Ans-2) : $h(x,y) = \begin{bmatrix} 0 & 1 & 0 \\ 1 & -4 & 1 \\ 0 & 1 & 0 \end{bmatrix}_{3\times3}$

Let $f(x,y) \rightarrow$ Image : $M\times N \equiv 512\times512$

The convolved product will be of dimensions

$(M+3-1)\times(N+3-1) \equiv (M+2)\times(N+2)$

→ Padding image :

$f_p(x,y)$ $\begin{bmatrix} f(x,y) & & & 0 \\ & & & \vdots \\ 0 & 0 & \cdots & \cdot \end{bmatrix}_{M+2\times N+2}$

→ Shifting $h(x,y)$ to first quadrant : $h_p(x,y)$

$h(-1,-1) = h(-1 \bmod 512, -1 \bmod 512) = h(511,511) = 0$

$h(-1,0) = h(-1 \bmod 512, 0 \bmod 512) = h(511,0) = 1$

$h(-1,1) = h(-1 \bmod 512, 1 \bmod 512) = h(511,1) = 0$

$h(0,-1) = h(0 \bmod 512, -1 \bmod 512) = h(0,511) = 1$

$h(0,0) = h(0 \bmod 512, 0 \bmod 512) = h(0,0) = -4$

$h(0,1) = h(0 \bmod 512, 1 \bmod 512) = h(0,1) = 1$

$$h(1,-1) = h(1 \bmod 512, -1 \bmod 512) = h(1, 511) = 0$$

$$h(1,0) = h(1 \bmod 512, 0 \bmod 512) = h(1,0) = 1$$

$$h(1,1) = h(1 \bmod 512, 1 \bmod 512) = h(1,1) = 0$$

$\therefore$ The padded version becomes

$$h_p(x,y) = \begin{bmatrix} -4 & 1 & 0 & \cdot & \cdot & 1 \\ 1 & 0 & 0 & \cdot & \cdot & 0 \\ 0 & \cdot & \cdot & & \cdot & \cdot \\ 1 & 0 & \cdot & \cdot & \cdot & 0 \\ 0 & \cdot & & \cdot & & \cdot \end{bmatrix}_{514 \times 514}$$