Abstract

This thesis is concerned with the construction and solution of various models of moving boundary problems (MBPs) by different approaches. The main feature of these problems is that they consist variable thermal coefficients or diffusion coefficients (Space-dependent, temperature-dependent) and different types of boundary conditions, due to which analytical solutions of these problems have not been derived yet. Therefore, different approximate and numerical techniques are applied on these problems to derive the almost accurate solutions.

This thesis contains five chapters. In chapter 1, introduction of MBPs, literature survey of MBPs, some definitions and basic concept of some proposed techniques are included.

In chapter 2, a moving boundary problem with moving phase change material and time dependent thermal conductivity is considered in a moving domain. The boundary fixation of this moving boundary has been done by using Landau type transformation. After that, the finite difference discretizations have been done for space and time derivatives, and then explicit scheme has been used to derive the solution. The error analysis, stability analysis and convergence of the have also been established for the considered method. The dependence of temperature distribution in the domain on various parameters is also analyzed.

Next, a space fractional population logistic diffusion model with density dependent dispersal rate has been considered in chapter 3, and explicit scheme is applied on it to get the solution of the problem. The proposed scheme for the above mentioned problem is consistent. It is proved that the scheme is conditionally stable and convergence for the proposed method. The analysis of various parameters of the model on the population growth is also presented through the different figures.

In chapter 4, a time-fractional Stefan problem in a semi-infinite domain with a Robin boundary condition at the first fixed boundary and variable thermal conductivity is presented. The classical approach of the heat balance integral method with quadratic and exponential temperature profiles is applied to the problem to find an approximate solution. To test the validation of the proposed approach, our solution is compared with the analytical solutions for integer-order derivative and fractional order cases when thermal conductivity is a constant. In this study, the effects of variable thermal conductivity and Biot number (Bi) on the temperature distribution and moving interface are also analyzed for the fractional-order system.

In chapter 5, an Operational Matrix Method based on Genocchi polynomials is used to determine the solution of a non-classical Stefan problem with space dependent thermal conductivity, variable latent heat and Robin boundary condition. The proposed method is easy to apply and the results obtained from this method are sufficiently accurate.

In chapter 6, the conclusion of the overall work and the scope for the future work related to this thesis is discussed.