After the Euler form of cosine and sinus function, transformations will be,

The 3 Fourier transforms are k dependent.

Then as we can see here, the cosine and sinus transformation can be rewritten as follow,

In above, I put fhat into the f.

The floor function is used here.

Put all them together in eqn. (2.3.1)

or

In our question domain of f between 0 to T, so we can rearrange above as follow.

And as we know the sin and cos functions are

The T must be .