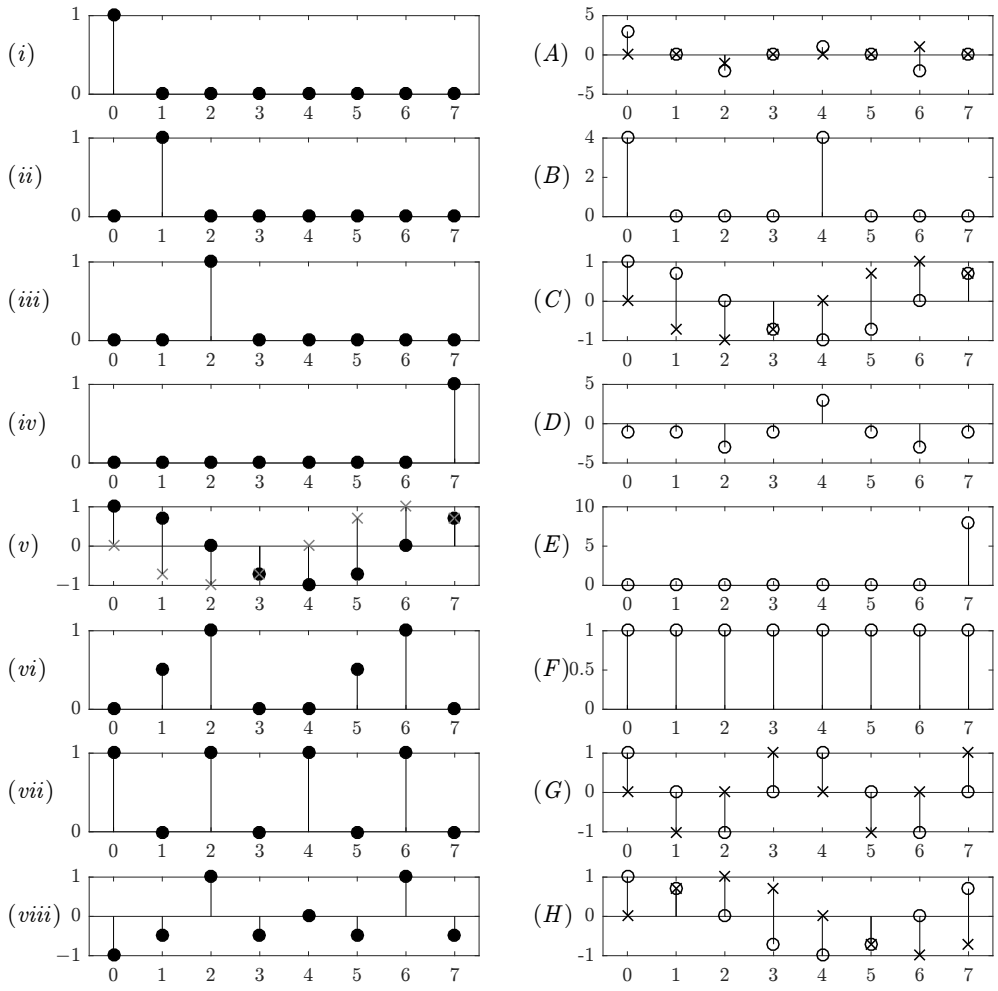
6 Digital Signal Processing (MGK)

(*a*) Figures (*i*)–(*viii*) show eight different input vectors $x \in \mathbb{C}^8$. For each, identify one of figures (*A*)–(*H*) that shows the DFT output $X \in \mathbb{C}^8$ with $X_k = \sum_{n=0}^{7} x_n \cdot \mathrm{e}^{-2\pi \mathrm{j} kn/8}$.

Briefly explain each choice. Real components are shown as circles. For non-real vectors, the imaginary components are shown in addition as crosses. [8 marks]



(*b*) Are these statements true or false? Explain your answers. [3 marks each]

(*i*) The system $y_n = x_n + y_{n-1}$ has an impulse response with z-transform $\frac{1}{1+z}$.

(*ii*) A continuous signal can *only* be reconstructed after sampling if the sampling frequency is larger than twice the highest frequency in the signal.

(*iii*) Convolution of a signal with a triangular window function causes its power spectrum to be multiplied with a sinc^3 function.

(*iv*) To convert the z-transform $H(z)$ of the impulse response of any LTI filter into the z-transform of its step response, divide $H(z)$ by $1 - z^{-1}$.