One of the fundamental problem in the spectral theory (or functional analysis) can be stated as: *find self-adjoint extensions of a densely defined closed symmetric operator*. We present our recent results concerning a solution of this problem in connection with the (time reversed) discrete symplectic system

$$z_k(\lambda) = \mathbb{S}_k(\lambda)\, z_{k+1}(\lambda), \qquad \mathbb{S}_k(\lambda) := \mathcal{S}_k + \lambda \mathcal{V}_k, \tag{S$_\lambda$}$$

where $\lambda \in \mathbb{C}$ is the spectral parameter and the $2n \times 2n$ complex-valued matrices $\mathcal{S}_k$ and $\mathcal{V}_k$ are such that

$$\mathcal{S}_k^* \mathcal{J} \mathcal{S}_k = \mathcal{J}, \;\; \mathcal{V}_k^* \mathcal{J} \mathcal{S}_k \text{ is Hermitian}, \;\; \mathcal{V}_k^* \mathcal{J} \mathcal{V}_k = 0, \;\; \Psi_k := \mathcal{J} \mathcal{S}_k \mathcal{J} \mathcal{V}_k^* \mathcal{J} \geq 0$$

with the skew-symmetric $2n \times 2n$ matrix $\mathcal{J} := \left(\begin{smallmatrix} 0 & I \\ -I & 0 \end{smallmatrix}\right)$, the superscript $*$ denoting the conjugate transpose, and k belonging to a discrete interval $\mathcal{I}$, which is finite or unbounded above. In contrast to the classical case, it is worth noticing that system (S$_\lambda$) does not produce a densely defined operator and so we need to employ the theory of linear relations. In addition, we discuss also the theory of square summable solutions of system (S$_\lambda$), i.e., solutions of (S$_\lambda$) satisfying $\sum_{k \in \mathcal{I}} z_k^*(\lambda)\, \Psi_k\, z_k(\lambda) < \infty$, which are utilized in the given characterization.