**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 $10a \times 10a$.

$$ \tilde{K}(\vec{r}) = \frac{2\pi}{a}(\hat{x}\cos \theta + \hat{y}\sin \theta) \quad \theta = 25^\circ $$

(1)

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

$$ \varepsilon_r(\vec{r}) = \cos(\tilde{K} \cdot \vec{r}) $$

(2)

Plot $K_X$, $K_Y$, and $ER$. Start with the following header:

```matlab
%% HW8_Prob1.m
%%
%% Homework #8, Problem #1
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%% 21ST CENTURY ELECTROMAGNETICS

%% INITIALIZE 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

```matlab
%% 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 centered about zero.

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

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

```matlab
%% 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.

$$ \varepsilon_r(\vec{r}) = \cos[\Phi(\vec{r})] \quad \nabla \Phi(\vec{r}) = \tilde{K}(\vec{r}) $$

(3)