Q5)

Ans Mean filter = $(2a+1) \times (2a+1)$

(Here)

$$M = \frac{1}{(2a+1)^2} \begin{bmatrix} 1 & 1 & 1 & \cdots & 1 \\ 1 & 1 & 1 & \cdots & 1 \\ \vdots & \vdots & \vdots & & \vdots \\ 1 & 1 & 1 & \cdots & 1 \end{bmatrix}_{(2a+1)\times(2a+1)}$$

$$\frac{1}{(2a+1)} \begin{bmatrix} 1 \\ 1 \\ \vdots \\ 1 \end{bmatrix} * \frac{1}{(2a+1)} \begin{bmatrix} 1 & 1 & \cdots & 1 \end{bmatrix}$$

$$f_c = (\underbrace{M(M(M \cdots (M * f)))}_{K \text{ times}})$$

$$f_c = (\underbrace{M * M * M \cdots M}_{K \text{ times}}) * f \quad \{\text{convolution is associative}\}$$

$$M_2 = \frac{1}{(2a+1)^4} \begin{bmatrix} 1 & 1 & 1 & \cdots & 1 \\ 1 & 1 & 1 & \cdots & 1 \\ \vdots & \vdots & \vdots & & \vdots \\ 1 & 1 & 1 & \cdots & 1 \end{bmatrix}$$

$$M_K = \frac{1}{(2a+1)^{2K}} * f \Rightarrow \boxed{M_K = \frac{1}{(2a+1)^{2K}}}$$

Yes it can be represent as a mean kernel with different quantity ($1/(2a+1)^{2K}$) as a multiplication.

↳ here M_K ~~should~~ is coefficient of each element of the matrix kernel.

↳ So, Kernel will be $(M)^K$, where M is given mean filter.