

## GLOBAL EXISTENCE AND UNIQUENESS FOR IMPLICIT DIFFERENTIAL EQUATION OF ARBITRARY ORDER

SAGAR T. SUTAR AND KISHOR D. KUCCHE

*Abstract.* The aim of this paper is to establish the existence result for implicit differential equation of fractional (arbitrary) order via topological transversality theorem known as Leray-Schauder alternative. Further we prove the uniqueness results. The Grownwall's lemma for singular kernels play an important role to prove our results. We verify our results by providing an example. *Mathematics subject classification (2010):* 26A33, 34A08.

*Keywords and phrases:* Implicit fractional differential equation, Leray-Schauder alternative, existence and uniqueness, integral inequality.

### REFERENCES

- [1] R. P. AGARWAL, M. BELMEKKI, M. BENCHOHRA, *A survey on semilinear differential equations and inclusions involving Riemann-Liouville fractional derivative*, Adv. Diff. Equ. **47** (2009), Article ID 981728.
- [2] R. P. AGARWAL, YONG ZHOU, YUNYUN HE, *Existence of fractional neutral functional differential equations*, Computers and Mathematics with Applications, **59** (2010), 1095–1100.
- [3] S. BHALEKAR, V. DAFTARDAR-GEJJI, *A predictor-corrector scheme for solving nonlinear delay differential equations of fractional order*, Journal of Fractional Calculus and Applications, **1** (5) (2011), 1–9.
- [4] M. BENCHOHRA, M. SAID SOUID, *Integrable solutions for implicit fractional order differential equations*, TJMM, **6** (2) (2014), 101–107.
- [5] K. DIETHELM, *The analysis of fractional differential equations*, Lecture Notes in Mathematics, Springer-Verlag Berlin Heidelberg, 2010.
- [6] K. DIETHELM, N. J. FORD, *Analysis of fractional differential equations*, J. Math. Anal. Appl., **265** (2002), 229–248.
- [7] J. DUGUNDJI, A. GRANAS, *Fixed Point Theory*, Vol-I, Monographic Matematycane, PNW Warsa, 1982.
- [8] D. HENRY, *Geometric theory of semi linear parabolic equations*, Springer-Verlag; Berlin, Heidelberg, New York, 1981.
- [9] A. A. KILBAS, H. M. SRIVASTAVA, J. J. TRUJILLO, *Theory and applications of fractional differential equations*, North-Holland Mathematics Studies, vol. 204, Elsevier Science B.V., Amsterdam, 2006.
- [10] V. LAKSHMIKANTHAM, S. LEELA, *A Krasnoselskii-Krein-type uniqueness result for fractional differential equations*, Nonlinear Analysis, **71** (2009), 3421–3424.
- [11] V. LAKSHMIKANTHAM, A. S. VATSALA, *Basic theory of fractional differential equations*, Nonlinear Analysis, **69** (2008), 2677–2682.
- [12] K. S. MILLER, B. ROSS, *An introduction to the fractional calculus and differential equations*, John Wiley, New York, 1993.
- [13] JUAN J. NIETO, ABELGHANI OUAHAB, VENKTESH VENKTESH, *Implicit fractional differential equations via Liouville-Caputo derivative*, Mathematics, **3** (2015), 398–411.
- [14] S. K. NTOUYAS, *Initial and boundary value problems for functional differential equations via the topological transversality method: A survey*, Bull. Greek Math. Soc. **40** (1998), 3–41.
- [15] I. PODLUBNY, *Fractional differential equations*, Academic Press, San Diego, 1999.