

AN EXPONENTIAL FITTED METHOD FOR SINGULARLY
PERTURBED REACTION-DIFFUSION EQUATIONS

Fevzi ERDOGAN¹, Kerem YAMAC², Mehmet Gıyas SAKAR³

^{1,2,3}*Yuzuncu Yil University, Van, TURKEY*

MSC 2000: 34D15, 33F05

Abstract

In this study we consider a numerical method for a singularly perturbed one-dimensional reaction-diffusion problem whose solution exhibits boundary layers. A finite difference scheme is constructed in an equidistant mesh, which gives first and second order uniform convergence in the discrete maximum norm. A fitting factor is introduced in finite difference scheme and is obtained from the theory of singular perturbations. Thomas algorithm is used to solve the system. The method is shown to uniformly convergent with respect to the perturbation parameter. A numerical experiment illustrate in practice the result of convergence proved theoretically.

Keywords: Reaction-diffusion, singular perturbation, numerov method

References

- [1] R.E. OMalley Jr., Singular Perturbation Methods for Ordinary Differential Equations, Springer-Verlag, New York, 1991.
- [2] J.J.H. Miller, E. O'Riordan, G.I. Shishkin, Fitted Numerical Methods for Singular Perturbation Problems. Error Estimates in the Maximum Norm for Linear Problems in One and Two Dimensions, World Scientific, Singapore, 1996.
- [3] K. Phaneendra, P. Pramod Chakravarthy and Y. N. Reddy, A Fitted Numerov Method for Singular Perturbation Problems Exhibiting Twin Layers, Applied Mathematics and Information Sciences 4(3) (2010), 341-352

¹ferdogan@yyu.edu.tr

²keremyamac@yyu.edu.tr

³giyassakar@hotmail.com