

# Multiple integral transformation of the extension of Zeta-function, a general class of polynomials, the multivariable Aleph-function and the multivariable I-function II

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## ABSTRACT

In the present paper we evaluate a multiple integral transformation involving the product of a extension of the Hurwitz-lerch Zeta-function, the multivariable Aleph-function, the multivariable I-function defined by Prasad and general class of polynomials of several variables. The importance of the result established in this paper lies in the fact they involve the Aleph-function of several variables which is sufficiently general in nature and capable to yielding a large of results merely by specializing the parameters their in.

Keywords: Multivariable Aleph-function, general class of polynomial, extension of the Hurwitz-lerch Zeta-function, multivariable I-function, multivariable H-function

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## 1. Introduction and preliminaries.

The function Aleph of several variables generalize the multivariable I-function recently study by C.K. Sharma and Ahmad [3] , itself is an a generalisation of G and H-functions of multiple variables. The multiple Mellin-Barnes integral occurring in this paper will be referred to as the multivariables Aleph-function throughout our present study and will be defined and represented as follows.

$$\begin{aligned}
 \text{We define : } \aleph(z_1, \dots, z_r) = \aleph_{P_i, Q_i, \tau_i; R; P_{i(1)}, Q_{i(1)}, \tau_{i(1)}; R^{(1)}; \dots; P_{i(r)}, Q_{i(r)}, \tau_{i(r)}; R^{(r)}}^{0, N; M_1, N_1, \dots, M_r, N_r} \\
 & \left[ (a_j; \alpha_j^{(1)}, \dots, \alpha_j^{(r)})_{1, N} \right], [\tau_i(a_{ji}; \alpha_{ji}^{(1)}, \dots, \alpha_{ji}^{(r)})_{N+1, P_i}] : \\
 & \dots, [\tau_i(b_{ji}; \beta_{ji}^{(1)}, \dots, \beta_{ji}^{(r)})_{M+1, Q_i}] : \\
 & [(c_j^{(1)}; \gamma_j^{(1)})_{1, N_1}], [\tau_{i(1)}(c_{ji^{(1)}}^{(1)}; \gamma_{ji^{(1)}}^{(1)})_{N_1+1, P_i^{(1)}}]; \dots; [(c_j^{(r)}; \gamma_j^{(r)})_{1, N_r}], [\tau_{i(r)}(c_{ji^{(r)}}^{(r)}; \gamma_{ji^{(r)}}^{(r)})_{N_r+1, P_i^{(r)}}] \\
 & [(d_j^{(1)}; \delta_j^{(1)})_{1, M_1}], [\tau_{i(1)}(d_{ji^{(1)}}^{(1)}; \delta_{ji^{(1)}}^{(1)})_{M_1+1, Q_i^{(1)}}]; \dots; [(d_j^{(r)}; \delta_j^{(r)})_{1, M_r}], [\tau_{i(r)}(d_{ji^{(r)}}^{(r)}; \delta_{ji^{(r)}}^{(r)})_{M_r+1, Q_i^{(r)}}] \\
 & = \frac{1}{(2\pi\omega)^r} \int_{L_1} \dots \int_{L_r} \psi(s_1, \dots, s_r) \prod_{k=1}^r \theta_k(s_k) y_k^{s_k} ds_1 \dots ds_r \tag{1.1}
 \end{aligned}$$

with  $\omega = \sqrt{-1}$

$$\psi(s_1, \dots, s_r) = \frac{\prod_{j=1}^N \Gamma(1 - a_j + \sum_{k=1}^r \alpha_j^{(k)} s_k)}{\sum_{i=1}^R [\tau_i \prod_{j=N+1}^{P_i} \Gamma(a_{ji} - \sum_{k=1}^r \alpha_{ji}^{(k)} s_k) \prod_{j=1}^{Q_i} \Gamma(1 - b_{ji} + \sum_{k=1}^r \beta_{ji}^{(k)} s_k)]} \tag{1.2}$$

$$\text{and } \theta_k(s_k) = \frac{\prod_{j=1}^{M_k} \Gamma(d_j^{(k)} - \delta_j^{(k)} s_k) \prod_{j=1}^{N_k} \Gamma(1 - c_j^{(k)} + \gamma_j^{(k)} s_k)}{\sum_{i^{(k)}=1}^{R^{(k)}} [\tau_{i^{(k)}} \prod_{j=M_k+1}^{Q_{i^{(k)}}} \Gamma(1 - d_{ji^{(k)}}^{(k)} + \delta_{ji^{(k)}}^{(k)} s_k) \prod_{j=N_k+1}^{P_{i^{(k)}}} \Gamma(c_{ji^{(k)}}^{(k)} - \gamma_{ji^{(k)}}^{(k)} s_k)]} \quad (1.3)$$

Suppose , as usual , that the parameters

$$b_j, j = 1, \dots, Q; a_j, j = 1, \dots, P;$$

$$c_{ji^{(k)}}^{(k)}, j = n_k + 1, \dots, P_{i^{(k)}}; c_j^{(k)}, j = 1, \dots, N_k;$$

$$d_{ji^{(k)}}^{(k)}, j = M_k + 1, \dots, Q_{i^{(k)}}; d_j^{(k)}, j = 1, \dots, M_k;$$

$$\text{with } k = 1 \dots, r, i = 1, \dots, R, i^{(k)} = 1, \dots, R^{(k)}$$

are complex numbers , and the  $\alpha'$ s,  $\beta'$ s,  $\gamma'$ s and  $\delta'$ s are assumed to be positive real numbers for standardization purpose such that

$$\begin{aligned} U_i^{(k)} &= \sum_{j=1}^N \alpha_j^{(k)} + \tau_i \sum_{j=N+1}^{P_i} \alpha_{ji}^{(k)} + \sum_{j=1}^{N_k} \gamma_j^{(k)} + \tau_{i^{(k)}} \sum_{j=n_k+1}^{P_{i^{(k)}}} \gamma_{ji^{(k)}}^{(k)} - \tau_i \sum_{j=1}^{Q_i} \beta_{ji}^{(k)} - \sum_{j=1}^{M_k} \delta_j^{(k)} \\ &- \tau_{i^{(k)}} \sum_{j=M_k+1}^{Q_{i^{(k)}}} \delta_{ji^{(k)}}^{(k)} \leq 0 \end{aligned} \quad (1.4)$$

The reals numbers  $\tau_i$  are positives for  $i = 1$  to  $R$ ,  $\tau_{i^{(k)}}$  are positives for  $i^{(k)} = 1$  to  $R^{(k)}$

The contour  $L_k$  is in the  $s_k$ -p lane and run from  $\sigma - i\infty$  to  $\sigma + i\infty$  where  $\sigma$  is a real number with loop , if necessary ,ensure that the poles of  $\Gamma(d_j^{(k)} - \delta_j^{(k)} s_k)$  with  $j = 1$  to  $m_k$  are separated from those of  $\Gamma(1 - a_j + \sum_{i=1}^{r^{(k)}} \alpha_j^{(k)} s_k)$  with  $j = 1$  to  $N$  and  $\Gamma(1 - c_j^{(k)} + \gamma_j^{(k)} s_k)$  with  $j = 1$  to  $N_k$  to the left of the contour  $L_k$ . The condition for absolute convergence of multiple Mellin-Barnes type contour (1.9) can be obtained by extension of the corresponding conditions for multivariable H-function given by as :

$$|arg z_k| < \frac{1}{2} A_i^{(k)} \pi, \text{ where}$$

$$\begin{aligned} A_i^{(k)} &= \sum_{j=1}^N \alpha_j^{(k)} - \tau_i \sum_{j=N+1}^{P_i} \alpha_{ji}^{(k)} - \tau_i \sum_{j=1}^{Q_i} \beta_{ji}^{(k)} + \sum_{j=1}^{N_k} \gamma_j^{(k)} - \tau_{i^{(k)}} \sum_{j=N_k+1}^{P_{i^{(k)}}} \gamma_{ji^{(k)}}^{(k)} \\ &+ \sum_{j=1}^{M_k} \delta_j^{(k)} - \tau_{i^{(k)}} \sum_{j=M_k+1}^{Q_{i^{(k)}}} \delta_{ji^{(k)}}^{(k)} > 0, \quad \text{with } k = 1 \dots, r, i = 1, \dots, R, i^{(k)} = 1, \dots, R^{(k)} \end{aligned} \quad (1.5)$$

The complex numbers  $z_i$  are not zero.Throughout this document , we assume the existence and absolute convergence conditions of the multivariable Aleph-function.

We may establish the the asymptotic expansion in the following convenient form :

$$\aleph(y_1, \dots, y_r) = 0(|y_1|^{\alpha_1}, \dots, |y_r|^{\alpha_r}), \max(|y_1|, \dots, |y_r|) \rightarrow 0$$

$$\aleph(y_1, \dots, y_r) = 0(|y_1|^{\beta_1}, \dots, |y_r|^{\beta_r}), \min(|y_1|, \dots, |y_r|) \rightarrow \infty$$

where, with  $k = 1, \dots, r$ :  $\alpha_k = \min[Re(d_j^{(k)}/\delta_j^{(k)})]$ ,  $j = 1, \dots, M_k$  and

$$\beta_k = \max[Re((c_j^{(k)} - 1)/\gamma_j^{(k)})], j = 1, \dots, N_k$$

Serie representation of Aleph-function of several variables is given by

$$\begin{aligned} \aleph(y_1, \dots, y_r) &= \sum_{G_1, \dots, G_r=0}^{\infty} \sum_{g_1=0}^{M_1} \dots \sum_{g_r=0}^{M_r} \frac{(-)^{G_1+\dots+G_r}}{\delta_{g_1} G_1! \dots \delta_{g_r} G_r!} \psi(\eta_{G_1, g_1}, \dots, \eta_{G_r, g_r}) \\ &\times \theta_1(\eta_{G_1, g_1}) \dots \theta_r(\eta_{G_r, g_r}) y_1^{-\eta_{G_1, g_1}} \dots y_r^{-\eta_{G_r, g_r}} \end{aligned} \quad (1.6)$$

Where  $\psi(\cdot, \dots, \cdot)$ ,  $\theta_i(\cdot)$ ,  $i = 1, \dots, r$  are given respectively in (1.2), (1.3) and

$$\eta_{G_1, g_1} = \frac{d_{g_1}^{(1)} + G_1}{\delta_{g_1}^{(1)}}, \dots, \eta_{G_r, g_r} = \frac{d_{g_r}^{(r)} + G_r}{\delta_{g_r}^{(r)}}$$

$$\text{which is valid under the conditions } \delta_{g_i}^{(i)}[d_j^i + p_i] \neq \delta_j^{(i)}[d_{g_i}^i + G_i] \quad (1.7)$$

$$\text{for } j \neq M_i, M_i = 1, \dots, \eta_{G_i, g_i}; P_i, N_i = 0, 1, 2, \dots; y_i \neq 0, i = 1, \dots, r \quad (1.8)$$

In the document, we will note :

$$G(\eta_{G_1, g_1}, \dots, \eta_{G_r, g_r}) = \phi(\eta_{G_1, g_1}, \dots, \eta_{G_r, g_r}) \theta_1(\eta_{G_1, g_1}) \dots \theta_r(\eta_{G_r, g_r}) \quad (1.9)$$

where  $\phi(\eta_{G_1, g_1}, \dots, \eta_{G_r, g_r})$ ,  $\theta_1(\eta_{G_1, g_1}), \dots, \theta_r(\eta_{G_r, g_r})$  are given respectively in (1.2) and (1.3)

$$\text{We will note the Aleph-function of r variables } \aleph_{u:w}^{0,N:v} \left( \begin{array}{c} z_1 \\ \dots \\ z_r \end{array} \right) \quad (1.10)$$

The multivariable I-function is defined in term of multiple Mellin-Barnes type integral :

$$I(z_1, z_2, \dots, z_s) = I_{p_2, q_2, p_3, q_3, \dots, p_s, q_s; p', q'; \dots, p^{(s)}, q^{(s)}}^{0, n_2; 0, n_3; \dots; 0, n_r; m', n'; \dots; m^{(s)}, n^{(s)}} \left( \begin{array}{c|c} z_1 & (a_{2j}; \alpha'_{2j}, \alpha''_{2j})_{1,p_2}; \dots; \\ \vdots & \\ \vdots & (b_{2j}; \beta'_{2j}, \beta''_{2j})_{1,q_2}; \dots; \\ z_s & (a_{sj}; \alpha'_{sj}, \dots, \alpha_{sj}^{(s)})_{1,p_s} : (a'_j, \alpha'_j)_{1,p'}; \dots; (a_j^{(s)}, \alpha_j^{(s)})_{1,p^{(s)}} \\ & (b_{sj}; \beta'_{sj}, \dots, \beta_{sj}^{(s)})_{1,q_s} : (b'_j, \beta'_j)_{1,q'}; \dots; (b_j^{(s)}, \beta_j^{(s)})_{1,q^{(s)}} \end{array} \right) \quad (1.11)$$

$$= \frac{1}{(2\pi\omega)^s} \int_{L_1} \cdots \int_{L_s} \xi(t_1, \dots, t_s) \prod_{i=1}^s \phi_i(t_i) z_i^{t_i} dt_1 \cdots dt_s \quad (1.12)$$

The defined integral of the above function, the existence and convergence conditions, see Y,N Prasad [2]. Throughout the present document, we assume that the existence and convergence conditions of the multivariable I-function.

The condition for absolute convergence of multiple Mellin-Barnes type contour (1.9) can be obtained by extension of the corresponding conditions for multivariable H-function given by as :

$$|arg z_k| < \frac{1}{2} \Omega_i^{(k)} \pi, \text{ where}$$

$$\begin{aligned} \Omega_i^{(k)} = & \sum_{k=1}^{n^{(i)}} \alpha_k^{(i)} - \sum_{k=n^{(i)}+1}^{p^{(i)}} \alpha_k^{(i)} + \sum_{k=1}^{m^{(i)}} \beta_k^{(i)} - \sum_{k=m^{(i)}+1}^{q^{(i)}} \beta_k^{(i)} + \left( \sum_{k=1}^{n_2} \alpha_{2k}^{(i)} - \sum_{k=n_2+1}^{p_2} \alpha_{2k}^{(i)} \right) + \cdots + \\ & \left( \sum_{k=1}^{n_s} \alpha_{sk}^{(i)} - \sum_{k=n_s+1}^{p_s} \alpha_{sk}^{(i)} \right) - \left( \sum_{k=1}^{q_2} \beta_{2k}^{(i)} + \sum_{k=1}^{q_3} \beta_{3k}^{(i)} + \cdots + \sum_{k=1}^{q_s} \beta_{sk}^{(i)} \right) \end{aligned} \quad (1.13)$$

where  $i = 1, \dots, s$

The complex numbers  $z_i$  are not zero.Throughout this document , we assume the existence and absolute convergence conditions of the multivariable I-function.

We may establish the the asymptotic expansion in the following convenient form :

$$I(z_1, \dots, z_s) = 0(|z_1|^{\alpha'_1}, \dots, |z_s|^{\alpha'_s}), \max(|z_1|, \dots, |z_s|) \rightarrow 0$$

$$I(z_1, \dots, z_s) = 0(|z_1|^{\beta'_1}, \dots, |z_s|^{\beta'_s}), \min(|z_1|, \dots, |z_s|) \rightarrow \infty$$

where, with  $k = 1, \dots, z : \alpha'_k = \min[Re(b_j^{(k)})/\beta_j^{(k)}], j = 1, \dots, m_k$  and

$$\beta'_k = \max[Re((a_j^{(k)} - 1)/\alpha_j^{(k)})], j = 1, \dots, n_k$$

We will use these following notations in this paper :

$$U = p_2, q_2; p_3, q_3; \dots; p_{s-1}, q_{s-1}; V = 0, n_2; 0, n_3; \dots; 0, n_{s-1} \quad (1.14)$$

$$W = (p', q'); \dots; (p^{(s)}, q^{(s)}); X = (m', n'); \dots; (m^{(s)}, n^{(s)}) \quad (1.15)$$

$$A = (a_{2k}, \alpha'_{2k}, \alpha''_{2k}); \dots; (a_{(s-1)k}), \alpha'_{(s-1)k}, \alpha''_{(s-1)k}, \dots, \alpha_{(s-1)k}^{(s-1)}) \quad (1.16)$$

$$B = (b_{2k}, \beta'_{2k}, \beta''_{2k}); \dots; (b_{(s-1)k}), \beta'_{(s-1)k}, \beta''_{(s-1)k}, \dots, \beta_{(s-1)k}^{(s-1)}) \quad (1.17)$$

$$\mathfrak{A} = (a_{sk}; \alpha'_{sk}, \alpha''_{sk}, \dots, \alpha_{sk}^s); \mathfrak{B} = (b_{sk}; \beta'_{sk}, \beta''_{sk}, \dots, \beta_{sk}^s) \quad (1.18)$$

$$A' = (a'_k, \alpha'_k)_{1,p'}; \dots; (a_k^{(s)}, \alpha_k^{(s)})_{1,p^{(s)}}; B' = (b'_k, \beta'_k)_{1,p'}; \dots; (b_k^{(s)}, \beta_k^{(s)})_{1,p^{(s)}} \quad (1.19)$$

The multivariable I-function write :

$$I(z_1, \dots, z_s) = I_{U:p_s, q_s; W}^{V; 0, n_s; X} \left( \begin{array}{c|c} z_1 & A; \mathfrak{A}; A' \\ \vdots & \vdots \\ z_s & B; \mathfrak{B}; B' \end{array} \right) \quad (1.20)$$

The generalized polynomials defined by Srivastava [4], is given in the following manner :

$$S_{N'_1, \dots, N'_t}^{M'_1, \dots, M'_t} [y_1, \dots, y_t] = \sum_{K_1=0}^{[N'_1/M'_1]} \dots \sum_{K_t=0}^{[N'_t/M'_t]} \frac{(-N'_1)_{M'_1 K_1}}{K_1!} \dots \frac{(-N'_t)_{M'_t K_t}}{K_t!} A[N'_1, K_1; \dots; N'_t, K_t] y_1^{K_1} \dots y_t^{K_t} \quad (1.21)$$

Where  $M'_1, \dots, M'_s$  are arbitrary positive integers and the coefficients  $A[N'_1, K_1; \dots; N'_t, K_t]$  are arbitrary constants, real or complex. In the present paper, we use the following notation

$$a_1 = \frac{(-N'_1)_{M'_1 K_1}}{K_1!} \dots \frac{(-N'_t)_{M'_t K_t}}{K_t!} A[N'_1, K_1; \dots; N'_t, K_t] \quad (1.22)$$

## 2. Extension of the Hurwitz-Lerch Zeta function

The extension of the Hurwitz-Lerch Zeta function  $\phi(z, s, a)$  is introduced by Srivastava et al ([6], eq.(6.2), page 503) as follows :

$$\phi_{(\lambda_1, \dots, \lambda_p, \mu_1, \dots, \mu_q)}^{(\rho_1, \dots, \rho_p, \sigma_1, \dots, \sigma_q)} (z; s, a) = \sum_{n=0}^{\infty} \frac{\prod_{j=1}^p (\lambda_j)_{n\rho_j}}{(a+n)^s \prod_{j=1}^q (\mu_j)_{n\sigma_j}} \times \frac{z^n}{n!} \quad (2.1)$$

with :  $p, q \in \mathbb{N}_0$ ,  $\lambda_j \in \mathbb{C}$  ( $j = 1, \dots, p$ ),  $a, \mu_j \in \mathbb{C} \setminus \mathbb{Z}_0^*$  ( $j = 1, \dots, q$ ),  $\rho_j, \sigma_k \in \mathbb{R}^+$

$$(j = 1, \dots, p; k = 1, \dots, q)$$

where  $\Delta > -1$  when  $s, z \in \mathbb{C}$ ;  $\Delta = -1$  and  $s \in \mathbb{C}$ , when  $|z| < \nabla^*$ ,  $\Delta = -1$  and  $Re(\chi) > \frac{1}{2}$  when  $|z| = \nabla^*$

$$\nabla^* = \prod_{j=1}^p \rho_j^{\rho_j} \prod_{j=1}^q \sigma_j^{\sigma_j}; \Delta = \sum_{j=1}^q \sigma_j - \sum_{j=1}^p \rho_j; \chi = s + \sum_{j=1}^q \mu_j - \sum_{j=1}^p \lambda_j + \frac{p-q}{2}$$

We denote these conditions the conditions (f).

## 3. Required formula

We have the following multiple integral transformation, see Marichev et al ([1], 33.4 page 590).  
let  $\bar{ax} = a_1x_1 + \cdots + a_nx_n$

$$\int_{x_1 \geq 0} \cdots \int_{x_n \geq 0} \frac{f(x_1 + \cdots + x_n)}{(ax + b)^{v_1 + \cdots + v_n}} \prod_{i=1}^n x_i^{v_i-1} dx_1 \cdots dx_n = \frac{\Gamma(v_1) \cdots \Gamma(v_n)}{\Gamma(v_1 + \cdots + v_n)} \times$$

$$\int_0^1 f(x) x^{v_1 + \cdots + v_n - 1} \prod_{i=1}^n (b + a_i x)^{-v_i} dx \quad (3.1)$$

where  $x_1 + \cdots + x_n \leq 1, b > 0, a_i > 0, v_i > 0, i = 1, \dots, n$

#### 4. Main integral

We note  $X_{v_1, \dots, v_n} = x_1^{v_1} \cdots x_n^{v_n}$  and  $b_n = \frac{\prod_{j=1}^p (\lambda_j)_{n\rho_j}}{(a+n)^s \prod_{j=1}^q (\mu_j)_{n\sigma_j}}$ , we have the following formula

##### Theorem

$$\int_{x_1 \geq 0} \cdots \int_{x_n \geq 0} \phi_{(\rho_1, \dots, \rho_p, \sigma_1, \dots, \sigma_q)}^{(\rho_1, \dots, \rho_p, \sigma_1, \dots, \sigma_q)}(z X_{\xi_1, \dots, \xi_n}; \mathfrak{s}, a) S_{N_1, \dots, N_t}^{M'_1, \dots, M'_t} \begin{pmatrix} y_1 X_{\gamma_1^{(1)}, \dots, \gamma_1^{(n)}} \\ \vdots \\ y_t X_{\gamma_t^{(1)}, \dots, \gamma_t^{(n)}} \end{pmatrix} \aleph_{u:w}^{0, N:v} \begin{pmatrix} z_1 X_{\alpha_1^{(1)}, \dots, \alpha_1^{(n)}} \\ \vdots \\ z_r X_{\alpha_r^{(1)}, \dots, \alpha_r^{(n)}} \end{pmatrix}$$

$$I_{U:p_s, q_s; W}^{V; 0, n_s; X} \begin{pmatrix} Z_1 X_{\eta_1^{(1)}, \dots, \eta_1^{(n)}} \\ \vdots \\ Z_s X_{\eta_s^{(1)}, \dots, \eta_s^{(n)}} \end{pmatrix} \frac{f(x_1 + \cdots + x_n)}{(ax + b)^{v_1 + \cdots + v_n}} \prod_{i=1}^n x_i^{v_i-1} dx_1 \cdots dx_n = \sum_{K_1=0}^{[N'_1/M'_1]} \cdots \sum_{K_t=0}^{[N'_t/M'_t]} \sum_{n'=0}^{\infty}$$

$$\sum_{G_1, \dots, G_r=0}^{\infty} \sum_{g_1=0}^{M_1} \cdots \sum_{g_r=0}^{M_r} \frac{(-)^{G_1 + \cdots + G_r}}{\delta_{g_1} G_1! \cdots \delta_{g_r} G_r!} G(\eta_{G_1, g_1}, \dots, \eta_{G_r, g_r}) a_1 \frac{b_{n'} z^{n'}}{n'!} z_1^{\eta_{G_1, g_1}} \cdots z_r^{\eta_{G_r, g_r}} y_1^{K_1} \cdots y_t^{K_t}$$

$$\int_0^1 f(x) \frac{x^{\sum_{i=1}^n (n' \xi_i + \sum_{j=1}^t K_j \gamma_j^{(i)} + \sum_{j=1}^r \eta_{G_j, g_j} \alpha_j^{(i)})}}{\prod_{i=1}^n (b + a_i x)^{\xi_i + \sum_{j=1}^t K_j \gamma_j^{(i)} + \sum_{j=1}^r \eta_{G_j, g_j} \alpha_j^{(i)}}} I_{U:p_s+n, q_s+1; W}^{V; 0, n_s+n; X} \begin{cases} Z_1 \frac{x^{\eta_1^{(1)} + \cdots + \eta_1^{(n)}}}{\prod_{i=1}^n (b + a_i x)^{\eta_1^{(i)}}} & |A|; \\ \vdots & \vdots \\ Z_s \frac{x^{\eta_s^{(1)} + \cdots + \eta_s^{(n)}}}{\prod_{i=1}^n (b + a_i x)^{\eta_s^{(i)}}} & |B|; \end{cases}$$

$$\left[ 1 - (v_i + n' \xi_i + \sum_{j=1}^t K_j \gamma_j^{(i)} + \sum_{j=1}^r \eta_{G_i, g_i} \alpha_j^{(i)}); \eta_1^{(i)}, \dots, \eta_s^{(i)} \right]_{1,n}, \mathfrak{A}; A' \right) dx \\ \vdots \\ B_1, \mathfrak{B}; B' \quad (4.1)$$

$$\text{where : } B_1 = \left\{ 1 - \sum_{i=1}^n \left[ v_i + n' \xi_i + \sum_{j=1}^t K_j \gamma_j^{(i)} + \sum_{j=1}^{\eta} G_{j,g_j} \alpha_j^{(i)} \right] ; \eta_1^{(1)} + \cdots + \eta_1^{(n)}, \right. \\ \left. \cdots, \eta_s^{(1)} + \cdots + \eta_s^{(n)} \right\} \quad (4.2)$$

Provided that

a)  $\min\{\xi_i, v_i, \gamma_j^{(i)}, \alpha_k^{(i)}, \eta_l^{(i)}, \dots\} > 0, i = 1, \dots, n, j = 1, \dots, t, k = 1, \dots, r, l = 1, \dots, s$

b)  $Re[v_i + n' \xi_i + \sum_{j=1}^r \alpha_j^{(i)} \min_{1 \leq j \leq M_i} \frac{d_j^{(i)}}{\delta_j^{(i)}} + \sum_{j=1}^s \eta_j^{(i)} \min_{1 \leq j \leq m_i} \frac{b_j^{(i)}}{\beta_j^{(i)}}] > 0, i = 1, \dots, n$

c)  $|arg z_k| < \frac{1}{2} A_i^{(k)} \pi$ , where  $A_i^{(k)}$  is defined by (1.5);  $i = 1, \dots, r$

d)  $|arg Z_k| < \frac{1}{2} \Omega_i^{(k)} \pi$ , where  $\Omega_i^{(k)}$  is defined by (1.11);  $i = 1, \dots, s$

e)  $x_1 + \cdots + x_n \leq 1, a_i > 0, i = 1, \dots, n, b > 0$

f) The conditions (f) are satisfied

g) The series occurring on the right-hand side of (4.1) is absolutely and uniformly convergent.

The quantities  $U, V, W, X, A, B, \mathfrak{A}, \mathfrak{B}, A'$  and  $B'$  are defined by the equations (1.14) to (1.19)

**Proof of (4.1) :** Let  $M = \frac{1}{(2\pi\omega)^s} \int_{L_1} \cdots \int_{L_s} \xi(t_1, \dots, t_s) \prod_{i=1}^s \phi_i(t_i)$ . We have :

$$\phi_{(\lambda_1, \dots, \lambda_p, \mu_1, \dots, \mu_q)}^{(\rho_1, \dots, \rho_p, \sigma_1, \dots, \sigma_q)}(zX_{\xi_1, \dots, \xi_n}; \mathfrak{s}, a) S_{N_1, \dots, N_t}^{M'_1, \dots, M'_t} \begin{pmatrix} y_1 X_{\gamma_1^{(1)}, \dots, \gamma_1^{(n)}} \\ \dots \\ y_t X_{\gamma_t^{(1)}, \dots, \gamma_t^{(n)}} \end{pmatrix} \aleph_{u:w}^{0, N:v} \begin{pmatrix} z_1 X_{\alpha_1^{(1)}, \dots, \alpha_1^{(n)}} \\ \dots \\ z_r X_{\alpha_r^{(1)}, \dots, \alpha_r^{(n)}} \end{pmatrix}$$

$$I_{U:p_s, q_s; W}^{V; 0, n_s; X} \begin{pmatrix} Z_1 X_{\eta_1^{(1)}, \dots, \eta_1^{(n)}} \\ \dots \\ Z_s X_{\eta_s^{(1)}, \dots, \eta_s^{(n)}} \end{pmatrix} = \sum_{G_1, \dots, G_r=0}^{\infty} \sum_{g_1=0}^{M_1} \cdots \sum_{g_r=0}^{M_r} \sum_{K_1=0}^{[N'_1/M'_1]} \cdots \sum_{K_t=0}^{[N'_t/M'_t]} \sum_{n'=0}^{\infty} \frac{(-)^{G_1+\dots+G_r}}{\delta_{g_1} G_1! \cdots \delta_{g_r} G_r!}$$

$$a_1 \frac{b_{n'} z^{n'}}{n'!} G(\eta_{G_1, g_1}, \dots, \eta_{G_r, g_r}) z_1^{\eta_{G_1, g_1}} \cdots z_r^{\eta_{G_r, g_r}} y_1^{K_1} \cdots y_t^{K_t} X_{\xi_1, \dots, \xi_n}^{n'} \prod_{j=1}^t X_{\gamma_j^{(1)}, \dots, \gamma_j^{(n)}}^{K_j}$$

$$\prod_{j=1}^r X_{\alpha_j^{(1)}, \dots, \alpha_j^{(n)}}^{\eta_{G_j, g_j}} M \left[ \prod_{j=1}^s Z^j X_{\eta_j^{(1)}, \dots, \eta_j^{(n)}}^{t_j} \right] dt_1 \cdots dt_s \quad (4.3)$$

Multiplying both sides of (4.3) by  $\frac{f(x_1 + \cdots + x_n)}{(\bar{a}x + b)^{v_1 + \cdots + v_n}} \prod_{i=1}^n x_i^{v_i - 1}$  and integrating with respect to  $x_1, \dots, x_s$  verifying the conditions e), changing the order of integration and summation (which is easily seen to be justified due to the absolute convergence of the integral and the summations involved in the process), we obtain :

$$\sum_{G_1, \dots, G_r=0}^{\infty} \sum_{g_1=0}^{M_1} \cdots \sum_{g_r=0}^{M_r} \sum_{K_1=0}^{[N'_1/M'_1]} \cdots \sum_{K_t=0}^{[N'_t/M'_t]} \sum_{n'=0}^{\infty} \frac{(-)^{G_1+\cdots+G_r}}{\delta_{g_1} G_1! \cdots \delta_{g_r} G_r!} G(\eta_{G_1, g_1}, \dots, \eta_{G_r, g_r}) a_1 \frac{b_{n'} z^{n'}}{n'!}$$

$$z_1^{\eta_{G_1, g_1}} \cdots z_r^{\eta_{G_r, g_r}} y_1^{K_1} \cdots y_t^{K_t} \int_{x_1 \geq 0} \cdots \int_{x_n \geq 0} \prod_{j=1}^t X_{\gamma_j^{(1)}, \dots, \gamma_j^{(n)}}^{K_j} X_{\xi_1, \dots, \xi_n}^{n'} \prod_{j=1}^r X_{\alpha_j^{(1)}, \dots, \alpha_j^{(n)}}^{\eta_{G_j, g_j}}$$

$$\left\{ M \left[ \prod_{j=1}^s Z^j X_{\eta_j^{(1)}, \dots, \eta_j^{(n)}}^{t_j} \right] dt_1 \cdots dt_s \right\} \frac{f(x_1 + \cdots + x_n)}{(\bar{a}x + b)^{v_1 + \cdots + v_n}} \prod_{i=1}^n x_i^{v_i - 1} dx_1 \cdots dx_n \quad (4.4)$$

Change the order of the  $(x_1, \dots, x_n)$ -integral and  $(t_1, \dots, t_s)$ -integral ,we get :

$$\sum_{G_1, \dots, G_r=0}^{\infty} \sum_{g_1=0}^{M_1} \cdots \sum_{g_r=0}^{M_r} \sum_{K_1=0}^{[N'_1/M'_1]} \cdots \sum_{K_t=0}^{[N'_t/M'_t]} \sum_{n'=0}^{\infty} \frac{(-)^{G_1+\cdots+G_r}}{\delta_{g_1} G_1! \cdots \delta_{g_r} G_r!} G(\eta_{G_1, g_1}, \dots, \eta_{G_r, g_r}) a_1 \frac{b_{n'} z^{n'}}{n'!}$$

$$z_1^{\eta_{G_1, g_1}} \cdots z_r^{\eta_{G_r, g_r}} y_1^{K_1} \cdots y_t^{K_t} M \left\{ \prod_{j=1}^s Z_j^{t_j} \int_{x_1 \geq 0} \cdots \int_{x_n \geq 0} \frac{f(x_1 + \cdots + x_n)}{(\bar{a}x + b)^{v_1 + \cdots + v_n}} \right. \\ \left. \prod_{i=1}^n x_i^{\xi_i n' + \sum_{j=1}^t K_j \gamma_j^{(i)} + \sum_{j=1}^r \eta_{G_j, g_j} \alpha_j^{(i)} + \sum_{j=1}^s t_j \eta_j^{(i)} + v_i - 1} dx_1 \cdots dx_n \right\} dt_1 \cdots dt_s \quad (4.5)$$

Use the equation (3.1) and interpreting the result thus obtained with the Mellin-barnes contour integral (1.12), we arrive at the desired result.

## 5. Particular case

If  $U = V = A = B = 0$ , the multivariable I-function defined by Prasad degenerates in multivariable H-function defined by Srivastava et al [5]. We have the following result.

**Lemme**

$$\int_{x_1 \geqslant 0} \cdots \int_{x_n \geqslant 0} \phi_{(\lambda_1, \dots, \lambda_p, \mu_1, \dots, \mu_q)}^{(\rho_1, \dots, \rho_p, \sigma_1, \dots, \sigma_q)}(z X_{\xi_1, \dots, \xi_n}; \mathfrak{s}, a) S_{N_1, \dots, N_t}^{M'_1, \dots, M'_t} \begin{pmatrix} y_1 X_{\gamma_1^{(1)}, \dots, \gamma_1^{(n)}} \\ \vdots \\ y_t X_{\gamma_t^{(1)}, \dots, \gamma_t^{(n)}} \end{pmatrix} \aleph_{u:w}^{0, N:v} \begin{pmatrix} z_1 X_{\alpha_1^{(1)}, \dots, \alpha_1^{(n)}} \\ \vdots \\ z_r X_{\alpha_r^{(1)}, \dots, \alpha_r^{(n)}} \end{pmatrix}$$

$$H_{p_s, q_s; W}^{0, n_s; X} \begin{pmatrix} Z_1 X_{\eta_1^{(1)}, \dots, \eta_1^{(n)}} \\ \vdots \\ Z_s X_{\eta_s^{(1)}, \dots, \eta_s^{(n)}} \end{pmatrix} \frac{f(x_1 + \dots + x_n)}{(ax + b)^{v_1 + \dots + v_n}} \prod_{i=1}^n x_i^{v_i - 1} dx_1 \cdots dx_n = \sum_{K_1=0}^{[N'_1/M'_1]} \cdots \sum_{K_t=0}^{[N'_t/M'_t]} \sum_{n'=0}^{\infty}$$

$$\sum_{G_1, \dots, G_r=0}^{\infty} \sum_{g_1=0}^{M_1} \cdots \sum_{g_r=0}^{M_r} \frac{(-)^{G_1 + \dots + G_r}}{\delta_{g_1} G_1! \cdots \delta_{g_r} G_r!} G(\eta_{G_1, g_1}, \dots, \eta_{G_r, g_r}) a_1 \frac{b_{n'} z^{n'}}{n'!} z_1^{\eta_{G_1, g_1}} \cdots z_r^{\eta_{G_r, g_r}} y_1^{K_1} \cdots y_t^{K_t}$$

$$\int_0^1 f(x) \frac{x^{\sum_{i=1}^n (n' \xi_i + \sum_{j=1}^t K_j \gamma_j^{(i)} + \sum_{j=1}^r \eta_{G_j, g_j} \alpha_j^{(i)})}}{\prod_{i=1}^n (b + a_i x)^{\xi_i + \sum_{j=1}^t K_j \gamma_j^{(i)} + \sum_{j=1}^r \eta_{G_j, g_j} \alpha_j^{(i)}}} H_{p_s+n, q_s+1; W}^{0, n_s+n; X} \begin{pmatrix} Z_1 \frac{x^{\eta_1^{(1)} + \dots + \eta_1^{(n)}}}{\prod_{i=1}^n (b + a_i x)^{\eta_1^{(i)}}} \\ \vdots \\ Z_s \frac{x^{\eta_s^{(1)} + \dots + \eta_s^{(n)}}}{\prod_{i=1}^n (b + a_i x)^{\eta_s^{(i)}}} \end{pmatrix}$$

$$\left[ 1 - (v_i + n' \xi_i + \sum_{j=1}^t K_i \gamma_j^{(i)} + \sum_{j=1}^r \eta_{G_i, g_i} \alpha_j^{(i)}); \eta_1^{(i)}, \dots, \eta_s^{(i)} \right]_{1,n}, \mathfrak{A}; A' \right)_{\text{d}x} \\ \vdots \\ B_1, \mathfrak{B}; B' \right) \quad (5.1)$$

under the same notations and conditions that (4.1) with  $U = V = A = B = 0$  and  $B_1$  is defined by (4.2)

## 6. Conclusion

In this paper we have evaluated a generalized multiple integral transformation involving the multivariable Aleph-function, a class of polynomials of several variables a extension of the Hurwitz-Lerch Zeta-function and the multivariable I-function defined by Prasad. The integral established in this paper is of very general nature as it contains Multivariable Aleph-function, which is a general function of several variables studied so far. Thus, the integral established in this research work would serve as a key formula from which, upon specializing the parameters, as many as desired results involving the special functions of one and several variables can be obtained.

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