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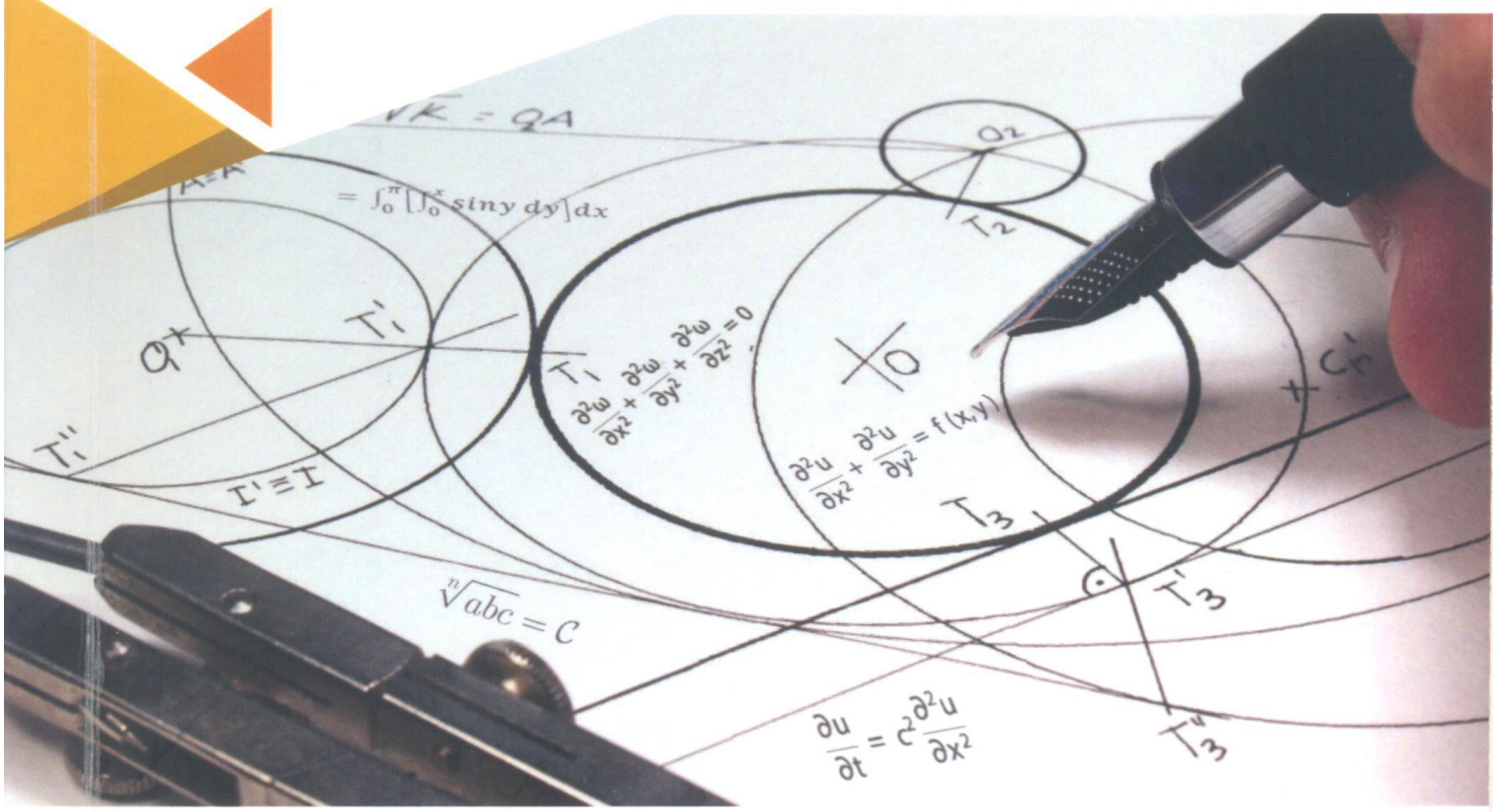

COLLEGE OF ARTS AND SCIENCES

Introduction to the Z-Transforms and Engineering Applications, a Survey

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We introduce the basic theory of Z-transforms, provide numerical examples and answer the question what are the benefits and advantages of using transforms in the solution of discrete systems. As it is well known, Laplace transform is commonly used for solving and analyzing linear ordinary differential equations and system of linear ODE, likely the Z-transform method is the most suitable for linear difference equations and systems of linear difference equations. Such sort of solutions are related with analyzing and designing of digital control, communication, and signal processing. The Z-transform is simply a power series representation of a discrete-time sequence.

Development of an Automated System for Optimal Management of Oil Production

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The work is dedicated to the development and research of methods of mathematical and computer modeling of fluid flow filtration process in porous media. It substantiates various approximate methods for solving the multiphase fluid filtration theory and shows the structures of building a system of automated analysis, monitoring and forecasting of technological parameters of oil and gas development.

The main objective of the work is to construct a mathematical model of the object, i.e., a formalization of the object's functioning laws, based on the structure and parameters of the system, the control law is determined, a hardware implementation is selected. This is due to the increased role of mathematical modeling and computational experiment for the discovery

of these laws, and the study of complex phenomena. The relatively recently developed structural theory of distributed systems makes it possible to study the behavior of objects in their mathematical models. In the oil and gas field development system the next part of the overall production process is a sequence of physical processes of gas filtration, condensate, water in the porous permeable formation and movement of these components in wells. Over 20 years researches on the development of automated systems of oil and gas fields have been conducted, which are designed for the specialists of the oil industry of the Republic of Kazakhstan.

In the paper the following basic mathematical problems are studied:

1. To determine the solvability of a mathematical model of nonequilibrium filtration, describing the process of oil displacement by polymer solutions.

2. To prove the correctness of the mathematical model and properties of solutions based on phase transitions.

3. Justify the fictitious domain method for solving problems of the theory of filtration.

4. Develop a comprehensive program for the evaluation of changes of technological parameters of the deposit.

Mathematical and Numerical Simulation of a Liquid Filtering Process in a Porous Medium

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The work is devoted to the description of the process of fluid filtration in porous media with phase transitions. The corresponding mathematical model is a sophisticated version of problems such as Stefan's and Verigin's. The boundaries between the subdomains are free (unknown), and shall be determined in the process of solution of the corresponding mathematical problem. The numerical algorithm for the numerical implementations and

test cases to describe the motion of a fluid in a porous medium are built. A comparative analysis with the real processes of a particular field is carried out. Test examples show that the construction of a mathematical model can be used to forecast calculations. At the same time by the history of development options to adapt the model are studied.

Investigating Hydrochemistry and the Groundwater Quality Prospects Evaluation and Its Suitability for Agricultural, Tabuk, Jauf and Hail Regions, Saudi Arabia Using Descriptive

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The current study emphasizes on the hydrochemical evaluation of groundwater in the Northwestern part of Saudi Arabia and particularly in Tabuk, Jauf and Hail regions. In these regions, the aquifers appear as confined aquifers. The main aquifer has extensive outcrop areas along the boundary with the Arabian Shield in the west, where it receives some recharge which is less than the volumes abstracted from the aquifer. Groundwater samples were gathered from about 60 groundwater wells and tested for various physico-chemical parameters such as electrical conductivity (EC), pH, temperature, total dissolved solids (TDS), Na^+, K^+, Ca^{2+}, Mg^{2+}, CO_3^{2-}, HCO_3^-, Cl^-, SO_4^{2-}, and NO_3^-. Groundwater in the area is slightly alkaline and hard in nature. Electrical conductivity (EC) varies between 171 and 5061 μS/cm with an average value of 982μS/cm. The distribution of major ions in the groundwater is $Ca^{++} > Na^+ > Mg^{++} > K^+$ and $Cl^- > SO_4^{2-} > HCO_3^-$. Using Pipers classification, groundwater was classified under Na-C-SO_4 water type. The GW has acquired unique chemical characteristics through prolonged rock water interactions, percolation of irrigation return water and reactions at vadose zone.

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