* DT signals are very different from CT signals:

Ex: Compute the fund. period of

$x_1[n] = e^{j(3\pi n)}$ or $x_2[n] = \cos(3\pi n)$

Ans:

Ex: Q: Is e^{jn} periodic?

A:

Note Title 9/9/2014

* The fundamental period of a DT signal is always an integer.

* The fund. freq. of DT signal is always $\frac{2\pi}{\text{fund. period}} = \frac{2\pi}{\text{integer}}$

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* DT. Harmonically Related Complex Exponentia

Consider a DT fund. freq $\omega_d = \frac{2\pi}{N_d}$

The DT HRCE is

$x_k[n] =$

Q: How many distinct DT HRCEs can we have?

Ans:

$$
\begin{array}{cccc}
\vdots & \vdots & & \vdots \\
\Rightarrow e^{j(\quad)\frac{2\pi}{N}n}, & e^{j(\quad)\frac{2\pi}{N}n}, & \cdots & e^{j(\quad)\frac{2\pi}{N}n}, \\
e^{j(\quad)\frac{2\pi}{N}n}, & e^{j(\quad)\frac{2\pi}{N}n}, & \cdots & e^{j(\quad)\frac{2\pi}{N}n}, \\
e^{j(\quad)\frac{2\pi}{N}n}, & e^{j(\quad)\frac{2\pi}{N}n}, & \cdots & e^{j(\quad)\frac{2\pi}{N}n}, \\
\vdots & \vdots & & \vdots
\end{array}
$$

This is a major difference between CT & DT signals.

Q: Why are we interested in HRCEs.

A: Recall that we are interested in linear systems.

$$\begin{tikzcd} x_1, \cdots, x_k \arrow[d, "\text{linear sys.}"] & x \arrow[r] \arrow[d] & x = \alpha_1 x_1 + \cdots + \alpha_k x_k \arrow[dl] \\ y_1, \cdots, y_k & y & y = \alpha_1 y_1 + \cdots + \alpha_k y_k \end{tikzcd}$$

* We use HRCEs as our test signals.

CT HRCE

Test sig. $x_k(t) =$

New $x(t) =$

DT HRCE

Test sig. $x_k[n] =$

New $x[n] =$