DETERMINATION OF THE CYCLIC PROCESS INVOLVING I-FUNCTION

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ABSTRACT

The aim of this paper is to determine the equation of cyclic process by I–Function of one variable.

Keywords: I-Function, Cyclic Process.

1. INTRODUCTION:

The I-function of one variable is defined by Saxena [3, p.366-375] and we will represent here in the following manner:

$$I^{m,\,n}_{p_i,\,q_i:\,r}\left[x\,\middle|\,\begin{matrix}[(a_j,\alpha_j)_{1,n}],[(a_{ji},\alpha_{ji})_{n+1,p_i}]\\ [(b_j,\beta_j)_{1,m}],[(b_{ji},\beta_{ji})_{m+1,q_i}]\end{matrix}\right] = (1/2\pi i)\int_L \theta(s)\,x^s\,ds \qquad (1)$$

where $i = \sqrt{(-1)}$,

$$\theta(s) = \frac{\prod_{j=1}^{m}\Gamma(b_j-\beta_j s)\prod_{j=1}^{n}\Gamma(1-a_j+\alpha_j s)}{\sum_{i=1}^{r}\left\{\prod_{j=m+1}^{q_i}\Gamma(1-b_{ji}+\beta_{ji}s)\prod_{j=n+1}^{p_i}\Gamma(a_{ji}-\alpha_{ji}s)\right\}},$$

integral is convergent, when ($B>0$, $A \le 0$), where

$$B = \sum_{j=1}^{n}\alpha_j - \sum_{j=n+1}^{pi}\alpha_{ji} + \sum_{j=1}^{m}\beta_j - \sum_{j=m+1}^{qi}\beta_{ji}, \qquad (2)$$

$$A = \sum_{j=1}^{pi}\alpha_{ji} - \sum_{j=1}^{qi}\beta_{ji}, \qquad (3)$$

$$|\arg x| < \tfrac{1}{2}B\pi,\ \forall\ i \in (1, 2, \ldots, r). \qquad (4)$$

2. MAIN RESULT:

The equation of cyclic process in terms of I-function of one variable to be represented is:

$$I^{m+1,n}_{p_i+1,q_i+1:r}\left[x\Big|^{\ldots\ldots\ldots,(1+Q,Q_1)}_{(Q,Q_1),\ldots\ldots\ldots}\right]$$

$$= I^{m,n+1}_{p_i+1,q_i+1:r}\left[x\Big|^{(-W,W_1),\ldots\ldots\ldots}_{\ldots\ldots\ldots,(1-W,W_1)}\right] + c\, I^{m,n}_{p_i,q_i:r}[x], \qquad (5)$$

valid for $Q > Q_1$, $W > W_1$ and $|\arg x| < \frac{1}{2}\pi B$, where B is given in (2).

Proof of the Formula:

When a system undergoes a series of physical changes and then returns to its original position then the change in its internal energy is zero because initial and final positions are same, i.e. dE = 0 The amount of heat dQ subjected to system is governed by the first law of thermodynamics

$$dQ = dW \qquad (6)$$

Such a process is known as cyclic process [1, p.273].

On integrating, (6) provides

$$\int dQ = \int dW + c$$

or $$Q = W + c$$

or $$\Gamma(Q+1)/\Gamma(Q) = \Gamma(W+1)/\Gamma(W) + c \qquad (7)$$

where c is constant.

Again put $W = W + W_1 s$, $Q = Q - Q_1 s$ (since as work increase, the amount of heat will be decreases) in (7) and multiply both side by $(1/2\pi i)\theta(s)x^s$, further integrate with respect to s in the direction of contour L and use (1), we get (5).

3. SPECIAL CASE:

On choosing r = 1 in (5), we get following equation of cyclic process in terms of H-function [2] of one variable as follows:

$$H^{m+1,n}_{p+1,q+1}\left[x\Big|^{(a_j,\alpha_j)_{1,p},(1+Q,Q_1)}_{(Q,Q_1),(b_j,\beta_j)_{1,q}}\right]$$

$$= H^{m,n+1}_{p+1,q+1}\left[x\Big|^{(-W,W_1),(a_j,\alpha_j)_{1,p}}_{(b_j,\beta_j)_{1,q},(1-W,W_1)}\right] + c\, H^{m,n}_{p,q}\left[x\Big|^{(a_j,\alpha_j)_{1,p}}_{(b_j,\beta_j)_{1,q}}\right], \qquad (8)$$

valid for $Q > Q_1$, $W > W_1$ and $|\arg x| < \frac{1}{2}\pi A$, where A is given by

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$$\sum_{j=1}^{n} \alpha_j - \sum_{j=n+1}^{p} \alpha_j + \sum_{j=1}^{m} \beta_j - \sum_{j=m+1}^{q} \beta_j \equiv A > 0,$$

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