1.1

(i)

a) Construct a 2n × 2n matrix which is circulant and whose left-upper n × n submatrix is the matrix T, and denote the 2n × 2n matrix as $T'$.

b) Construct a 2n × 1 vector whose upper n × 1 subvector is the vector y, the below n× 1 subvector is all consist of 1, and denote the 2n × 1 vector as $y'$.

c) Calculate the Fourier transform of T $'y'$,

$$\mathcal{F}_k(t')\mathcal{F}_k(y') \quad \text{for } k = 0,1,\dots,2n-1$$

where t′= $(t'_0, t'_1, t'_2, \dots, t'_{2n-1})$ is the first column of the circulant matrix T $'$.

In MATLAB, use fft$(T'(:,1))$.∗ fft$(y')$ and denote the result as zfft.

d) Calculate the inverse Fourier transform of zfft: in MATLAB, use ifft(zfft), denote as z.

e) The answer of $Ty$ is Pre n element of z: in MATLAB, z(1: n, 1).