Problem #1: Direct Construction From Uniform *K*-Function

Write a MATLAB code to calculate a 1D grating from the following *K*-function over an area the size of $10a \times 10a$.

$$\vec{K}(\vec{r}) = \frac{2\pi}{a}\left(\hat{x}\cos\theta + \hat{y}\sin\theta\right) \qquad \theta = 25° \tag{1}$$

For this problem, use direct construction of the grating from $\vec{K}(\vec{r})$. That is,

$$\varepsilon_r(\vec{r}) = \cos\left(\vec{K} \bullet \vec{r}\right) \tag{2}$$

Plot `KX`, `KY`, and `ER`. Start with the following header:

```
% HW8_Prob1.m
%
% Homework #8, Problem #1
% ECE 5322 - 21st Century Electromagnetics
% 21ST CENTURY ELECTROMAGNETICS

% INITIALIZSE MATLAB
close all;
clc;
clear all;

% UNITS
degrees = pi/180;

% DEVICE PARAMETERS
a  = 1;
Sx = 10*a;
Sy = 10*a;
```

Calculate the uniform *K*-function this way

```
% CREATE UNIFORM K-FUNCTION
A = (25*degrees) * ones(Nx,Ny);
R = (2*pi/a) * ones(Nx,Ny);
[KX,KY] = pol2cart(A,R);
```

Note that `X` and `Y` are generated our usual way using `meshgrid()` and <u>centered about zero</u>.

Problem #2: Direct Construction From Spatially Variant *K*-Function

Repeat the above problem, but calculate the *K*-function this way:

```
% CREATE SPATIALLY VARIANT K-FUNCTION
A = exp(-(X.^2 + Y.^2)/(2*a)^2);
A = (45*degrees) * (A>0.5);
R = (2*pi/a) * ones(Nx,Ny);
[KX,KY] = pol2cart(A,R);
```

Problem #3: Construction Using Grating Phase

Repeat Problem #2, but construct the grating using the grating phase method summarized in Eq. (3). Show side-by-side spatially-variant gratings constructed using direct construction and using the grating phase approach. Discuss the differences.

$$\varepsilon_r(\vec{r}) = \cos\left[\Phi(\vec{r})\right] \qquad \nabla\Phi(\vec{r}) = \vec{K}(\vec{r}) \tag{3}$$