$$f_{XY}(x,y)=\begin{cases}k \text{ if } x\in[a,b] \ \& \ y\in[a,b]\\ 0 \qquad o.w.\end{cases}$$

1) $$\int_{-\infty}^{\infty}dx\int_{-\infty}^{\infty}dy\, f_{XY}(x,y)=1 \overset{iif}{\Longleftrightarrow} \int_a^b dx\int_a^b dy\, k=1 \Leftrightarrow \int_a^b dx\,[ky]_{y=a}^{y=b}=1$$

$$\Longleftrightarrow \int_a^b dx\, k(b-a)=1 \Leftrightarrow k(b-a)[x]_a^b=1$$

$$\Longleftrightarrow k(b-a)(b-a)=1 \Leftrightarrow k=\frac{1}{(b-a)^2}$$

2) $$m_X=\int_{-\infty}^{\infty}dx\int_{-\infty}^{\infty}dy\, x f(x,y)=\int_a^b dx\int_a^b dy\,\frac{x}{(b-a)^2}=\frac{1}{(b-a)^2}\int_a^b dx\,[xy]_{y=a}^{y=b}$$

$$=\frac{1}{(b-a)^2}\int_a^b dx\, x\cancel{(b-a)}=\frac{1}{(b-a)}\left[\frac{x^2}{2}\right]_a^b=\frac{1}{2}\frac{b^2-a^2}{(b-a)}=\frac{1}{2}\frac{(a+b)\cancel{(a-b)}}{\cancel{(a-b)}}$$

$$\boxed{m_X=\frac{a+b}{2}}$$

3) $$E[X^2]=\int_{-\infty}^{\infty}dx\int_{-\infty}^{\infty}dy\, x^2 f(x,y)=\int_a^b dx\int_a^b dy\,\frac{x^2}{(b-a)^2}=\frac{1}{(b-a)^2}\int_a^b dx\,[x^2y]_{y=a}^{y=b}$$

$$=\frac{\cancel{(b-a)}}{(b-a)^2}\left[\frac{x^3}{3}\right]_{x=a}^{x=b}=\frac{1}{(b-a)}\frac{(a^3-b^3)}{3}=\frac{(a-b)(a^2+ab+b^2)}{3(a-b)}$$

$$E[X^2]=\frac{a^2+ab+b^2}{3}$$

$$var_X=E[X^2]-m_X^2=\frac{a^2}{3}+\frac{ab}{3}+\frac{b^2}{3}-\frac{(a+b)^2}{4}=\frac{a^2}{3}+\frac{ab}{3}+\frac{b^2}{3}-\frac{a^2}{4}-\frac{ab}{2}-\frac{b^2}{4}$$

$$=\frac{a^2}{12}-\frac{ab}{6}+\frac{b^2}{12}=\frac{a^2-2ab+b^2}{12}=\frac{(b-a)^2}{12}$$

$$\boxed{Var_X=\frac{(b-a)^2}{12}}$$

4) $E[Y] = \int_a^b dx \int_a^b dy \frac{y}{(b-a)^2} = \int_a^b dx \frac{[y^2/2]_a^b}{(b-a)^2} = \frac{a+b}{2(b-a)}[x]_a^b = \frac{a+b}{2}$

5) $E[XY] = \int_a^b dx \int_a^b dy \frac{xy}{(b-a)^2} = \int_a^b dx \frac{[x\frac{y^2}{2}]_{y=a}^{y=b}}{(b-a)^2} = \frac{(a+b)}{2(b-a)}\left[\frac{x^2}{2}\right]_a^b = \frac{(a+b)^2}{4}$

$cov[XY] = E[XY] - E[X]E[Y] = \frac{(a+b)^2}{4} - \frac{(a+b)}{2}\frac{(a+b)}{2} = 0$

$\boxed{cov[XY] = 0}$