Int. Jr. of Mathematical Sciences & Applications
Vol. 8, No. 1, (January-June, 2018)
Copyright: Mind Reader Publications
ISSN No: 2230-9888
www.ijmsa.yolasite.com

On some generalized results of fractional derivatives I

$F.Y.\ AYANT$[1]

1 Teacher in High School , France
E-mail : fredericayant@gmail.com

ABSTRACT
The purpose of the present document is to derive a number of key formulas for fractional derivatives of modified multivariable H-function and generalized multivariable polynomials. Some of the applications of the key formulas provide potentially useful generalizations of know results in the theory of fractional calculus.

KEYWORDS : Modified multivariable H-function, general fractional derivative formulae, special function, general class of polynomials.

2010 Mathematics Subject Classification. 33C99, 33C60, 44A20

1. Introduction and preliminaries.

The object of this document is to study the fractional derivative formula from the modified multivariable H-function. The modified H-function defined by Prasad and Singh [5] generalizes the multivariable H-function defined by Srivastava and Panda [10]. It is defined in term of multiple Mellin-Barnes type integral :

$$H(z_1,\cdots,z_r) = H^{\mathbf{m},\mathbf{n}:|R':m_1,n_1;\cdots;m_r,n_r}_{\mathbf{p},\mathbf{q}:|R:p_1,q_1;\cdots,p_r,q_r}\left(\begin{array}{c|c} \mathrm{z}_1 & (\mathrm{a}_j;\alpha_j^{(1)},\cdots,\alpha_j^{(r)})_{1,\mathbf{p}}: \\ \cdot & \\ \cdot & \\ \cdot & \\ \mathrm{z}_r & (\mathrm{b}_j;\beta_j^{(1)},\cdots,\beta_j^{(r)})_{1,\mathbf{q}}: \end{array}\right.$$

$$\left.\begin{array}{c} (\mathrm{e}_j;u_j'g_j',\cdots,u_j^{(r)}g_j^{(r)})_{1,R'}:(c_j';\gamma_j')_{1,p_1},\cdots,(c_j^{(r)};\gamma_j^{(r)})_{1,p_r} \\ \\ (\mathrm{l}_j;U_j'f_j',\cdots,U_j^{(r)}f_j^{(r)})_{1,R}:(d_j';\delta_j')_{1,q_1},\cdots,(d_j^{(r)};\delta_j^{(r)})_{1,q_r} \end{array}\right) \tag{1.1}$$

$$=\frac{1}{(2\pi\omega)^r}\int_{L_1}\cdots\int_{L_r}\phi(s_1,\cdots,s_r)\prod_{i=1}^{r}\theta_i(s_i)z_i^{s_i}\mathrm{d}s_1\cdots\mathrm{d}s_r \tag{1.2}$$

where $\phi(s_1,\cdots,s_r),\theta_i(s_i), i=1,\cdots,r$ are given by :

$$\phi(s_1,\cdots,s_r)=\frac{\prod_{j=1}^{\mathbf{m}}\Gamma(b_j-\sum_{i=1}^{r}\beta_j^{(i)}s_i)\prod_{j=1}^{\mathbf{n}}\Gamma\left(1-a_j+\sum_{i=1}^{r}\alpha_j^{(i)}s_j\right)}{\prod_{j=\mathbf{n}+1}^{\mathbf{p}}\Gamma\left(a_j-\sum_{i=1}^{r}\alpha_j^{(i)}s_j\right)\prod_{j=\mathbf{m}+1}^{\mathbf{q}}\Gamma\left(1-b_j+\sum_{i=1}^{r}\beta_j^{(i)}s_j\right)}$$

$$\frac{\prod_{j=1}^{R'}\Gamma(e_j+\sum_{i=1}^{r}u_j^{(i)}g_j^{(i)}s_i)}{\prod_{j=1}^{R}\Gamma(l_j+\sum_{i=1}^{r}U_j^{(i)}f_j^{(i)}s_i)} \tag{1.3}$$

$$\phi_i(s_i) = \frac{\prod_{j=1}^{n_i}\Gamma\left(1-c_j^{(i)}+\gamma_j^{(i)}s_i\right)\prod_{j=1}^{m_i}\Gamma\left(d_j^{(i)}-\delta_j^{(i)}s_i\right)}{\prod_{j=n_i+1}^{p_i}\Gamma\left(c_j^{(i)}-\gamma_j^{(i)}s_i\right)\prod_{j=m_i+1}^{q_i}\Gamma\left(1-d_j^{(i)}+\delta_j^{(i)}s_i\right)} \tag{1.4}$$

The multiple integral (1.2) converges absolutely if

$$|argZ_k| < \frac{1}{2}U_i\pi \quad (i=1,\cdots,r) \tag{1.5}$$

$$U_i = \sum_{j=1}^{\mathbf{m}}\beta_j^{(i)} - \sum_{j=\mathbf{m}+1}^{\mathbf{q}}\beta_j^{(i)} + \sum_{j=1}^{\mathbf{n}}\alpha_j^{(i)} - \sum_{j=\mathbf{n}+1}^{\mathbf{p}}\alpha_j^{(i)} + \sum_{j=1}^{m_i}\delta_j^{(i)} - \sum_{j=1+m_i}^{q_i}\delta_j^{(i)}$$

$$+\sum_{j=1}^{n_i}\gamma_j^{(i)} - \sum_{j=n_i+1}^{p_i}\gamma_j^{(i)} + \sum_{j=1}^{R'}g_j^{(i)} - \sum_{j=1}^{R}f_j^{(i)} > 0 (i=1,\cdots,r) \tag{1.6}$$

In this paper, we shall note.

$$X = m_1,n_1;\cdots;m_r,n_r \quad : Y = p_1,q_1;\cdots;p_r,q_r \tag{1.7}$$

$$A = (a_j;\alpha_j^{(1)},\cdots,\alpha_j^{(r)})_{1,p} : (\mathrm{e}_j;u'_jg'_j,\cdots,u_j^{(r)}g_j^{(r)})_{1,R'} : (c'_j;\gamma'_j)_{1,p_1},\cdots,(c_j^{(r)};\gamma_j^{(r)})_{1,p_r} \tag{1.8}$$

$$B = (b_j;\beta_j^{(1)},\cdots,\beta_j^{(r)})_{1,q} : (l_j;U'_jf'_j,\cdots,U_j^{(r)}f_j^{(r)})_{1,R} : (d'_j;\delta'_j)_{1,q_1},\cdots,(d_j^{(r)};\delta_j^{(r)})_{1,q_r} \tag{1.9}$$

Srivastava and Garg introduced and defined a general class of multivariable polynomials [9] as follows

$$S_L^{h_1,\cdots,h_s}[z_1,\cdots,z_s] = \sum_{R_1,\cdots,R_s=0}^{h_1R_1+\cdots h_sR_s\leqslant L}(-L)_{h_1R_1+\cdots+h_sR_s}B(E;R_1,\cdots,R_s)\frac{z_1^{R_1}\cdots z_s^{R_s}}{R_1!\cdots R_s!} \tag{1.10}$$

The fractional derivative of a function f (x) of a complex order μ is defined by Oldham et al[4], (1974 , page 49) in the followin manner :

$${}_aD_x^{\mu}f(x) = \frac{1}{\Gamma(-\mu)}\int_a^x(x-y)^{-\mu-1}f(y)\,\mathrm{d}y \text{ if } Re(\mu)<0\,;\ \frac{d^m}{dx^m}\ {}_aD_x^{\mu-m}f(x) \text{ if } 0\leqslant Re(\mu)<m$$

where m is a positive integer.

For simplicity , the special ense of the fractional derivative operator ${}_aD_x^{\mu}$ when $a=0$, will be written as D_x^{μ}

Also we have :

$$D_x^{\mu}(x^{\lambda}) = \frac{d^{\mu}}{dx^{\mu}}(x^{\lambda}) = \frac{\Gamma(\lambda+1)}{\Gamma(\lambda-\mu+1)}x^{\lambda-\mu} \quad , Re(\lambda) > -1 \tag{1.11}$$

and the binomial expansion

$$(x+\mu)^{\lambda} = \mu^{\lambda}\sum_{m=0}^{\infty}\binom{\lambda}{m}\left(\frac{x}{\mu}\right)^m \quad , \quad \left|\frac{x}{\mu}\right| < 1 \tag{1.12}$$

For $0\leqslant\alpha<1,\beta,\eta,x\in\mathbb{R};m\in\mathbb{N}$, the generalized modified fractional derivative operator due to Saigo is defined in Samko, Kilbas and Marichev [6] as

$$D_{0,x,m}^{\alpha,\beta,\eta}f(x) = \frac{d}{dz}\left(\frac{z^{-m(\beta-\eta)}}{\Gamma(1-\alpha)}\int_a^x (x^m - t^m)^{-\alpha}F(\beta-\alpha,1-\eta;1-\alpha;1-t^m/x^m)\right)f(t)\mathrm{d}t^m \quad (1.13)$$

the multiplicity of $t^m - x^m$ is above equation is removed by requiring $log(t^m - x^m)$ as real for $t^m - x^m > 0$ and is assumed to be well defined in the unit disk.

We have . $D_{0,x,1}^{\alpha,\alpha,\eta}f(x) = D_x^\alpha f(x)$ (1.14)

Where D_x^α is the familiar Riemann-Liouville fractional derivative operator.

For $0 \leqslant \alpha < 1, \beta, \eta, x \in \mathbb{R}; m \in \mathbb{N}, \mu > max(0, \beta - \eta)$, the refined form due to Bhatt and Raina [1] is given by.

$$D_{0,x,m}^{\alpha,\beta,\eta}\{x^{(\mu-1)m}\} = \frac{\Gamma(\mu)\Gamma(\mu+\eta-\beta)}{\Gamma(\mu-\beta)\Gamma(\mu+\eta-\alpha)}x^{(\mu-\beta-1)m} \quad (1.15)$$

2.Formulae

In these section, we give three formulas fractional derivatives of multivariable Aleph-function.

Formula 1

$$D_{x_1}^{\mu_1}\cdots D_{x_r}^{\mu_r}\Big[x_1^{m_1}(x_1^{v_1}+\zeta_1)^{\lambda_1}\cdots x_r^{m_r}(x_r^{v_r}+\zeta_r)^{\lambda_r}$$

$$H\left(\begin{array}{c} \mathrm{z}_1 x_1^{\rho_1'}(x_1^{v_1}+\zeta_1)^{-\sigma_1'}\cdots x_r^{\rho_r'}(x_r^{v_r}+\zeta_r)^{-\sigma_r'} \\ \cdots \\ \cdots \\ \mathrm{z}_n x_1^{\rho_1^n}(x_1^{v_1}+\zeta_1)^{-\sigma_1^n}\cdots x_r^{\rho_r^n}(x_r^{v_r}+\zeta_r)^{-\sigma_r^n} \end{array}\right)\Bigg]$$

$$= \zeta_1^{\lambda_1}\cdots\zeta_r^{\lambda_r}x_1^{m_1-\mu_1}\cdots x_r^{m_r-\mu_r}\sum_{N_1,\cdots,N_r=0}^{\infty}\frac{(-x_1^{v_1}/\zeta_1)^{N_1}}{N_1!}\cdots\frac{(-x_r^{v_r}/\zeta_r)^{N_r}}{N_r!}$$

$$H_{\mathbf{p}+2r,\mathbf{q}+2r:|R:Y}^{\mathbf{m},\mathbf{n}+2r:|R':X}\left(\begin{array}{c} \mathrm{z}_1 A_1 \\ \cdot\ \cdot \\ \mathrm{z}_n A_n \end{array}\middle| \begin{array}{c} (1+\lambda_1-N_1:\sigma_1',\cdots,\sigma_1^n),\cdots,(1+\lambda_r-N_r:\sigma_r',\cdots,\sigma_r^n), \\ \cdots\cdots \\ (1+\lambda_1:\sigma_1',\cdots,\sigma_1^n),\cdots,(1+\lambda_r:\sigma_r',\cdots,\sigma_r^n), \end{array}\right.$$

$$\left.\begin{array}{c} (\text{-m}_1 - v_1N_1:\rho_1',\cdots,\rho_1^n),\cdots,(-m_r-v_rN_r:\rho_r',\cdots,\rho_r^n), A \\ \cdots\cdots \\ (\mu_1-m_1-v_1N_1:\rho_1',\cdots,\rho_1^n),\cdots,(\mu_r-m_r-v_rN_r:\rho_r',\cdots,\rho_r^n), B \end{array}\right) \quad (2.1)$$

Where $A_i = \dfrac{x_1^{\rho_1^i}\cdots x_r^{\rho_r^i}}{\zeta_1^{\sigma_1^i}\cdots\zeta_r^{\sigma_r^i}}, i = 1,\cdots,n$

Provided

a) $min(v_1,\cdots,v_r;\rho_1^i,\cdots,\rho_r^i;\sigma_1^i,\cdots,\sigma_r^i) > 0, i = 1,\cdots,n$

b) $max[|arg(x_1^{v_1}/\zeta_1)|,\cdots,|arg(x_r^{v_r}/\zeta_r)|]<\pi$

c) $Re(m_1)+\sum_{i=1}^{n}\rho_1^i\min_{1\leqslant j\leqslant m_i}Re\left(\frac{d_j^{(i)}}{\delta_j^{(i)}}\right)>-1,\cdots,Re(m_r)+\sum_{i=1}^{n}\rho_r^i\min_{1\leqslant j\leqslant m_i}Re\left(\frac{d_j^{(i)}}{\delta_j^{(i)}}\right)>-1$

Proof of (2.1)

Let $M = \; = \frac{1}{(2\pi\omega)^n}\int_{L_1}\cdots\int_{L_n}\psi(s_1,\cdots,s_n)\prod_{k=1}^{n}\theta_k(s_k)$

Where $\psi(s_1,\cdots,s_n),\theta_k(s_k)$ are defined respectively by (1.2) and (1.3), thefore

$$D_{x_1}^{\mu_1}\cdots D_{x_r}^{\mu_r}\{M[x_1^{m_1}(x_1^{v_1}+\zeta_1)^{\lambda_1}\cdots x_r^{m_r}(x_r^{v_r}+\zeta_r)^{\lambda_r}\cdots[z_1x_1^{\rho_1'}(x_1^{v_1}+\zeta_1)^{-\sigma_1'}\cdots x_r^{\rho_r'}(x_r^{v_r}+\zeta_r)^{-\sigma_r'}]^{s_1}$$

$$[z_nx_1^{\rho_1^n}(x_1^{v_1}+\zeta_1)^{-\sigma_1^n}\cdots x_r^{\rho_r^n}(x_r^{v_r}+\zeta_r)^{-\sigma_r^n}]^{s_n}\;\mathrm{d}s_1\cdots\mathrm{d}s_n\}$$

Using the formulas (1.11) and (1.12), we obtain.

$$\Bigg[M\frac{z_1^{s_1}\cdots z_n^{s_n}\zeta_1^{\lambda_1}\cdots\zeta_r^{\lambda_r}}{\zeta_r^{\sigma_1's_1+\cdots+\sigma_1^ns_n}\zeta_1^{\sigma_r's_1+\cdots+\sigma_r^ns_n}}\sum_{N_1,\cdots,N_r=0}^{\infty}\frac{(-)^{N_1+\cdots+N_n}}{N_1!\cdots N_r!\zeta_1^{N_1}\cdots\zeta_r^{N_r}}\frac{\Gamma(-\lambda_1+\sum_{i=1}^n\sigma_1^is_i+N_1)}{\Gamma(-\lambda_1+\sum_{i=1}^n\sigma_1^is_i)}$$

$$\cdots\frac{\Gamma(-\lambda_r+\sum_{i=1}^n\sigma_r^is_i+N_r)}{\Gamma(-\lambda_r+\sum_{i=1}^n\sigma_r^is_i)}\frac{\Gamma(h_1+\sum_{i=1}^n\sigma_1^is_i+v_1N_1+1)}{\Gamma(h_1+\sum_{i=1}^n\sigma_1^is_i+v_1N_1-\mu_1)}\cdots$$

$$\frac{\Gamma(h_r+\sum_{i=1}^n\sigma_r^is_i+v_rN_r+1)}{\Gamma(h_r+\sum_{i=1}^n\sigma_r^is_i+v_rN_r-\mu_r)}\;x_1^{h_1+\sum_{i=1}^n\rho_1^is_i+v_1N_1-\mu_1}\cdots x_1^{h_1+\sum_{i=1}^n\rho_r^is_i+v_rN_r-\mu_r}\mathrm{d}s_1\cdots\mathrm{d}s_n]$$

Finally, interpreting the result thus obtained with the Mellin-barnes contour integral, we arrive at the desired result.

Formula 2

$$D_{0,x_1,m_1}^{\alpha_1,\beta_1,\eta_1}\cdots D_{0,x_r,m_r}^{\alpha_r,\beta_r,\eta_r}[x_1^{(\mu_1-1)m_1}(x_1^{m_1v_1}+\zeta_1)^{\lambda_1}\cdots x_r^{m_r(\mu_r-1)}(x_r^{m_rv_r}+\zeta_r)^{\lambda_r}$$

$$H\left(\begin{array}{c}\mathrm{z}_1x_1^{m_1\rho_1'}(x_1^{m_1v_1}+\zeta_1)^{-\sigma_1'}\cdots x_r^{m_r\rho_r'}(x_r^{m_rv_r}+\zeta_r)^{-\sigma_r'}\\ \cdots\\ \cdots\\ \mathrm{z}_nx_1^{m_1\rho_1^n}(x_1^{m_1v_1}+\zeta_1)^{-\sigma_1^n}\cdots x_r^{m_r\rho_r^n}(x_r^{m_rv_r}+\zeta_r)^{-\sigma_r^n}\end{array}\right)\Bigg]$$

$$=\zeta_1^{\lambda_1}\cdots\zeta_r^{\lambda_r}x_1^{(\mu_1-\beta_1-1)m_1}\cdots x_r^{(\mu_r-\beta_r-1)m_r}\sum_{N_1,\cdots,N_r=0}^{\infty}\frac{(-x_1^{m_1v_1}/\zeta_1)^{N_1}}{N_1!}\cdots\frac{(-x_r^{m_rv_r}\zeta_r)^{N_r}}{N_r!}$$

$$H_{\mathbf{p}+3r,\mathbf{q}+3r:|R:Y}^{\mathbf{m},\mathbf{n}+3r:|R':X}\left(\begin{array}{c}\mathrm{z}_1B_1\\ \cdot\;\cdot\\ \mathrm{z}_nB_n\end{array}\middle|\begin{array}{c}(1\text{-}\mu_1-v_1N_1:\rho_1',\cdots,\rho_1^n),\cdots,(1-\mu_r-v_rN_r:\rho_r',\cdots,\rho_r^n),\\ \cdots\cdots\\ (1+\beta_1-\mu_1-v_1N_1:\rho_1',\cdots,\rho_1^n),\cdots,(1+\beta_r-\mu_r-v_rN_r:\rho_r',\cdots,\rho_r^n),\end{array}\right.$$

$$(1\text{-}\mu_1-\eta_1+\beta_1-v_1N_1:\rho_1',\cdots,\rho_1^n),\cdots,(1-\mu_r-\eta_r+\beta_r-v_rN_r:\rho_r',\cdots,\rho_r^n),$$
$$\cdots\cdots$$
$$(1\text{-}\mu_1-\eta_1+\alpha_1-v_1N_1:\rho_1',\cdots,\rho_1^n),\cdots,(1-\mu_r-\eta_r+\alpha_r-v_rN_r:\rho_r',\cdots,\rho_r^n),$$

$$\left.\begin{matrix}(1+\lambda_1-N_1:\sigma_1',\cdots,\sigma_1^n),\cdots,(1+\lambda_r-N_r:\sigma_r',\cdots,\sigma_r^n),A\\ \cdots\cdots\\ (1+\lambda_1:\sigma_1',\cdots,\sigma_1^n),\cdots,(1+\lambda_r:\sigma_r',\cdots,\sigma_r^n),B\end{matrix}\right) \tag{2.2}$$

Where $B_i=\dfrac{x_1^{m_1\rho_1^i}\cdots x_r^{m_r\rho_r^i}}{\zeta_1^{\sigma_1^i}\cdots\zeta_r^{\sigma_r^i}}\ i=1,\cdots,n$

Provided that

a) For $0\leqslant\alpha_i<1,\beta_i,\eta_i,x_i\in\mathbb{R};m_i\in\mathbb{N},\mu_i>max(0,\beta_i-\eta_i),$

b) $min(v_1,\cdots,v_r;\rho_1^i,\cdots,\rho_r^i;\sigma_1^i,\cdots,\sigma_r^i)>0,i=1,\cdots,n$

c) $max[|arg(x_1^{m_1v_1}/\zeta_1)|,\cdots,|arg(x_r^{m_rv_r}/\zeta_r)|]<\pi$

d)$Re\,(\mu_1-1)+\sum_{i=1}^n\rho_1^i\min_{1\leqslant j\leqslant m_i}Re\left(\dfrac{d_j^{(i)}}{\delta_j^{(i)}}\right)>0,\cdots,Re\,(\mu_r-1)+\sum_{i=1}^n\rho_r^i\min_{1\leqslant j\leqslant m_i}Re\left(\dfrac{d_j^{(i)}}{\delta_j^{(i)}}\right)>0$

Proof of (2.2)

Let $M=\ =\dfrac{1}{(2\pi\omega)^n}\int_{L_1}\cdots\int_{L_n}\psi(s_1,\cdots,s_n)\prod_{k=1}^n\theta_k(s_k)$

Where $\psi(s_1,\cdots,s_n),\theta_k(s_k)$ are defined respectively by (1.2) and (1.3)

Therefore

$$D_{0,x_1,m_1}^{\alpha_1,\beta_1,\eta_1}\cdots D_{0,x_r,m_r}^{\alpha_r,\beta_r,\eta_r}[Mx_1^{(mu_1+\sum_{i=1}^n\rho_1^in_i)m_1}(x^{m_1v_1}+\zeta_1)^{\lambda_1-(\sum_{i=1}^n\rho_1^in_i)}$$

$$[x_1^{(mu_r+\sum_{i=1}^n\rho_r^in_i)m_r}(x^{m_rv_r}+\zeta_r)^{\lambda_r-(\sum_{i=1}^n\rho_r^in_i)}]\mathrm{d}s_1\cdots\mathrm{d}s_n]$$

Using the formulas (1.12) and (1.15), we obtain.

$$\Bigg[M\frac{z_1^{s_1}\cdots z_n^{s_n}\zeta_1^{\lambda_1}\cdots\zeta_r^{\lambda_r}}{\zeta_r^{\sigma_1's_1+\cdots+\sigma_1^ns_n}\zeta_1^{\sigma_r's_1+\cdots+\sigma_r^ns_n}}\sum_{N_1,\cdots,N_r=0}^{\infty}\frac{(-)^{N_1+\cdots+N_n}}{N_1!\cdots N_r!\zeta_1^{N_1}\cdots\zeta_r^{N_r}}\frac{\Gamma(-\lambda_1+\sum_{i=1}^n\sigma_1^is_i+N_1)}{\Gamma(-\lambda_1+\sum_{i=1}^n\sigma_1^is_i)}$$

$$\cdots\frac{\Gamma(-\lambda_r+\sum_{i=1}^n\sigma_r^is_i+N_r)}{\Gamma(-\lambda_r+\sum_{i=1}^n\sigma_r^is_i)}\frac{\Gamma(\mu_1+\sum_{i=1}^n\rho_1^is_i+v_1N_1)}{\Gamma(\mu_1+\sum_{i=1}^n\sigma_1^is_i+v_1N_1-\beta_1)}\cdots$$

$$\cdots\frac{\Gamma(\mu_r+\sum_{i=1}^n\rho_r^is_i+v_rN_r)}{\Gamma(\mu_r+\sum_{i=1}^n\sigma_r^is_i+v_1N_r-\beta_r)}\frac{\Gamma(\mu_1+\sum_{i=1}^n\rho_1^is_i+v_1N_1+\eta_1-\beta_1)}{\Gamma(\mu_1+\sum_{i=1}^n\sigma_1^is_i+v_1N_1+\eta_1-\alpha_1)}$$

$$\frac{\Gamma(\mu_r+\sum_{i=1}^n\rho_r^i s_i+v_rN_r+\eta_r-\beta_r)}{\Gamma(\mu_r+\sum_{i=1}^n\sigma_r^i s_i+v_rN_r+\eta_r-\alpha_r)}\quad x_1^{m_1(\mu_1-1+\sum_{i=1}^n\rho_1^i s_i+v_1N_1-\beta_1+\sum_{i=1}^s k_1^iR_i)}\cdots$$

$$x_r^{m_r(\mu_r-1+\sum_{i=1}^n\rho_1^i s_i+v_rN_r-\beta_r+\sum_{i=1}^s k_r^iR_i)}\mathrm{d}s_1\cdots\mathrm{d}s_n\Big]$$

Finally, interpreting the result thus obtained with the Mellin-barnes contour integral, we arrive at the desired result.

Formula 3

$$D_{0,x_1,m_1}^{\alpha_1,\beta_1,\eta_1}\cdots D_{0,x_r,m_r}^{\alpha_r,\beta_r,\eta_r}\{x_1^{(\mu_1-1)m_1}(x_1^{m_1v_1}+\zeta_1)^{\lambda_1}\cdots x^{m_r(\mu_r-1)}(x_r^{m_rv_r}+\zeta_r)^{\lambda_r}$$

$$H\left(\begin{array}{c}\mathrm{z}_1x_1^{m_1\rho_1'}(x_1^{m_1v_1}+\zeta_1)^{-\sigma_1'}\cdots x_r^{m_r\rho_r'}(x_r^{m_rv_r}+\zeta_r)^{-\sigma_r'}\\ \cdots\\ \cdots\\ \mathrm{z}_nx_1^{m_1\rho_1^n}(x_1^{m_1v_1}+\zeta_1)^{-\sigma_1^n}\cdots x_r^{m_r\rho_r^n}(x_r^{m_rv_r}+\zeta_r)^{-\sigma_r^n}\end{array}\right)$$

$$S_L^{F_1,\cdots,F_u}[w_1x_1^{k_1'm_1}\cdots x_r^{k_r'm_r},\cdots,w_ux_1^{k_1^sm_1}\cdots x_r^{k_r^um_r}]\}$$

$$=\zeta_1^{\lambda_1}\cdots\zeta_r^{\lambda_r}x_1^{(\mu_1-\beta_1-1)m_1}\cdots x_r^{(\mu_r-\beta_r-1)m_r}\sum_{N_1,\cdots,N_r=0}^{\infty}\frac{(-1/\zeta_1)^{N_1}}{N_1!}\cdots\frac{(-1/\zeta_r)^{N_r}}{N_r!}\sum_{R_1,\cdots,R_u=0}^{h_1R_1+\cdots h_uR_u\leqslant L}$$

$$(-L)_{h_1R_1+\cdots+h_uR_u}B(L;R_1,\cdots,R_u)\frac{w_1^{R_1}\cdots w_u^{R_u}}{R_1!\cdots R_u!}x_1^{m_1(v_1N_r+\sum_{i=1}^u k_1^iR_i)}\cdots x_r^{m_r(v_rN_r+\sum_{i=1}^u k_r^iR_i)}$$

$$H_{\mathbf{p}+3r,\mathbf{q}+3r:|R:Y}^{\mathbf{m},\mathbf{n}+3r:|R':X}\left(\begin{array}{c}\mathrm{z}_1B_1\\ \cdot\ \cdot\\ \mathrm{z}_nB_n\end{array}\left|\begin{array}{c}(1+\lambda_1-N_1:\sigma_1',\cdots,\sigma_1^n),\cdots,(1+\lambda_r-N_r:\sigma_r',\cdots,\sigma_r^n),\\ \cdots\cdots\\ (1+\lambda_1:\sigma_1',\cdots,\sigma_1^n),\cdots,(1+\lambda_r:\sigma_r',\cdots,\sigma_r^n),\end{array}\right.\right.$$

$$\begin{array}{c}(1\text{-}\mu_1-\eta_1+\beta_1-v_1N_1-\sum_{i=1}^u k_1^iR_i:\rho_1',\cdots,\rho_1^n),\cdots,\\ \cdots\cdots\\ (1\text{-}\mu_1-\eta_1+\alpha_1-v_1N_1-\sum_{i=1}^u k_1^iR_i:\rho_1',\cdots,\rho_1^n),\cdots,\end{array}$$

$$\begin{array}{c}(1\text{-}\mu_r-\eta_r+\beta_r-v_rN_r-\sum_{i=1}^u k_r^iR_i:\rho_r',\cdots,\rho_r^n),\\ \cdots\cdots\\ (1\text{-}\mu_r-\eta_r+\alpha_r-v_rN_r-\sum_{i=1}^u k_r^iR_i:\rho_r',\cdots,\rho_r^n),\end{array}$$

$$\begin{array}{c}(1\text{-}\mu_1-v_1N_1-\sum_{i=1}^u k_1^iR_i:\rho_1',\cdots,\rho_1^n),\cdots,\\ \cdots\cdots\\ (1\text{-}\mu_1+\beta_1-v_1N_1-\sum_{i=1}^u k_1^iR_i:\rho_1',\cdots,\rho_1^n),\cdots,\end{array}$$

$$\left.\begin{array}{c}(1\text{-}\mu_r-v_rN_r-\sum_{i=1}^u k_r^iR_i:\rho_r',\cdots,\rho_r^n),A\\ \cdots\cdots\\ (1\text{-}\mu_r+\beta_r-v_rN_r-\sum_{i=1}^u k_r^iR_i:\rho_r',\cdots,\rho_r^n),B\end{array}\right)\tag{2.3}$$

Where $B_i = \dfrac{x_1^{m_1\rho_1^i}\cdots x_r^{m_r\rho_r^i}}{\zeta_1^{\sigma_1^i}\cdots\zeta_r^{\sigma_r^i}}$ $i=1,\cdots,n$

Provided that

a) For $0 \leqslant \alpha_i < 1, \beta_i, \eta_i, x_i \in \mathbb{R}; m_i \in \mathbb{N}, \mu_i > max(0, \beta_i - \eta_i)$,

b) $min(v_1,\cdots,v_r;\rho_1^i,\cdots,\rho_r^i;\sigma_1^i,\cdots,\sigma_r^i) > 0, i=1,\cdots,n$

c) $max[|arg(x_1^{m_1v_1}/\zeta_1)|,\cdots,|arg(x_r^{m_rv_r}/\zeta_r)|] < \pi$

d) $Re(\mu_1-1)+\sum_{i=1}^n \rho_1^i \min_{1\leqslant j\leqslant m_i} Re\left(\frac{d_j^{(i)}}{\delta_j^{(i)}}\right) > 0,\cdots,Re(\mu_r-1)+\sum_{i=1}^n \rho_r^i \min_{1\leqslant j\leqslant m_i} Re\left(\frac{d_j^{(i)}}{\delta_j^{(i)}}\right) > 0$

Proof of (2.3)

Let $M = \ = \dfrac{1}{(2\pi\omega)^n}\int_{L_1}\cdots\int_{L_n}\psi(s_1,\cdots,s_n)\prod_{k=1}^n\theta_k(s_k)$

Where $\psi(s_1,\cdots,s_r), \theta_k(s_k)$ are defined respectively by (1.2) and (1.3)

Use the formula (1.12), the left hand side of (2.3) is given by

$$\Bigg[M\frac{z_1^{s_1}\cdots z_n^{s_n}\zeta_1^{\lambda_1}\cdots\zeta_r^{\lambda_r}}{\zeta_r^{\sigma_1' s_1+\cdots+\sigma_1^n s_n}\zeta_1^{\sigma_r' s_1+\cdots+\sigma_r^n s_n}}\sum_{N_1,\cdots,N_r=0}^{\infty}\frac{(-)^{N_1+\cdots+N_n}}{N_1!\cdots N_r!\zeta_1^{N_1}\cdots\zeta_r^{N_r}}(-\lambda_1+\sum_{i=0}^n\sigma_1^i s_i,N_1)\cdots$$

$$(-\lambda_r+\sum_{i=0}^n\sigma_r^i s_i,N_r)\sum_{R_1,\cdots,R_u=0}^{h_1R_1+\cdots h_uR_u\leqslant L}(-L)_{h_1R_1+\cdots+h_uR_u}B(L;R_1,\cdots,R_u)\frac{w_1^{R_1}\cdots w_u^{R_u}}{R_1!\cdots R_u!}$$

$$D_{0,x_1,m_1}^{\alpha_1,\beta_1,\eta_1}\cdots D_{0,x_r,m_r}^{\alpha_r,\beta_r,\eta_r}\{x_1^{(\mu_1-1+\sum_{i=1}^n\rho_1^i s_i+\sum_{i=1}^u k_1^i R_i)m_1}\cdots x_r^{(\mu_r-1+\sum_{i=1}^n\rho_r^i s_i+\sum_{i=1}^u k_r^i R_i)m_r}\}$$
$$\mathrm{d}s_1\cdots\mathrm{d}s_n]$$

Use the formula (1.15), we get

$$\Bigg[M\frac{z_1^{s_1}\cdots z_n^{s_n}\zeta_1^{\lambda_1}\cdots\zeta_r^{\lambda_r}}{\zeta_r^{\sigma_1' s_1+\cdots+\sigma_1^n s_n}\zeta_1^{\sigma_r' s_1+\cdots+\sigma_r^n s_n}}\sum_{N_1,\cdots,N_r=0}^{\infty}\sum_{R_1,\cdots,R_u=0}^{h_1R_1+\cdots h_uR_u\leqslant L}\frac{(-)^{N_1+\cdots+N_n}}{N_1!\cdots N_r!\zeta_1^{N_1}\cdots\zeta_r^{N_r}}$$

$$(-\lambda_1+\sum_{i=0}^n\sigma_1^i s_i,N_1)\cdots(-\lambda_r+\sum_{i=0}^n\sigma_r^i s_i,N_r)(-L)_{h_1R_1+\cdots+h_sR_s}B(E;R_1,\cdots,R_s)\frac{w_1^{R_1}\cdots w_s^{R_s}}{R_1!\cdots R_s!}$$

$$\frac{\Gamma(-\lambda_1+\sum_{i=1}^n\sigma_1^i s_i+N_1)}{\Gamma(-\lambda_1+\sum_{i=1}^n\sigma_1^i s_i)}\cdots\frac{\Gamma(-\lambda_r+\sum_{i=1}^n\sigma_r^i s_i+N_r)}{\Gamma(-\lambda_r+\sum_{i=1}^n\sigma_r^i s_i)}$$

$$\frac{\Gamma(\mu_1+\sum_{i=1}^n\rho_1^i s_i+v_1N_1+\sum_{i=1}^u k_i'R_i)}{\Gamma(\mu_1+\sum_{i=1}^n\sigma_1^i s_i+v_1N_1-\beta_1+\sum_{i=1}^u k_i'R_i)}\cdots\frac{\Gamma(\mu_r+\sum_{i=1}^n\rho_r^i s_i+v_1N_r+\sum_{i=1}^u k_i'R_i)}{\Gamma(h_r+\sum_{i=1}^n\sigma_1^i s_i+v_rN_r-\beta_r+\sum_{i=1}^u k_i'R_i)}$$
$$\cdots$$

$$\frac{\Gamma(\mu_1+\sum_{i=1}^n \rho_1^i s_i + v_1 N_1 + \sum_{i=1}^u k_1^s R_i + \eta_1 - \beta_1)}{\Gamma(\mu_1+\sum_{i=1}^n \sigma_1^i s_i + v_1 N_1 + \eta_1 - \alpha_1 + \sum_{i=1}^u k_1^s R_i)} \cdots$$

$$\frac{\Gamma(\mu_r+\sum_{i=1}^n \rho_r^i s_i + v_r N_r + \sum_{i=1}^u k_i' R_i)}{\Gamma(\mu_r+\sum_{i=1}^n \sigma_r^i s_i + v_1 N_1 - \beta_r + \sum_{i=1}^u k_i' R_i)} \; x_1^{m_1(\mu_1-1+\sum_{i=1}^n \rho_1^i s_i + v_1 N_1 - \beta_1 + \sum_{i=1}^u k_1^i R_i)} \cdots$$

$$x_r^{m_r(\mu_r-1+\sum_{i=1}^n \rho_1^i s_i + v_r N_r - \beta_r + \sum_{i=1}^u k_r^i R_i)} \mathrm{d}s_1 \cdots \mathrm{d}s_n]$$

Finally, interpreting the result thus obtained with the Mellin-barnes contour integral, we arrive at the desired result.

3. Particular case

a) If $B(L;R_1,\cdots,R_u) = \dfrac{\prod_{j=1}^A (a_j)_{R_1\theta_j'+\cdots+R_u\theta_j^{(u)}} \prod_{j=1}^{B'} (b_j')_{R_1\phi_j'} \cdots \prod_{j=1}^{B^{(u)}} (b_j^{(u)})_{R_s\phi_j^{(u)}}}{\prod_{j=1}^C (c_j)_{m_1\psi_j'+\cdots+m_u\psi_j^{(u)}} \prod_{j=1}^{D'} (d_j')_{R_1\delta_j'} \cdots \prod_{j=1}^{D^{(u)}} (d_j^{(u)})_{R_u\delta_j^{(u)}}}$ (3.1)

then the general class of multivariable polynomial $S_L^{R_1,\cdots,R_u}[x_1,\cdots,x_u]$ reduces to generalized Lauricella function defined by Srivastava et al [8].

$$F_{C:D';\cdots;D^{(u)}}^{1+A:B';\cdots;B^{(u)}}\left(\begin{array}{c|c} \mathrm{z}_1 & \text{(-L: R}_1,\cdots,R_u],[(a);\theta',\cdots,\theta^{(u)}]:[(b');\phi'];\cdots;[(b^{(u)});\phi^{(u)}] \\ \cdot & \cdot \\ \cdot & [\mathrm{(c)};\psi',\cdots,\psi^{(u)}]:[(d');\delta'];\cdots;[(d^{(u)});\delta^{(u)}] \\ \mathrm{z}_u & \end{array}\right) \tag{3.2}$$

The formula (2.3) write

$$D_{0,x_1,m_1}^{\alpha_1,\beta_1,\eta_1} \cdots D_{0,x_r,m_r}^{\alpha_r,\beta_r,\eta_r} \{x_1^{(\mu_1-1)m_1}(x_1^{m_1 v_1}+\zeta_1)^{\lambda_1} \cdots x_r^{m_r(\mu_r-1)}(x_r^{m_r v_r}+\zeta_r)^{\lambda_r}$$

$$\aleph_{p_i,q_i,\tau_i;R:W}^{0,\mathfrak{n}:V}\left(\begin{array}{c} \mathrm{z}_1 x_1^{m_1\rho_1'}(x_1^{m_1 v_1}+\zeta_1)^{-\sigma_1'} \cdots x_r^{m_r\rho_r'}(x_r^{m_r v_r}+\zeta_r)^{-\sigma_r'} \\ \cdots \\ \cdots \\ \mathrm{z}_n x_1^{m_1\rho_1^n}(x_1^{m_1 v_1}+\zeta_1)^{-\sigma_1^n} \cdots x_r^{m_r\rho_r^n}(x_r^{m_r v_r}+\zeta_r)^{-\sigma_r^n} \end{array}\right)$$

$$F_{C:D';\cdots;D^{(s)}}^{1+A:B';\cdots;B^{(s)}}\left(\begin{array}{c|c} \mathrm{w}_1 x_1^{k_1' m_1} \cdots x_r^{k_r' m_r} & \text{(-L: R}_1,\cdots,R_u],[(a);\theta',\cdots,\theta^{(u)}]:[(b');\phi'];\cdots;[(b^{(u)});\phi^{(u)}] \\ \cdots & \cdot \\ \mathrm{w}_u x_s^{k_1^u m_1} \cdots x_r^{k_r^u m_r} & [\mathrm{(c)};\psi',\cdots,\psi^{(u)}]:[(d');\delta'];\cdots;[(d^{(u)});\delta^{(u)}] \end{array}\right)\Bigg\}$$

$$=\zeta_1^{\lambda_1} \cdots \zeta_r^{\lambda_r} x_1^{(\mu_1-\beta_1-1)m_1} \cdots x_r^{(\mu_r-\beta_r-1)m_r} \sum_{N_1,\cdots,N_r=0}^{\infty} \frac{(-1/\zeta_1)^{N_1}}{N_1!} \cdots \frac{(-1\zeta_r)^{N_r}}{N_r!} \sum_{R_1,\cdots,R_u=0}^{h_1R_1+\cdots h_uR_u \leqslant L}$$

$$(-L)_{h_1R_1+\cdots+h_uR_u} B(L;R_1,\cdots,R_u) \frac{w_1^{R_1} \cdots w_u^{R_u}}{R_1! \cdots R_u!} x_1^{m_1(v_1N_r+\sum_{i=1}^u k_1^i R_i)} \cdots x_r^{m_r(v_r N_r + \sum_{i=1}^u k_r^i R_i)}$$

$$H^{\mathbf{m},\mathbf{n}+3r:|R':X}_{\mathbf{p}+3r,\mathbf{q}+3r:|R:Y}\left(\begin{array}{c} \mathrm{z}_1B_1 \\ \cdot\ \cdot \\ \mathrm{z}_nB_n \end{array}\ \middle|\ \begin{array}{c} (1+\lambda_1-N_1:\sigma'_1,\cdots,\sigma^n_1),\cdots,(1+\lambda_r-N_r:\sigma'_r,\cdots,\sigma^n_r), \\ \cdots\cdots \\ (1+\lambda_1:\sigma'_1,\cdots,\sigma^n_1),\cdots,(1+\lambda_r:\sigma'_r,\cdots,\sigma^n_r), \end{array}\right.$$

$$\begin{array}{c} (1\text{-}\mu_1-\eta_1+\beta_1-v_1N_1-\sum_{i=1}^u k_1^iR_i:\rho'_1,\cdots,\rho^n_1),\cdots, \\ \cdots\cdots \\ (1\text{-}\mu_1-\eta_1+\alpha_1-v_1N_1-\sum_{i=1}^u k_1^iR_i:\rho'_1,\cdots,\rho^n_1),\cdots, \end{array}$$

$$\begin{array}{c} (1\text{-}\mu_r-\eta_r+\beta_r-v_rN_r-\sum_{i=1}^u k_r^iR_i:\rho'_r,\cdots,\rho^n_r), \\ \cdots\cdots \\ (1\text{-}\mu_r-\eta_r+\alpha_r-v_rN_r-\sum_{i=1}^u k_r^iR_i:\rho'_r,\cdots,\rho^n_r), \end{array}$$

$$\begin{array}{c} (1\text{-}\mu_1-v_1N_1-\sum_{i=1}^u k_1^iR_i:\rho'_1,\cdots,\rho^n_1),\cdots, \\ \cdots\cdots \\ (1\text{-}\mu_1+\beta_1-v_1N_1-\sum_{i=1}^u k_1^iR_i:\rho'_1,\cdots,\rho^n_1),\cdots, \end{array}$$

$$\left.\begin{array}{c} (1\text{-}\mu_r-v_rN_r-\sum_{i=1}^u k_r^iR_i:\rho'_r,\cdots,\rho^n_r),A \\ \cdots\cdots \\ (1\text{-}\mu_r+\beta_r-v_rN_r-\sum_{i=1}^u k_r^iR_i:\rho'_r,\cdots,\rho^n_r),B \end{array}\right) \tag{3.3}$$

Where $B_i=\dfrac{x_1^{m_1\rho_1^i}\cdots x_r^{m_r\rho_r^i}}{\zeta_1^{\sigma_1^i}\cdots\zeta_r^{\sigma_r^i}}$ $i=1,\cdots,n$ and $B(E;R_1,\cdots,R_s)$ is defined by (3.1)

which holds true under the same conditions as needed in (2.3)

b) If $x_2=\cdots,x_s=0$, then $S_L^{R_1,\cdots,R_s}[x_1,\cdots,x_s]$ degenere to $S_N^M(x)$ defined by Srivastava [7] and we have

$$D^{\alpha_1,\beta_1,\eta_1}_{0,x_1,m_1}\cdots D^{\alpha_r,\beta_r,\eta_r}_{0,x_r,m_r}\{x_1^{(\mu_1-1)m_1}(x_1^{m_1v_1}+\zeta_1)^{\lambda_1}\cdots x_r^{m_r(\mu_r-1)}(x_r^{m_rv_r}+\zeta_r)^{\lambda_r}$$

$$H\left(\begin{array}{c} \mathrm{z}_1x_1^{m_1\rho'_1}(x_1^{m_1v_1}+\zeta_1)^{-\sigma'_1}\cdots x_r^{m_r\rho'_r}(x_r^{m_rv_r}+\zeta_r)^{-\sigma'_r} \\ \cdots \\ \cdots \\ \mathrm{z}_nx_1^{m_1\rho^n_1}(x_1^{m_1v_1}+\zeta_1)^{-\sigma^n_1}\cdots x_r^{m_r\rho^n_r}(x_r^{m_rv_r}+\zeta_r)^{-\sigma^n_r} \end{array}\right)S_N^M[wx_1^{k'_1m_1}\cdots x_r^{k'_rm_r}]\Bigg\}$$

$$=\zeta_1^{\lambda_1}\cdots\zeta_r^{\lambda_r}x_1^{(\mu_1-\beta_1-1)m_1}\cdots x_r^{(\mu_r-\beta_r-1)m_r}\sum_{N_1,\cdots,N_r=0}^{\infty}\sum_{K=0}^{[N/M]}\frac{(-1/\zeta_1)^{N_1}}{N_1!}\cdots\frac{(-1\zeta_r)^{N_r}}{N_r!}$$

$$\frac{(-N)_{MK}}{K!}A_{N,K}\frac{w^K}{K!}\ \ x_1^{m_1(v_1N_r+k'_1K)}\cdots x_r^{m_r(v_rN_r+k'_rK)}$$

$$H^{\mathbf{m},\mathbf{n}+3r:|R':X}_{\mathbf{p}+3r,\mathbf{q}+3r:|R:Y}\left(\begin{array}{c|c} \mathrm{z}_1B_1 & (1{+}\lambda_1-N_1:\sigma_1',\cdots,\sigma_1^n),\cdots,(1+\lambda_r-N_r:\sigma_r',\cdots,\sigma_r^n), \\ \cdot\ \cdot & \cdot\ \cdot\ \cdot\ \cdot\ \cdot\ \cdot \\ \mathrm{z}_nB_n & (1{+}\lambda_1:\sigma_1',\cdots,\sigma_1^n),\cdots,(1+\lambda_r:\sigma_r',\cdots,\sigma_r^n), \end{array}\right.$$

$$\begin{array}{c} (1\text{-}\mu_1-\eta_1+\beta_1-v_1N_1-k_1K:\rho_1',\cdots,\rho_1^n),\cdots,(1\text{-}\mu_r-\eta_r+\beta_r-v_rN_r-k_rK:\rho_r',\cdots,\rho_r^n), \\ \cdot\ \cdot\ \cdot\ \cdot\ \cdot\ \cdot \qquad\qquad \cdot\ \cdot\ \cdot\ \cdot\ \cdot\ \cdot \\ (1\text{-}\mu_1-\eta_1+\alpha_1-v_1N_1-k_1K:\rho_1',\cdots,\rho_1^n),\cdots,(1\text{-}\mu_r-\eta_r+\alpha_r-v_rN_r-k_rK:\rho_r',\cdots,\rho_r^n), \end{array}$$

$$\left.\begin{array}{c} (1\text{-}\mu_1-v_1N_1-k_1K:\rho_1',\cdots,\rho_1^n),\cdots,\qquad (1\text{-}\mu_r-v_rN_r-k_rK:\rho_r',\cdots,\rho_r^n),A \\ \cdot\ \cdot\ \cdot\ \cdot\ \cdot\ \cdot \qquad\qquad \cdot\ \cdot\ \cdot\ \cdot\ \cdot\ \cdot \\ (1\text{-}\mu_1+\beta_1-v_1N_1-k_1K:\rho_1',\cdots,\rho_1^n),\cdots,(1\text{-}\mu_r+\beta_r-v_rN_r-k_rK:\rho_r',\cdots,\rho_r^n),B \end{array}\right) \tag{3.4}$$

Where $B_i=\dfrac{x_1^{m_1\rho_1^i}\cdots x_r^{m_r\rho_r^i}}{\zeta_1^{\sigma_1^i}\cdots\zeta_r^{\sigma_r^i}}\ i=1,\cdots,n$

which holds true under the same conditions as needed in (2.3)

4. Conclusion

The modified H-function of several variables presented in this paper, is quite basic in nature. Therefore , on specializing the parameters of this function, we may obtain various other special functions of one and several variables, such as, the multivariable H-function defined by Srivastava and Panda [10].

References

[1] Bhatt S. and Raina R.K. A new class of analytic function involving certain fractional derivatives operator. Acta. Math. Univ. Comenianee, vol 68,1, 1999, p.179-193.

[2] Chandel R.C.S and Kumar . On some generalized results of fractional derivatives. Jnanabha vol36, 2006, p.105-112

[3] Chandel R.C.S and Gupta V. On some generalized fractional derivatives formulas. Jnanabha Vol41, 2011, p.109-130

[4] Oldham K.B.and Spanier J. The fractional calculus. Academic Press , New York 1974.

[5] Prasad Y.N. and Singh A.K. Basic properties of the transform involving and H-function of r-variables as kernel. Indian Acad Math, no 2, 1982, page 109-115

[6] Samko S.G. Kilbas A.A. And Marichev O.I. Fractional integrals and derivatives, Theory and Applications, Gordon and Beach, New-York, 1993

[7] Srivastava H.M., A contour integral involving Fox's H-function. Indian J.Math. 14(1972), page1-6.

[8] Srivastava H.M. and Daoust M.C. Certain generalized Neumann expansions associated with Kampé de Fériet function. Nederl. Akad. Wetensch. Proc. Ser. A72 = Indag. Math, 31, (1969), p 449-457.

[9] Srivastava H.M. And Garg M. Some integral involving a general class of polynomials and multivariable H-function. Rev. Roumaine Phys. 32(1987), page 685-692.

[10] H.M. Srivastava And R.Panda. Some expansion theorems and generating relations for the H-function of several complex variables. Comment. Math. Univ. St. Paul. 24(1975), p.119-137.