Interchange the roles of $i$ and $r$ in the second summation

$$\sum_{i=1}^{n}\sum_{r=1}^{n} \bar{x}_i \bar{m}_{ir} y_r = \sum_{i=1}\sum_{r=1} y_r m_{ri} \bar{x}_i = \sum_{i=1}\sum_{r=1} \bar{x}_i m_{ri} y_r$$

then $\sum_{i=1}\sum_{r=1} (\bar{x}_i \bar{m}_{ir} y_r - \bar{x}_i m_{ri} y_r) = 0$

$$\therefore \sum_{i=1}\sum_{r=1} \bar{x}_i (\bar{m}_{ir} - m_{ri}) y_r = 0 \quad (1)$$

For this summation to be true for each $i, r$ we must have $\bar{m}_{ir} = m_{ri}$ (take $x_i = (0\,0\,0 \ldots 1, 0\,0 \ldots 0)$
$i$th place

$y_r = (0, 0 \ldots . 1, 0, 0, \ldots 0)^T$
$r$th place

then if $\bar{m}_{ir} \neq m_{ri}$, $(1) \neq 0$), but then $M = M^+$ ie $M$ is Hermitian.

v) $\{x, x\} = x M x^+$

$M x^+ = (\sum_{j=1}^{n} m_{ij} \bar{x}_j)^T$

$$x M x^+ = \sum_{i=1}^{n}\sum_{j=1}^{n} x_i m_{ij} \bar{x}_j \quad (1)$$

If $x M x^+$ is real, so is $(x M x^+)^T$
$= x M^+ x^+$

$M^+ x^+ = (\sum_{j=1}^{n} \bar{m}_{ji} \bar{x}_j)$

$$x M^+ x^+ = \sum_{i=1}\sum_{j=1} x_i \bar{m}_{ji} \bar{x}_j \quad (2)$$

Equating (1) and (2)