

*The Z-transform*  
*The Discrete Fourier Transform (DFT)*  
*The Laplace Transform*  
*The Fourier Transform*

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I. Compute the Z-transforms of the following signals:

- 1)  $x(n) = \frac{4n^2+1}{(n+2)!}$ .
- 2)  $x(n) = 2^n \cos\left(\frac{n\pi}{6}\right)$ .
- 3)  $x(n) = [\sigma(n-3) - \sigma(n-1)] 2^n$ .
- 4)  $x(n) = \frac{1}{(n+2)(n+3)(n+4)(n+5)}$ .
- 5)  $x(n) = 5\frac{n^2}{5^n} + \frac{n}{2^n}$ .
- 6)  $x(n) = \sum_{k=1}^n k 2^k \cos^2 k$ .

II. Compute the DFT of the following transforms:

- 7)  $x(n) = 7\binom{N-1}{n}, n = \overline{0, N-1}$ .
- 8)  $x(n) = 5\delta(n) + 7n, n = \overline{0, N-1}$ .
- 9)  $x(n) = 5^n + 1, n = \overline{0, N-1}$ .

III. For the given Z-transform  $X(z)$ , find the signal  $x(n)$ :

- 10)  $X(z) = \frac{z}{(z-1)^4}$ .
- 11)  $X(z) = \frac{z}{z+1}$ .
- 12)  $X(z) = \frac{5z}{(z-2)^2(z-3)}$ .
- 13)  $X(z) = \frac{5z-4z^2+z^3-1}{z^5}$ .
- 14)  $X(z) = \frac{z}{z^2-3z+2} e^{2/z}$ .

IV. Compute the Laplace transform of the following functions:

- 15)  $f(t) = \sin 4t + [4t]$ .
- 16)  $f(t) = t \sin t + (1-t) \cos t - 1$ .
- 17)  $f(t) = \cos 4t \cos 5t$ .

18)  $f(t) = \frac{e^{5t}-1}{t}$ .

19)  $f(t) = \frac{\sin^2 4t}{t}$ .

20)  $f(t) = |\sin 2t|$ .

21)

$$f(t) = \begin{cases} e^{-t}, & t \in [0, 2) \\ t^2, & t \in [2, 4) \\ e^t, & t \in [4, \infty) \end{cases}$$

IV. Compute the Fourier transforms of the following functions:

22)  $f(x) = \frac{1}{x^2-8x+17}$ .

23)  $f(x) = e^{-4|x|} \cos(5x)$ .

24)  $f(x) = e^{-|x|}(x^4 + x^5)$ .

25)  $f(x) = \frac{1}{(x^2+36)^2}$ .

V. Compute the Fourier transforms of the following functions:

26)  $f(x) = e^{-2x} \sigma(x)$ .

27)  $f(x) = e^{-|5x|} \cos(5x)$ .

28)  $f(x) = \frac{1}{25x^2+25}$ .

29)  $f(x) = \frac{1}{(25x^2+25)^2}$ .

30)  $f(x) = \frac{1}{(2x^2+4x+6)^2}$ .