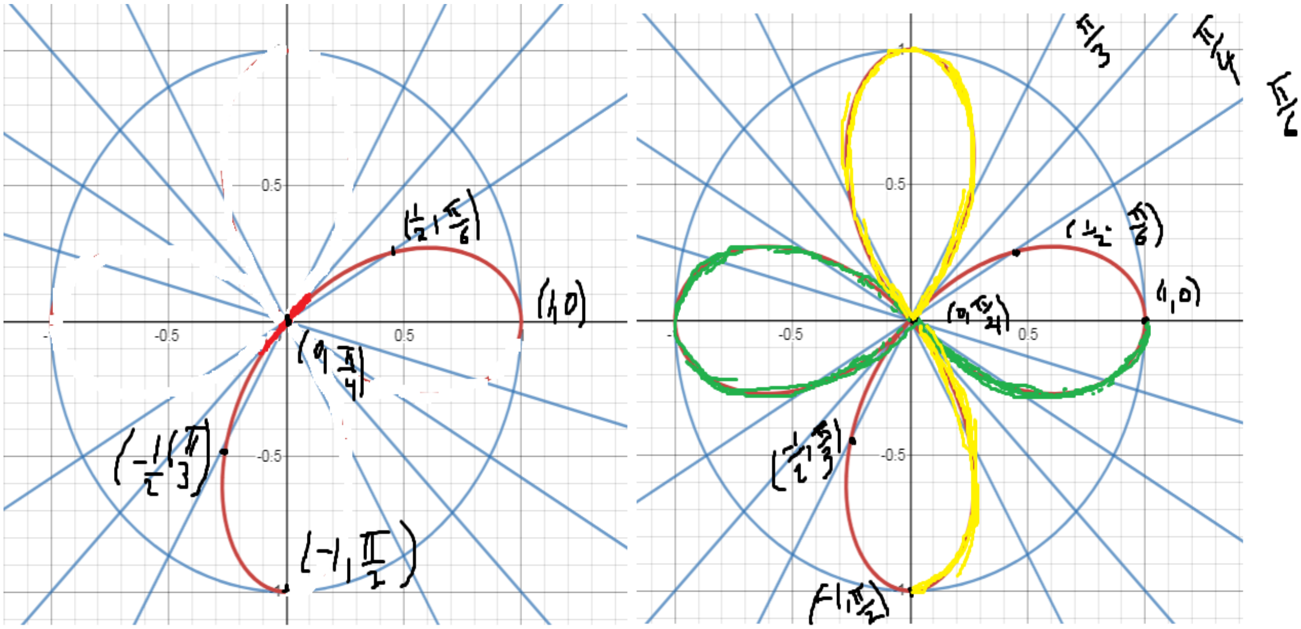
$r = \cos 2(\pi - \theta) \rightarrow r = \cos 2\pi \cos 2\theta + \sin 2\pi \sin 2\theta \rightarrow r = \cos 2\theta$, So

$(r, \pi - \theta)$ on the graph

Together, these two symmetries imply symmetry about the origin point

θ	r	(r, θ)
0	1	(1,0)
$\frac{\pi}{6}$	$\frac{1}{2}$	$\left(0.5, \frac{\pi}{6}\right)$
$\frac{\pi}{4}$	0	$\left(0, \frac{\pi}{4}\right)$
$\frac{\pi}{3}$	$\frac{-1}{2}$	$\left(-0.5, \frac{\pi}{3}\right)$
$\frac{\pi}{2}$	-1	$\left(-1, \frac{\pi}{2}\right)$

$r = \cos 2\theta$



because the curve is symmetric about the *x*-axis *and* the y-axis

2) Graph the Curve $r = \sin 2\theta$

Solution:

●The curve is symmetric about the *x*-axis because (r, θ) on the graph then

$-r = \sin 2(\pi - \theta) \ \rightarrow \ -r = \sin 2\pi \cos 2\,\theta - \sin 2\theta \cos 2\pi \rightarrow -r = -\sin 2\theta$,
$r = \sin 2\theta$ So $(r, \pi - \theta)$ on the graph

●The curve is symmetric about the *y*-axis because (r, θ) on the graph then

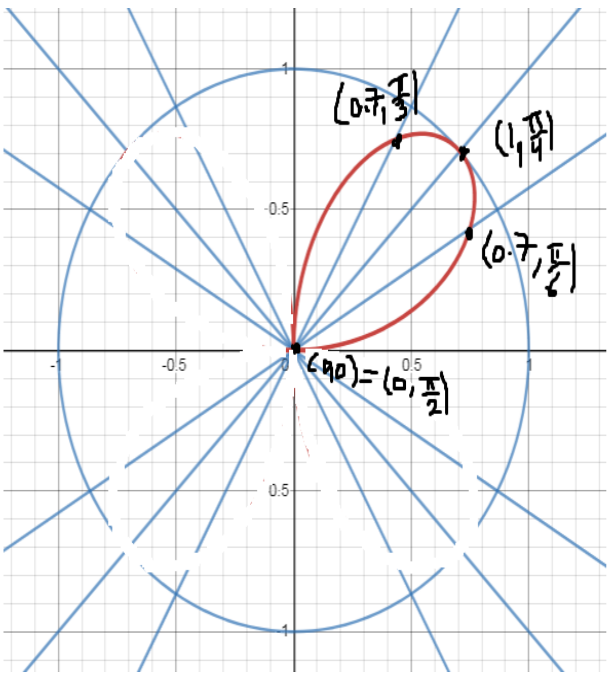
$-r = \sin -2\theta \ \rightarrow \ -r = -\sin 2\theta \rightarrow r = \sin 2\theta$, So $(-r, -\theta)$ on the graph

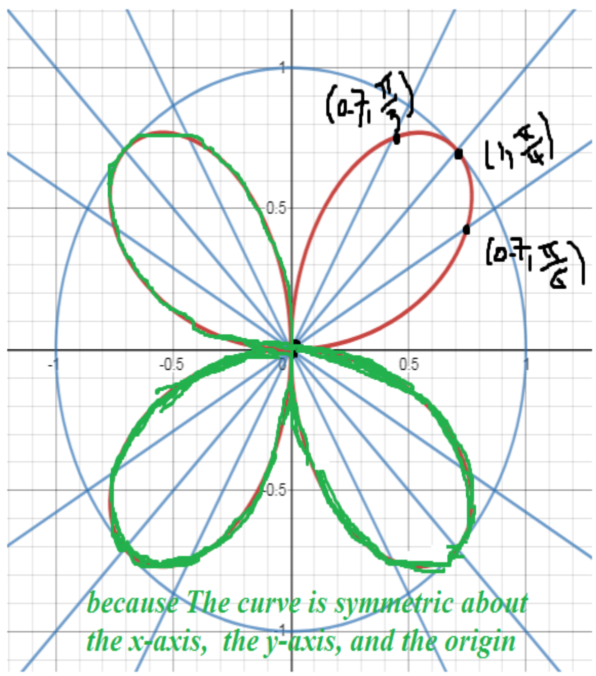
Together, these two symmetries imply symmetry about the origin point

θ	r	(r, θ)

0	0	$(0,0)$
$\frac{\pi}{6}$	$\frac{\sqrt{3}}{2}$	$\left(0.8, \frac{\pi}{6}\right)$
$\frac{\pi}{4}$	1	$\left(1, \frac{\pi}{4}\right)$
$\frac{\pi}{3}$	$\frac{\sqrt{3}}{2}$	$\left(0.8, \frac{\pi}{3}\right)$
$\frac{\pi}{2}$	0	$\left(0, \frac{\pi}{2}\right)$

$r = \sin 2\theta$





3) Graph the Curve $r = \sin 3\theta$

Solution:

●The curve is symmetric about the y-axis because (r, θ) on the graph then

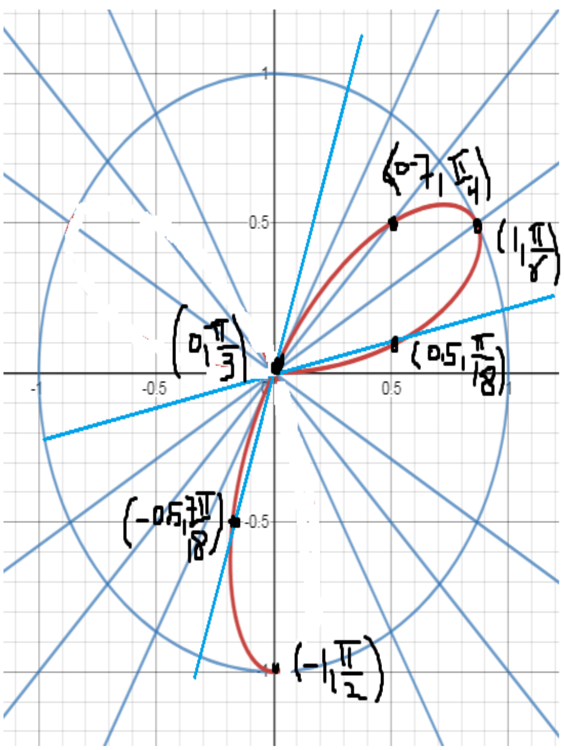
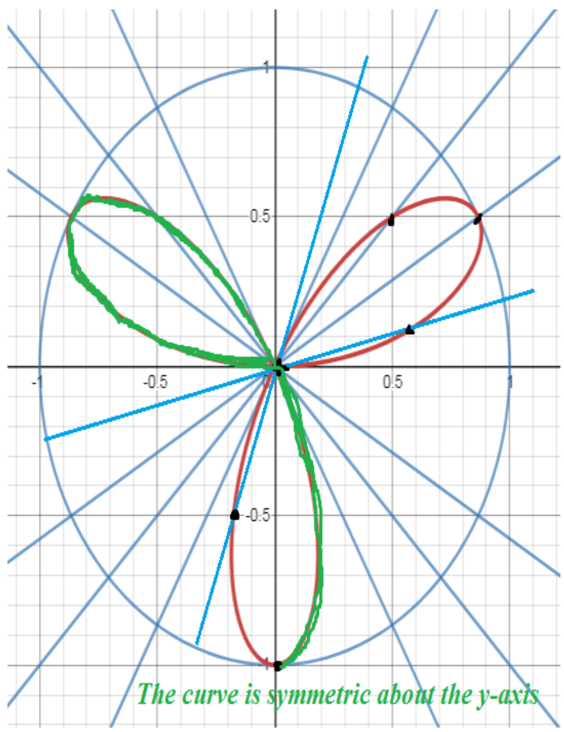
$-r = \sin(-3\theta) \rightarrow -r = -\sin 3\theta \rightarrow r = \sin 3\theta$ So $(-r, -\theta)$ on the graph

There is not symmetric about the x-axis and the origin point

θ	r	(r, θ)

0	0	(0,0)
$\frac{\pi}{18}$	$\frac{1}{2}$	$\left(0.5, \frac{\pi}{18}\right)$
$\frac{\pi}{6}$	1	$\left(1, \frac{\pi}{6}\right)$
$\frac{\pi}{4}$	$\frac{1}{\sqrt{2}}$	$\left(0.7, \frac{\pi}{4}\right)$
$\frac{\pi}{3}$	0	$\left(0, \frac{\pi}{3}\right)$
$\frac{7\pi}{18}$	$\frac{-1}{2}$	$\left(-0.5, \frac{7\pi}{18}\right)$
$\frac{\pi}{2}$	-1	$\left(-1, \frac{\pi}{2}\right)$

$r = \sin 3\theta$

4) Graph the Curve $r = \cos 3\theta$

Solution: The curve is symmetric about the x-axis because (r, θ) on the graph then $r = \cos(-3\theta) \rightarrow r = \cos 3\theta \rightarrow (r, -\theta)$ on the graph

There is not symmetric about the y-axis and the origin point

θ	r	(r,θ)
0	1	$(1,0)$
$\frac{\pi}{18}$	$\frac{\sqrt{3}}{2}$	$\left(0.8,\frac{\pi}{18}\right)$
$\frac{\pi}{6}$	0	$\left(0,\frac{\pi}{6}\right)$
$\frac{\pi}{4}$	$\frac{-1}{\sqrt{2}}$	$\left(-0.7,\frac{\pi}{4}\right)$
$\frac{\pi}{3}$	-1	$\left(-1,\frac{\pi}{3}\right)$
$\frac{7\pi}{18}$	$\frac{-\sqrt{3}}{2}$	$\left(-0.8,\frac{\pi}{18}\right)$
$\frac{\pi}{2}$	0	$\left(0,\frac{\pi}{2}\right)$
$\frac{2\pi}{3}$	-1	$\left(-1,\frac{2\pi}{3}\right)$
π	-1	$(-1,\pi)$

$$r = \cos 3\theta$$