ICMASE 2025

DIFFERENTIAL EQUATIONS FOR ULTRASPHERICAL JACOBIAN POLYNOMIALS.

Sahib ALIYEV [1,*], Jeyhun ALIYEV[2], Elshad AGAYEV[3],

[1]*Department of General Mathematics,Nakhchivan State University, Nakhchivan, Azerbaijan*
[2]*Department of General Mathematics,Nakhchivan State University, Nakhchivan, Azerbaijan*
[3]*Department of General Mathematics,Nakhchivan State University, Nakhchivan, Azerbaijan*

ABSTRACT

The aim of this article is to show a method of constructing Jacobi's system of polynomials and Differential equations for ultraspherical Jacobian polynomials.Generalized Jacobian polynomials, which are one of the classical orthogonal polynomials, and orthonormal Jacobian polynomials with respect to the weight function have been determined. Fourier series for this polynomial has been investigated. Now we will look at the problem with some applications of Jacobian polynomials, including the application of differential equations.For any weight function $h(x)$ there is a unique sequence of many terms $P_n(x)$ that have a positive leading coefficient and satisfy the orthonormality condition. Given the weight function $h(x) = (1-x)^{\alpha}(1+x)^{\beta},\ x \in (-1,1), \alpha > -1\ , \beta > -1$ using the Leibniz formula, a polynomial of degree n $P_n^{(\alpha,\beta)}(x)$ is defined. It is clear that the polynomial $P_n^{(\alpha,\beta)}(x)$ is a Jacobi polynomial with a high degree coefficient and it is proved that orthogonal with respect to the weight function in the interval $(-1,1)$.By defining the norm, the corresponding orthonormal polynomial is determined. Using the orthogonality and orthonormality conditions, a zero-order polynomial $\bar{P}_0^{(\alpha,\beta)}(x)$is defined and constant. C_0, C_1 coefficients are determined using the corresponding lemma.$\bar{P}_1^{(\alpha,\beta)}(x)$ is defined and other $\bar{P}_2^{(\alpha,\beta)}(x)$ polynomials etc. can be found.Taking all this into account, it can be applied to differential equations and their solution methods for ultraspheric Jacobian polynomials.

Keywords Weight function, ultraspherical Jacobi polynomial · Rodrigues formula, Kronecker delta, · Leibniz rule

References

[1] Ya.L. Geronimus, On the polynomials orthogonal with respect to a given number sequence and a theorem by W. Hahn, Izv. Akad. Nauk SSSR 4 (1940) 215–228.

[2] J.Aliyev, S.Aliyev, Fourier series for orthogonal and orthonormal functions,Nakhchivan Teachers Institute, Scientific works, 2020, №4, p.155-158

[3] S.Aliyev, E.Agayev, J.Aliyev, On a method of construction of a system of Chebyshev -Lager polynomials Nakhchivan State University , Scientific works, 2020, № 5 (106), 7-11

[4] J.Aliyev, On a method of construction of a system of Jacobi polynomials, International Scientific and Practical Conference «New problems of science and ways of their solution», February 20-21,Paris,France, 102 p. 51-55,2024

[5] S.Alıyev,Constructing a System of First Kind Chebyshev Polynomials Operators in General Morrey-Type Spaces and Applications (OMTSA 2019), Kutahya Dumlupinar University, Kutahya, Türkiye, 16-20 July, 2019

*Corresponding Author's E-mail: jeyhunaliyev@ndu.edu.az