

1. Bilateral Filter ( $10 + 5 = 15$ )

- a. Give the expression for the data-dependent range kernel in a bilateral filter. What is the purpose of this kernel and how does it achieve this purpose?
- b. Under what conditions do the bilateral filter approach a gaussian filter?

2. Edge Detection ( $6 + 9 = 15$ )

- a. Give the expression for derivative as a symmetric difference.
- b. How do you find the expression for second derivative using this. How is it different from the one computed from the one-sided first derivative?

3. Bit Plane Slicing ( $6 + 9 = 15$ )

- c. What is bit-place slicing and how can it be used in Image understanding?
- d. Show how one can implement an edge detector by working on independent bit planes and then combining the results?

4. Transforms of common functions ( $10 + 5 = 15$ )

- a. Compute Fourier transform of a triangle function:  $f(x) = \max(2 - |x|, 0)$ .
- b. Derive the Fourier transform of  $\sin(x)$  using Euler formula, plot its magnitude and phase spectrum.

5. Dirac Delta function (15)

- a. Is  $\delta(\tau - a) = \delta(a - \tau)$ ? If so, prove it. If not, show why it is not.