Dissertation Review Form
-for members of the Dissertation Commission-

Please write a review of the dissertation taking the following criteria into account, where appropriate:

- **General remarks**

  This dissertation solves <u>difference equations</u> Dx = y. Here x and y are arrays (tables) of numbers and D is an difference operator that converts the array x into the array y. The problem : given y compute x arises in mathematics, science and engineering. Each entry in y is a linear combination of the neighbors of the corresponding entry in x. Directy computing x is not feasible because it requires solving an infinite systems of equations in an infinite number of variables. This dissertation uses the method of <u>generating functions</u> which transform the original equation to an equation P(D) G(x) = G(y). Here G(x) and G(y) are the generating functions of x and y, respectively, and P(D) is a polynomial determined by D. A generating function is a formal power series (infinite polynomial) whose coefficients are elements of the array it represents. The solution of the transformed equation is:

  $$G(x) \; = \; P(D)^{-1}G(y)$$

  where $P(D)^{-1}$ is a formal power series called a fundamental solution of D. There are several fundamental solutions so the <u>challenge</u> is to determine the one that gives a correct solution by using <u>initial values</u> and <u>boundary constraints</u> of x.

  The main application of difference equations in this dissertation is to count lattice paths. Numbers in each position are nonnegative

integers that count the number of paths from an initial position to each position with specified step sizes and restricted regions.

- **The significance and status of the dissertation in the field**

  The dissertation <u>is significant</u> because it develops new powerful methods to solve difference equations.

  The dissertation <u>earned high status</u>, even before its publication, because the author published her results in 5 refereed journals and presented them in 5 conferences.

- **The sufficiency and quality of the material**

  The material is sufficient and the quality is good.

- **The adequacy of the methods used**

  The main method of generating functions, is adequate.

- **The validity of results**

  The results appear valid.

- **The logic of the dissertation's structure**

  The structure, consisting of inroduction, three chapters, conclusion, and references is logical.

- **The knowledge and use of literature in the field**

  The dissertation used knowledge from 45 journal articles and 12 books in addition to her own 5 articles and 5 conference proceedings.

- **The project's contribution to the research area**

  The dissertation's main contributions include: 1. Deriving a solution to multidimensional Cauchy (initial value) problems using generating functions and fundamental solutions, 2. Applying this solution method to extend the Chaundy and Bullard identities for one dimensional to multidimensions, 3. Derived generating functions for restricted lattice paths by using diagonal sequences and non constant coefficient difference equations which extend the

conventional kernel method, 4. Illustrating these new methods by applying them to count Dyck, Schröder , and Motzkin paths.

- **The author's input into the achievement of the dissertation results**

  I assume that the author wrote the dissertation.

- **Language**

  The dissertation is written in English and in the international language of mathematics

- **The shortcomings of the manuscript**

  I did not discover any shortcomings.

Name of the PhD Candidate   : Mrs Sreelatha Chandragiri
Planned Date of Graduation   : October, year: 2020

Title of the Dissertation: «The Cauchy problem for difference equations in lattice cones and generating functions for its solution

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Name of the Dissertation Commission Member :   Wayne Michael LAWTON
Chair / Function   : ……………………………

Date   : **4 June 2020**

Signature   : ……………………………

Please send the completed form to the Head of Department of Highly Qualified Personnel Training Grigorieva O.A. e-mail:grigorieva_00@mail.ru, tel. +7 (391) 206-22-62, address: 79/10 Svobodny pr., Room P6-16, 660041 Krasnoyarsk, Russia