We introduce some special operator classes and study in terms of Berezin symbols their properties. In particular, we give some characterizations of compact operators and Schatten-von Neumann class operators in terms of Berezin symbols. We also consider some classes of compact operators on a Hilbert space $H$, which are generalizations of the well known Schatten-von Neumann classes of compact operators. Namely, for any number $p$, $0 < p < \infty$, and the sequence $w := (w_n)_{n \geq 0}$ of complex numbers $w_n$, $n \geq 0$, we define the following classes of compact operators on $H$:

$$S_p^w(H) = \{ KS_\infty(H) : \sum_{n=0}^{\infty} (s_n(K))^{p} w_n^{p} \text{ is convergent series} \},$$

where $s_n(K)$ denotes the $n$th singular number of the operator $K$. The characterizations of these classes are given in terms of Berezin symbols.