DAILY ASSESSMENT FORMAT

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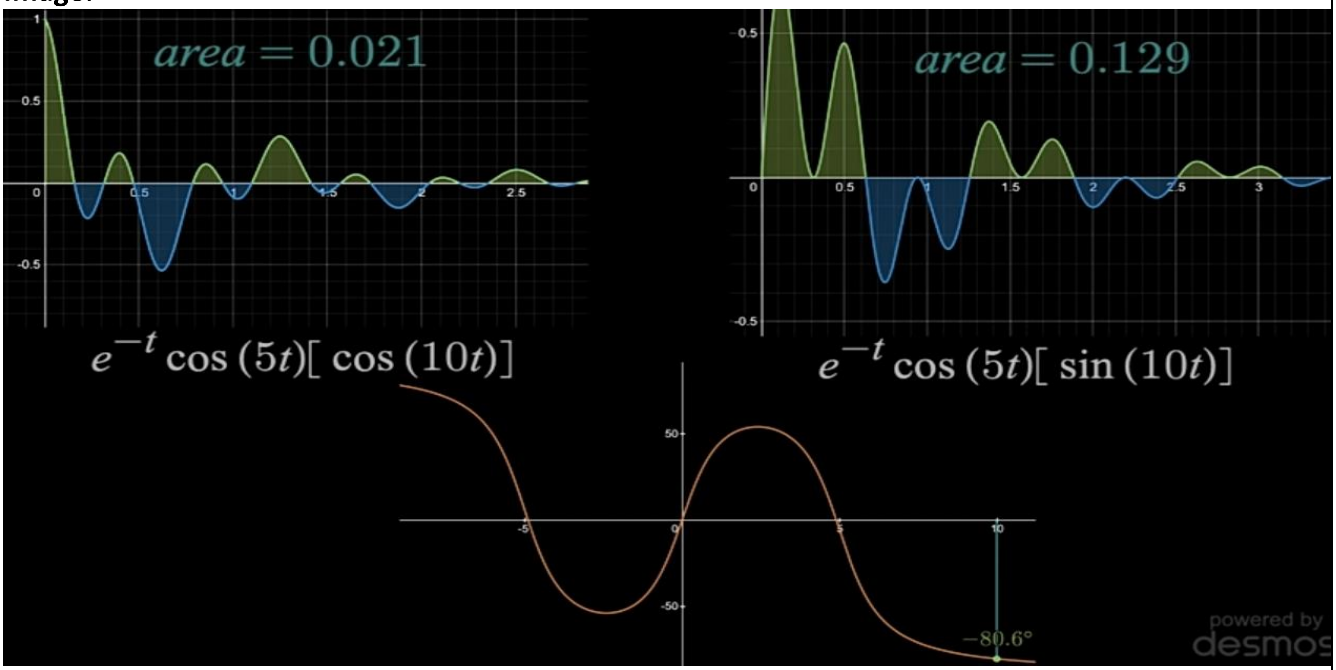
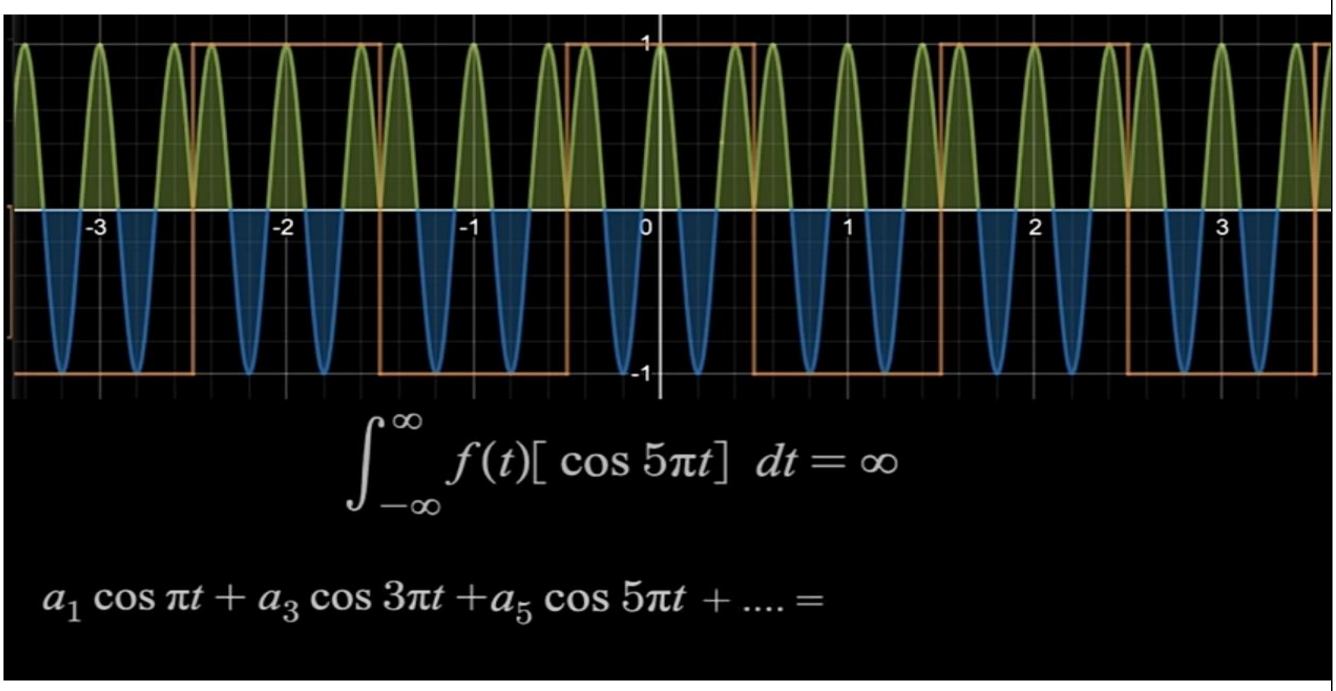
Course:	Coursera	**USN:**	4AL16EC077
Topic:	Digital Signal Processing	**Semester & Section:**	8th - B

Image:





Report:

The problem:

Given the Fourier transform of a general function, find the Fourier transform of its derivative. Use this result to find the Fourier transform of a window function out of the Fourier transform of an antisymmetric pair of delta functions.

The solution:

We are given the following:

F.T[f(t)] = F(ω),

and we take into account that:

lim t→±∞ f(t) → 0.

We begin by writing explicitly:

F.T[f 0 (t)] = Z ∞ −∞ f 0 (t)eiωtdt.

Integration by parts gives us:

f(t)eiωt| +∞ −∞ − iω Z ∞ −∞ f(t)eiωtdt = −iωF(ω),

and we get:

F.T[f 0 (t)] = −iωF(ω).

Let us represent a window function in the region [−a, a] as a sum of two step functions:

Π(t) = Θ(t + a) − Θ(t − a).

We also note that δ(t + a) = d dtΘ(t + a).

Now, using what we have derived earlier we find:

F.T[δ(t + a) − δ(t − a)] = F.T[d dtΘ(t + a) − d dtΘ(t − a)] = −iωF.T[Θ(t + a) − Θ(t − a)] = −iωF.T[Π(t)], and,

F.T[δ(t + a) − δ(t − a)] = Z ∞ −∞ δ(t + a)eiωtdt − Z ∞ −∞ δ(t − a)eiωtdt = e−iωa − e iωa = −2isin(ωa).

⇒ F.T[Π(t)] = 2asinc(ωa)

In the remainder of the course, we'll study several methods that depend on analysis of images or reconstruction of structure from images:

- Light microscopy (particularly fluorescence microscopy)
- Electron microscopy (particularly for single-particle reconstruction)
- X-ray crystallography

The computational aspects of each of these methods involve Fourier transforms and convolution. These concepts are also important for:

- Some approaches to ligand docking (and protein-protein docking)
- Fast evaluation of electrostatic interactions in molecular dynamics
- (You're not responsible for these additional applications)

Calculate the Laplace Transform using Matlab Calculating the Laplace F(s) transform of a function f(t) is quite simple in Matlab.

First you need to specify that the variable t and s are symbolic ones. This is done with the command

>> syms t s Next you define the function f(t).

The actual command to calculate the transform is >> F=laplace(f,t,s) To make the expression more readable one can use the commands, simplify and pretty. here is an example for the function

f(t), t t tf ete 2 2 25.15.325.1)

```
>> syms t s
>> f=-1.25+3.5*t*exp(-2*t)+1.25*exp(-2*t);
>> F=laplace(f,t,s)
F =
-5/4/s+7/2/(s+2)^2+5/4/(s+2)
>> simplify(F)
ans =
(s-5)/s/(s+2)^2
>> pretty(ans)
s - 5 ---------- 2 s (s + 2)
```

which corresponds to

F(s), 2)2( )5( )(+ − = ss s sF

Alternatively, one can write the function f(t) directly as part of the laplace command:

```
>>F2=laplace(-1.25+3.5*t*exp(-2*t)+1.25*exp(-2*t))
```