1. Prove the following DFT properties:

- the periodicity property for the DFT $X(k)$ and the IDFT $x(n)$
- the linearity property

2. Define the **minimum** sampling frequency of the digital signal that has the following frequency range: (a) 1-200Hz, (b) 20-200Hz (c) 190-200Hz Define the **required** sampling frequency, if the attenuation of anti-aliasing filter in the transition band is 80dB/oct.

3. Estimate the frequency resolution of the following PSD estimations: the sampling frequency of a discrete time signal is 200 Hz and the number of samples are: a) 20; b) 200; c) 2000; d) 20000

4. Verify the resolution condition for resolving two discrete sin signals with central frequencies a)15 Hz and 16 Hz; b) 35Hz and 37Hz; c) 175Hz and 179Hz; and frequency resolutions from Task 3.

5. The sampling frequency of a discrete time signal is 200 Hz and the number of samples are 2000. Estimate the frequency resolutions for using the Bartlett method with division by K sub-segments: a) K=2 b) K=4 c) K=8