

Note: All questions carry equal marks. Solve any 5 questions.

Ques 1.

- I. Show that the Gaussian smoothing operator satisfies the following properties:

$$H_{i,j} = \frac{1}{2\pi\sigma^2} \exp\left(-\frac{((i-k-1)^2 + (j-k-1)^2)}{2\sigma^2}\right)$$

- a. Homogeneity
b. Superposition
c. Time-invariance
- II. Check if the above three properties hold for the gradient operator

Ques 2.

If an image is rotated by an angle θ_0 , show mathematically that the Fourier Transform is also rotated by the same angle θ_0 .

Ques 3.

What objective function does the Harris corner optimize? Explain clearly the reason for choosing this objective function. Propose a different objective function and explain why you chose that objective function

Ques 4.

- I. Draw the block diagram to illustrate the functioning of the SIFT descriptor.
- II. What is the size of a standard SIFT descriptor? Clearly explain the computations, which lead to this dimension.

Ques 5.

- I. Why do we perform rectification in texture representation? How do we perform rectification, explain mathematically.
- II. Draw the block diagram of a typical local texture representation scheme. Clearly label all the blocks.

Ques 6.

- I. What is the role of kernel smoothing in mean shift technique for clustering?
- II. Given a kernel function $k(t) = (1 - t)$, if $|t| < 1$ and 0 otherwise. Derive the estimate update equation.