Abstract

Let $\mathbf{U}$ be the set of all functions from $[0, \infty)^n$ to $\mathbb{R}$ and $\mathbf{V}$ be the set of all functions from $S \subseteq \mathbb{C}^n$ to $\mathbb{C}$.Then the n^{th} dimensional Laplace transform is the mapping

$$L^n : \mathbf{U} \rightarrow \mathbf{V}$$

defined by:

$$f(\tilde{\mathbf{s}}_\mathbf{n}) = L^n\{\mathbf{F}(\tilde{\mathbf{x}}_\mathbf{n}), \tilde{\mathbf{s}}_\mathbf{n}\} = \widetilde{\int_\mathbf{R}} \mathbf{F}(\tilde{\mathbf{x}}_\mathbf{n})\mathbf{e}^{-(\tilde{\mathbf{s}}_\mathbf{n} \cdot \tilde{\mathbf{x}}_\mathbf{n})}\mathbf{d}\tilde{\mathbf{x}}_\mathbf{n}$$

Where $\mathbf{F}(\tilde{\mathbf{x}}_\mathbf{n}) \in \mathbf{U}$ and $\tilde{\mathbf{s}}_\mathbf{n} \in \mathbb{C}^\mathbf{n}$

In this paper we gave alternative proof for some theorems on properties of n^{th} dimensional Laplace transform, we proved that if $\mathbf{F}(\tilde{\mathbf{x}}_\mathbf{n})$ is piecewise continuous on $[0, \infty)^n$ and function of exponential order $\tilde{\gamma}_\mathbf{n} = (\gamma_1, \gamma_2, ..., \gamma_n)$ then the n^{th} dimensional Laplace transform defined above exists, absolutely and uniformly convergent, analytic and infinitely differentiable on $Re(s_1) \; > \gamma_1, Re(s_2) \; > \gamma_2, ..., Re(s) \; > \gamma_n$, and we gave also some corollaries of these results.

We also derived the n^{th} dimensional Laplace transform of even and odd functions, homogeneous function, the n^{th} order mixed partial derivatives of a function, and multiple integral of a function.

Lastly we derived some special multiple integral identities and their n^{th} dimensional Laplace transform.