Digital Signal processing & Its Applications
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Lecture – 13 c
Example of Z Transform

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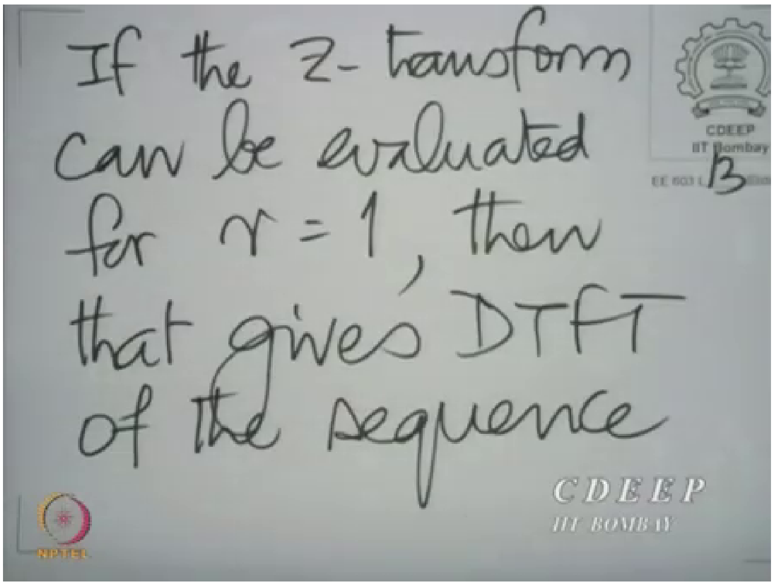

Right. Let us take an example. Suppose we take this tiger once again.

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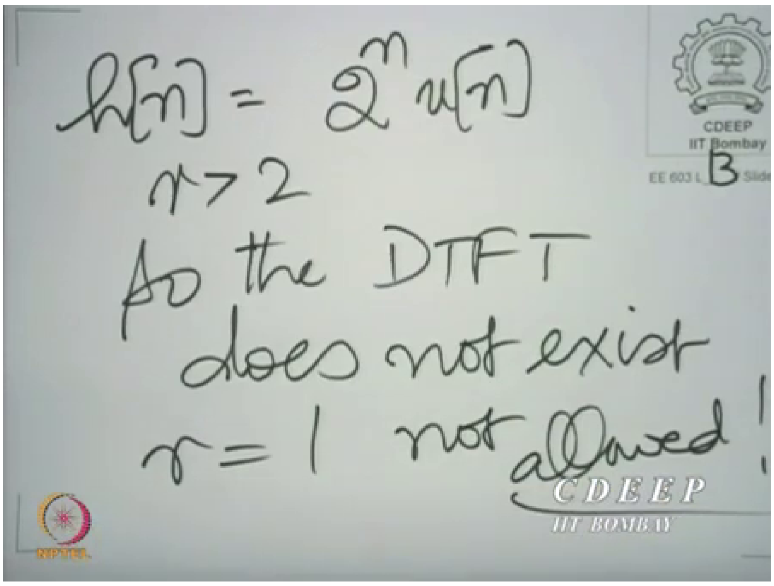

$2^n u[n]$. Of course, we need $r \geq 2$ so the DTFT cannot be evaluated, if DTFT does not exist. Because, $r = 1$ not allowed. But, of course we can always take any another example $h[n]$is $\left(\frac{1}{2}\right)^n u[n]$.

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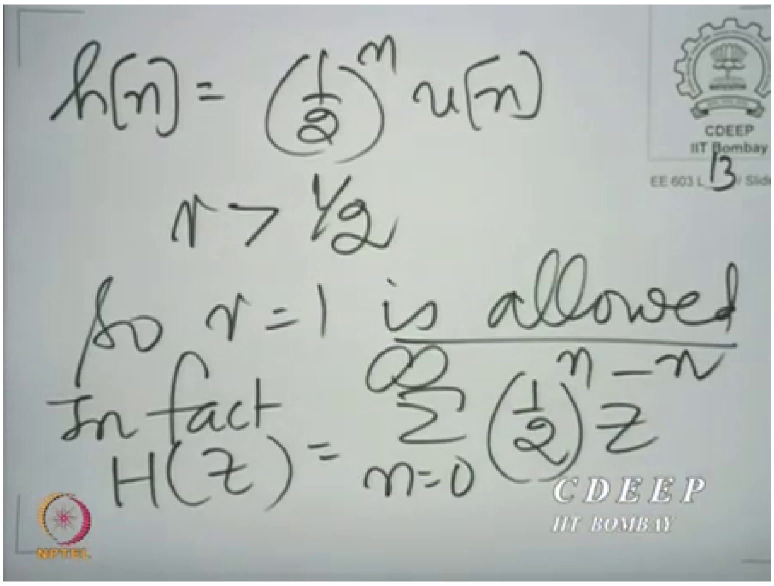

And indeed in this case *r* needs to be greater than $\frac{1}{2}$, so $r = 1$ is allowed. And therefore the DTFT exists. In fact, $H(z)$ which is $\sum_{n=0}^{\infty} \left(\frac{1}{2}\right)^n z^{-n}$ which is the Z-transform of $h[n]$ can be evaluated for $r = 1$, right? So, this is Z-transform.

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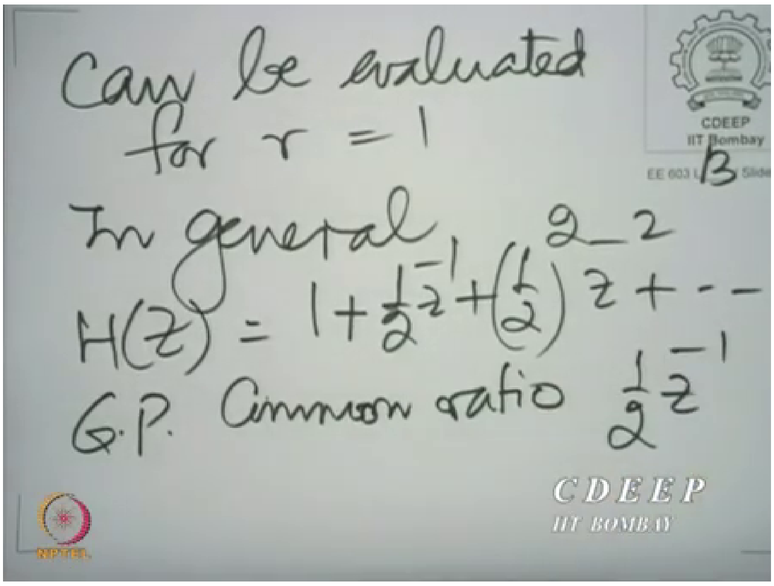
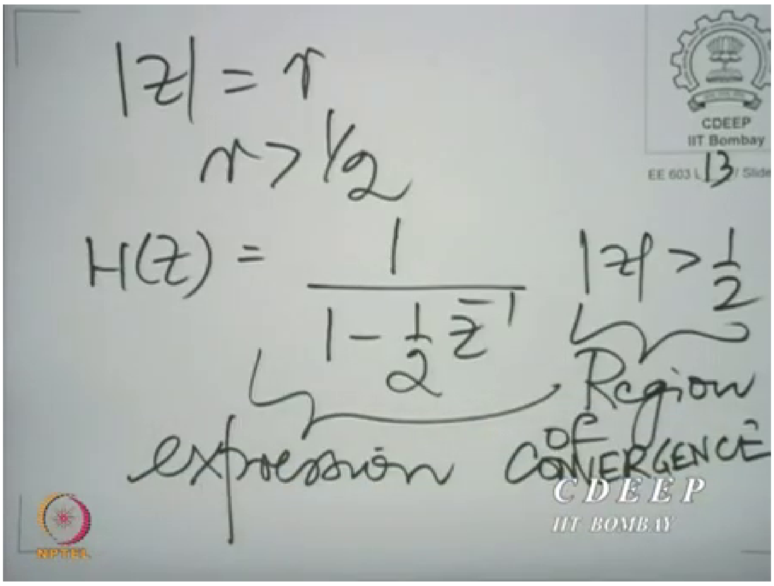


And this can be evaluated. In general of course $H(z) \; = \; 1 + \left(\frac{1}{2}\right)z^{-1} + \left(\frac{1}{2}\right)^{2}z^{-2} \; + \ldots$ it is a geometric progression with common ratio $\left(\frac{1}{2}\right)z^{-1}$. And therefore the sum is of course easy to evaluate now you know obviously the GP converges if $|\left(\frac{1}{2}\right)z^{-1}|$ is less than 1. Which means |z| is greater than $\left(\frac{1}{2}\right)$ or its the same thing as saying r is greater than $\left(\frac{1}{2}\right)$.

|Z| is equal to r by definition. So, we have |Z|. (Refer Slide Time: 03:13)



Is equal to r so we need r to be greater than $\left(\frac{1}{2}\right)$. And of course this $H(z)$ can be written as $\left(\frac{1}{1-\left(\frac{1}{2}\right)z^{-1}}\right)$, $|z| > \left(\frac{1}{2}\right)$. Notice a Z-transform always has an expression and a region of convergence. A Z-transform is incomplete without any of these two. I shall shortly illustrate that if we did not specify the region of convergence here there would be an ambiguity in the sequence.