EEE328
Digital Signal Processing

Ankara University

Faculty of Engineering

Electrical and Electronics Engineering Department

Frequency Domain Representation of Discrete-Time Signals & Systems

EEE328 Digital Signal Processing

Lecture 5

Agenda

- Frequency Domain by Fourier Transform
- Eigenfunctions for LTI Systems
- Ideal Filters

Discrete-Time Fourier Transform (D-T FT)

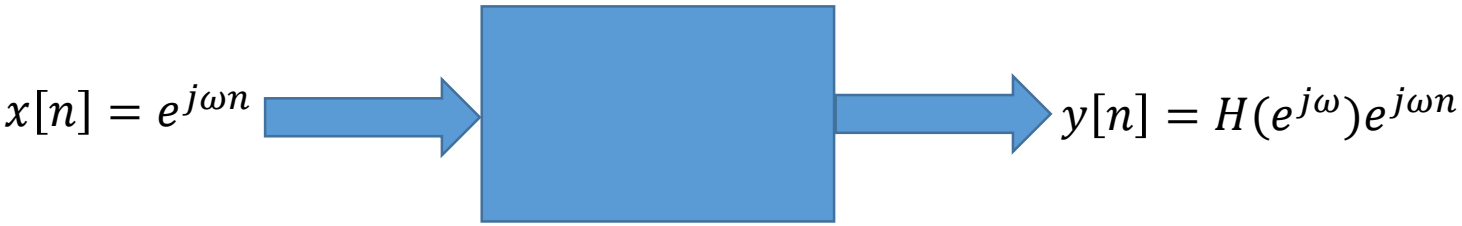
$$X(e^{j\omega}) = \sum_{n=-\infty}^{\infty} x[n]e^{-j\omega n}$$

D-T FT

$$x[n] = \frac{1}{2\pi}\int_{2\pi} X(e^{j\omega})e^{j\omega n}d\omega$$

D-T Inverse FT

Eigenfunction and Eigenvalue



$$y[n] = \sum_{k=-\infty}^{\infty} h[k]e^{-j\omega(n-k)}$$

$$y[n] = e^{j\omega n}\sum_{k=-\infty}^{\infty} h[k]e^{-j\omega k}$$

$$H(e^{j\omega}) = \sum_{k=-\infty}^{\infty} h[k]e^{-j\omega k}$$

$$y[n] = H(e^{j\omega})e^{j\omega n}$$

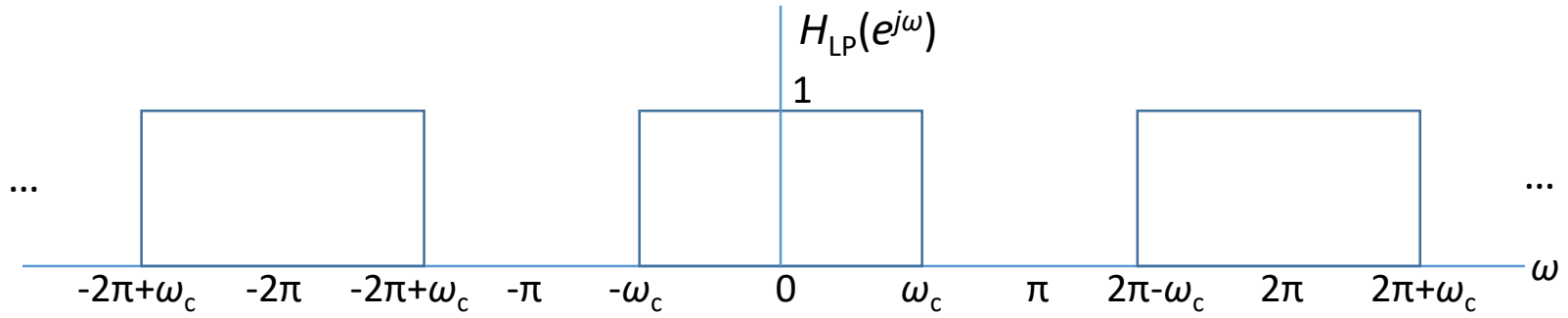
$$H(e^{j\omega}) = H_R(e^{j\omega}) + jH_I(e^{j\omega})$$

$H_R(e^{j\omega})$: Real Part

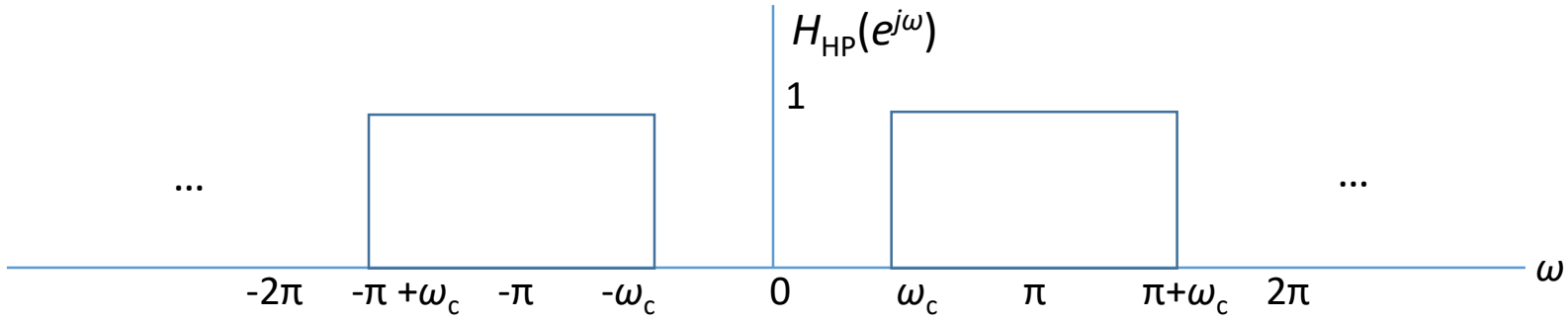
$H_I(e^{j\omega})$: Imaginary Part

$$H(e^{j\omega}) = |H(e^{j\omega})|e^{j\sphericalangle H(e^{j\omega})}$$

Ideal Frequency Selective Filters

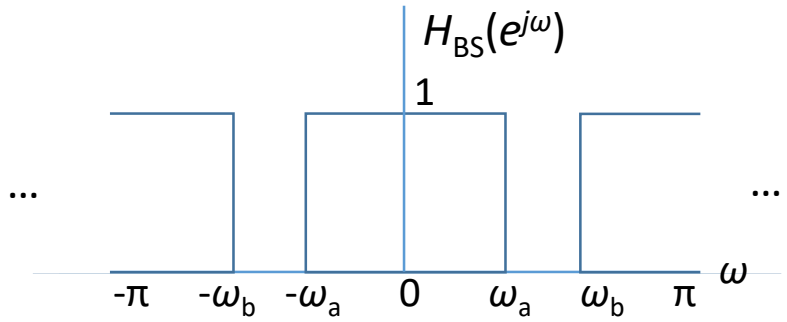


Ideal Low-Pass Filter

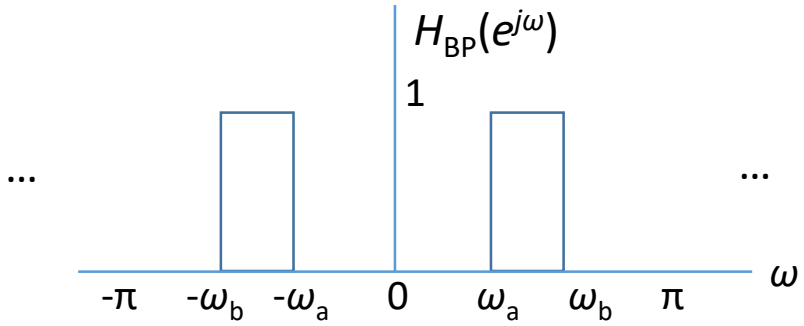


Ideal High-Pass Filter

Ideal Frequency Selective Filters



Ideal Band-Stop Filter



Ideal Band-Pass Filter

References

- Signals & Systems, Second Edition, A. V. Oppenheim, A. S. Willsky with S. H. Nawab, Prentice Hall, 1997
- Discrete-Time Signal Processing, Second Edition, A. V. Oppenheim, R. W. Schafer with J. R. Buck, Prentice Hall, 1999