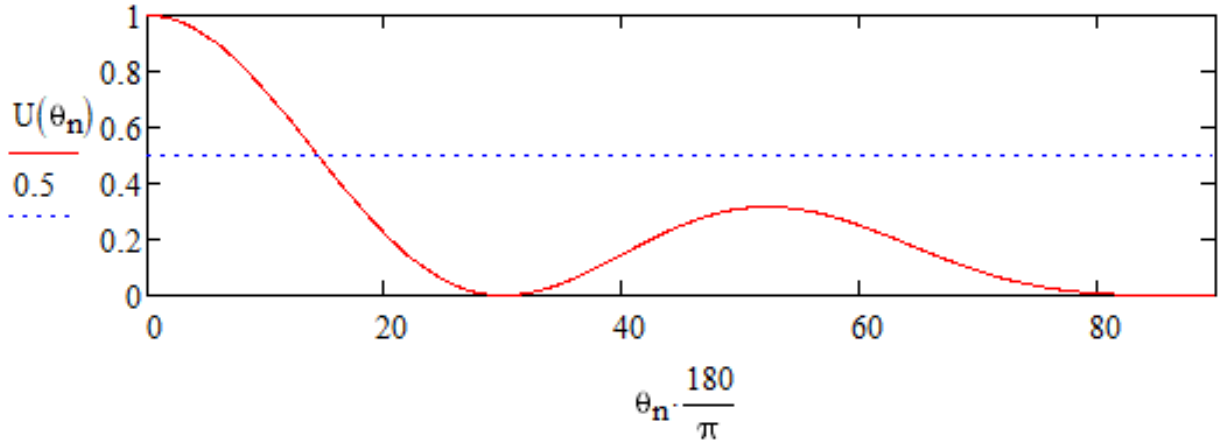
2.5 Find the half-power beamwidth (HPBW) and first-null beamwidth (FNBW), *in radians and degrees*, for the following normalized radiation intensities:

(d) $U(\theta) = \cos^2(\theta)\cos^2(3\theta)$ $\quad (0 \le \theta \le 90°,\ 0 \le \phi \le 360°)$

Using MathCAD, plot U(θ) below.

$U(x) := (\cos(x))^2 \cdot (\cos(3 \cdot x))^2$ $\quad n := 0..900$ $\quad \theta_n := 0.1 \cdot n \cdot \frac{\pi}{180}$



Using the graph as a starting point, find the angle θh where U(θh) = 0.5 by trial and error to determine the HPBW.

$\theta hdeg := 14.37252$ $\quad \theta hrad := \theta hdeg \cdot \frac{\pi}{180}$ $\quad U(\theta hrad) = 0.5$

$HPBW := 2 \cdot \theta hrad$

$\boxed{HPBW = 0.5017}$ radians

$\boxed{HPBW \cdot \frac{180}{\pi} = 28.74504}$ degrees

Using the graph as a starting point, find the angle θn where U(θn) = 0 by trial and error to determine the FNBW **OR** observe that cos(3θ) is zero when 3θ = 90 deg & θ = 30 deg.

$\theta ndeg := 30$ $\quad \theta nrad := \theta ndeg \cdot \frac{\pi}{180}$ $\quad U(\theta nrad) = 0$

$FNBW := 2 \cdot \theta nrad$

$\boxed{FNBW = 1.0472}$ radians

$\boxed{FNBW \cdot \frac{180}{\pi} = 60}$ degrees