**DAILY ASSESSMENT FORMAT**

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| **Date:** | 27 May 2020 | **Name:** | Rasika Patil |
| **Course:** | DSP | **USN:** | 4AL16EC057 |
| **Topic:** | 1. Fourier Series & Gibbs Phenomena using Python 2. Fourier Transform 3. Fourier Transform Derivatives 4. Fourier Transform and Convolution | **Semester & Section:** | 8th B |
| **Github Repository:** | Rasika B Patil |  |  |

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| **FORENOON SESSION DETAILS** |
| **Image of session**    C:\Users\User\Downloads\WhatsApp Image 2020-05-27 at 6.42.42 PM.jpeg\  **C:\Users\User\Downloads\WhatsApp Image 2020-05-27 at 6.42.42 PM (1).jpeg** |
| **Report – Report can be typed or hand written for up to two pages.**  **FOURIER SERIES & GIBBS PHENOMENA USING PYTHON**  In [mathematics](https://en.wikipedia.org/wiki/Mathematics), the Gibbs phenomenon, discovered by [Henry Wilbraham](https://en.wikipedia.org/wiki/Henry_Wilbraham) ([1848](https://en.wikipedia.org/wiki/Gibbs_phenomenon#CITEREFWilbraham1848)) and rediscovered by [J. Willard Gibbs](https://en.wikipedia.org/wiki/Willard_Gibbs) ([1899](https://en.wikipedia.org/wiki/Gibbs_phenomenon#CITEREFGibbs1899)) is the peculiar manner in which the [Fourier series](https://en.wikipedia.org/wiki/Fourier_series) of a [piecewise](https://en.wikipedia.org/wiki/Piecewise) continuously differentiable [periodic function](https://en.wikipedia.org/wiki/Periodic_function) behaves at a [jump discontinuity](https://en.wikipedia.org/wiki/Jump_discontinuity). The *n*th [partial sum](https://en.wikipedia.org/wiki/Partial_sum) of the Fourier series has large oscillations near the jump, which might increase the maximum of the partial sum above that of the function itself. The overshoot does not die out as *n* increases, but approaches a finite limit. This sort of behavior was also observed by experimental physicists, but was believed to be due to imperfections in the measuring apparatus. The Gibbs phenomenon involves both the fact that Fourier sums overshoot at a jump discontinuity, and that this overshoot does not die out as more terms are added to the sum. The three pictures on the right demonstrate the phenomenon for a square wave (of height {\displaystyle \pi /4}\pi /4) whose Fourier expansion is As can be seen, as the number of terms rises, the error of the approximation is reduced in width and energy, but converges to a fixed height. A calculation for the square wave (see Zygmund, chap. 8.5., or the computations at the end of this article) gives an explicit formula for the limit of the height of the error. It turns out that the Fourier series exceeds the height {\displaystyle \pi /4}\pi /4 of the square wave by about 9 percent of the jump. More generally, at any jump point of a piecewise continuously differentiable function with a jump of a, the nth partial Fourier series will (for n very large) overshoot this jump by approximately at one end and undershoot it by the same amount at the other end; thus the "jump" in the partial Fourier series will be about 18% larger than the jump in the original function. At the location of the discontinuity itself, the partial Fourier series will converge to the midpoint of the jump (regardless of what the actual value of the original function is at this point).  **FOURIER TRANSFORM DERIVATIVES AND CONVOLUTION**  C:\Users\User\Downloads\WhatsApp Image 2020-05-27 at 6.42.42 PM (2).jpeg  C:\Users\User\Downloads\WhatsApp Image 2020-05-27 at 6.42.43 PM.jpeg  We’re given an array of numerical values – We can think of this array as specifying values of a function at regularly spaced intervals • To compute a moving average, we replace each value in the array with the average of several values that precede and follow it (i.e., the values within a window) • We might choose instead to calculate a weighted moving average, where we again replace each value in the array with the average of several surrounding values, but we weight those values differently • We can express this as a convolution of the original function (i.e., array) with another function (array) that specifies the weights on each value in the window If f and g are functions defined at evenly spaced points, their convolution is given by: ( f ∗ g)[n] = f [m] m=−∞ ∞ ∑ g[n − m]  **Two-dimensional convolution** • In two-dimensional convolution, we replace each value in a two-dimensional array with a weighted average of the values surrounding it in two dimensions – We can represent two-dimensional arrays as functions of two variables, or as matrices, or as images  **Multidimensional convolution •** The concept generalizes to higher dimensions • For example, in three-dimensional convolution, we replace each value in a three-dimensional array with a weighted average of the values surrounding it in three dimensions |

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