ECE468: EXAM 2

NAME: _____

INSTRUCTIONS

- This is a 45 minute exam containing **FIVE** problems
- For the exam, you may use the textbook, one letter-size crib sheet, calculator, and pens/pencils
- Cheating during the exam will result in a failing grade for the entire course

Problem	Max points	Earned points
1	40pts	
2	10pts	
3	20pts	
4	10pts	
5	20pts	
TOTAL	100pts	

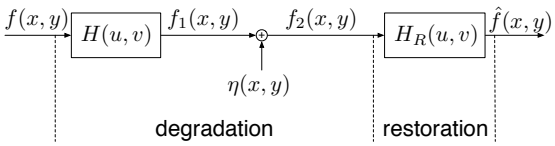

Fig. 1. Degradation/restoration system: $H(u,v)$ models the effect of motion blur in the frequency domain on visual input $f(x,y)$; $\eta(x,y)$ is an additive noise; and $H_R(u,v)$ is the restoration filter, aimed at restoring the original, uncorrupted visual input.

In this exam we consider a degradation/restoration system shown in Fig. 1. The input image, $f(x,y)$ is corrupted by motion blur, resulting in $f_1(x,y)$. Motion blur is modeled with the degradation function, $H(u,v)$, in the frequency domain. $f(x,y)$ is also corrupted by stationary, additive noise $\eta(x,y)$. Our goal is to restore $f(x,y)$ using the restoration filter, $H_R(u,v)$.

1. (40pts)

Compute $H(u,v)$? It is known that the camera is fixed, but its shutter speed is $T = 1s$. This means that motion blur occurs because an object in the image moves during the camera exposure time $t \in [0,1]$. It is also known that the image shows a human body, centered at (0,0). Because of breathing, the body increases in size, radially in all directions, during $t \in [0,1]$. The radial speed of the body is constant, i.e., the displacement of every point of the body along the radial direction is $\rho_0(t) = t$ during $t \in [0,1]$.

(Hint: Since the body motion is radial, it makes sense to define the model of motion blur in the radial coordinates.)

2. (10pts)

Explain whether $H(u, v)$ is a lowpas or highpass filter? (No points for guessing)

3. (20pts)

Given that the power spectrum of noise $\eta(x, y)$ is defined as

$$|N(u, v)|^2 = \frac{\sin^2(\pi\sqrt{u^2 + v^2})}{\pi^2(u^2 + v^2)},$$

Compute the power spectrum of $f_2(x, y)$?

4. (10pts)

Derive the expression for $H_R(u, v)$, if this filter is defined as inverse filter? Is the inverse filter suitable for restoration in this case? Explain your reasoning.

5. (20pts)

What is the expression for $H_R(u, v)$, if this filter is defined as Wiener filter? What is the criterion with respect to which the Wiener filter is optimal? Explain your reasoning.