In this paper, by using the Orlicz function, we introduce the paranormed sequence space $C_2(s)$ which is the generalization of the space $C_2(s_p)$ of all absolutely $p$-summable $C_2$-double sequences. Some topological properties of the space $C_2(s)$ are examined and determine its $\alpha$-, $\beta$- and $\gamma$-duals. Also, some classes of bicomplex matrix transformations are characterized from the space $C_2(s)$ into other spaces of double sequences. (Received September 12, 2019)