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On Certain new identities associated with Ramanujan's modular equations

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Abstract: In this paper, making use of certain modular equations due to Ramanujan, an attempt has been made to establish some new P-Q identities.
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1. Introduction, Notations and Definitions:

Ramanujan has recorded several P-Q eta function identities in chapter 25 of his second notebook. Berndt [4] and Berndt and Zhang [6] proved these P-Q identities by employing various modular equations belonging to the classical theory. In this paper, an attempt has been made to establish certain P-Q identities by making use of modular equations due to Ramanujan. Many other mathematicians have used P-Q eta function identities to evaluate Ramanujan's theta functions, Ramanujan's class invariants, Rogers-Ramanujan continued fraction. In this regard the works of Berndt and Chan [7], Berndt, Chan and Zhang [9], Bhargava and Adiga [10] are note worthy.

Let $Z_r = Z(r,x) = {}_2F_1[1/r,(r-1)/r;1;x]$ and

$$q_r = q_r(x) = exp\left(-\pi cosec(\pi/r)\frac{{}_2F_1[1/r,(r-1)/r;1;1-x]}{{}_2F_1[1/r,(r-1)/r;1;x]}\right), \qquad (1.1)$$

where $r = 2,3,4$ and 6 and ${}_2F_1[1/r,(r-1)/r;1;x]$ denotes the ordinary hypergeometric functions defined as;

$${}_2F_1[a,b;c;z] = \sum_{n=0}^{\infty}\frac{(a)_n(b)_n z^n}{(c)_n n!},$$