



LJUBOMIR B. ĆIRIĆ (1935 - 2016)

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Abstract. Professor Ljubomir B. Ćirić, one of the pioneers in the study of fixed point theory and nonlinear analysis in Serbia, died on Saturday, 23th July 2016. Here, we present his brief biography, some comments on main streams of his research work and complete bibliography.

1. Biographical Data

Professor Ljubomir B. Ćirić died on Saturday, 23th July 2016. He was born on August 13, 1935 (Resnik, Region Pirot). After completing Gymnasium in Belgrade in 1954 he enrolled in Mathematics at the Faculty of Sciences and Mathematics at the University of Belgrade. He graduated in 1959. After military service, in 1960 he was elected for the assistant of Mathematics at the Faculty of Mechanical Engineering in Belgrade, where he worked until his retirement. He was elected assistant professor in 1971, associate professor in 1976 and 1982, to full professor. In 2001 he retired as head of the Department of Mathematics.

He started postgraduate studies in Topology at the Faculty of Sciences and Mathematics in Belgrade, under supervision of Zlatko P. Mamuzić in 1961. In 1965 his mentor become academician Đuro Kurepa. Postgraduate studies completed in 1968, and in 1970 he defended at the same Faculty doctoral thesis "Fixed and periodic points of contractive operator". It was the first doctoral thesis in the field of fixed point theory written in Serbia. For both theses his advisor was Đuro Kurepa.

On the Faculty of Mechanical Engineering in Belgrade, he was giving teaching courses in Calculus, Ordinary and Partial Differential equations, Laplace transform, Probability and Statistics, for graduate students and Linear algebra and Special functions for postgraduate students. The quality of his lectures and standard of his teaching deserves a special mention. Besides, he wrote several very good textbooks, but only had three published.

He was editor in chief of journal *Advances in Fixed Point Theory*, editor of important mathematical journals: *Fixed Point Theory and Application*, *Journal of Nonlinear Science and Applications*, and *Filomat* (Niš); and associate editor of international journals: *Scientific World Journal*, *Current advanced in Mathematical Research*, *Applied Mathematical and Computational Sciences*, *Applied Mathematics*, *International Journal of Engineering*, *Contemporary Mathematics and Sciences*, *International Journal of Interdisciplinary and Multidisciplinary Studies* and *Karbala International Journal of Modern Science*. He was also a member of the editorial committees of *Handbook of Mechanical Engineering* (printed in Serbian, Belgrade 1987, reprinted 1992).

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2. Research Work

In Ćirić's time bachelor of mathematics who enrolled in doctoral studies at the University of Belgrade, had to overcome certain obstacles. In our opinion, is that our mathematicians have not been able to learn enough on doctoral studies (according high international standards) due to the lack of leaders. Those who were persistent and hardworking managed to reach high international standards. In this group was prof. Ćirić. It is hard to explain how they managed in international competition and therefore their results should be more appreciated.

All prof. Ćirić's scientific papers belong to nonlinear analysis except papers [2] (Special functions), [3] and [32] (General topology). His new ideas and fundamental results opened new fields of research and inspired prominent mathematicians in the world and in our country. Now we present the most important of them.

1. Generalized contractions. The notion of generalized contraction was introduced by prof. Ćirić in his Ph.D. thesis [5]. In this thesis he also presented first fixed point result for this class of mappings, which was published in [7]. Further generalization of this result he obtained in [10] (for multi-valued mappings), [17] (for common fixed point of not necessarily commuting mappings), [19] (for probabilistic metric spaces), [22] (fixed point result of Mair - Keeler's type). The paper [1] is cited over 50 times, [17] over 20 times, [17] over 80 times. In our opinion the most general of this results is a common fixed point theorem for not necessarily commuting multi-valued mappings from [58].

2. Quasi - contractions. This class of mappings was introduced in [15], which is the most important Ćirić's paper. The paper [15] is cited over 700 times. Ćirić's theorem on existence and uniqueness of fixed point for quasi - contractions is the most general result in classical metrical fixed point theory (see B. E. Rhoades, A comparison of various definitions of contractive mappings, *Trans. Amer. Math. Soc.* 226 (1977) 257-290). First nonlinear generalizations of this result were presented in papers: J. Danes, Two fixed point theorems in topological and metric spaces, *Bull. Austral. Math. Soc.* 14 (1976) 259-265 and A. Ivanov, Fixed points of mappings on metric spaces, (in Russian), *Studies in topology II - Zap. Naučn. Sem. Leningrad. Otdel. Mat. Inst. Steklov (LOMI)* 66 (1976) 5-102. Further Ćirić's result on this class of mappings can be found in the papers: [24] (fixed point result for Banach spaces), [36] (contrary-examples for two conjectures of Ivanov), [57] (fixed point result for quasi-contractions, which is non-self mappings on Banach space), [60] (convergence results for a sequence of Ishikawa iterations for nonlinear quasi-contractive mappings), [64] (fixed point result for non-linear generalized quasi-contractions), [68] (fixed point result for quasi-contractions which is non-self mappings on convex subset of Banach space), [77] (fixed point result for multi-valued non-linear quasi-contractions), [84] (fixed point result for quasi-contractions which is non-self mappings on hyperbolic metric space), [88] (Common fixed point results for weakly compatible quasi contraction).

3. Coupled fixed points. This notion was introduced by V. Lakshmikantham and Lj. Ćirić in papers [108] and [115]. The paper [115] is cited over 700 times.

4. Mappings with non-unique fixed point. [16], [56].

5. Generalizations of Caristi - Kirk fixed point theorem. [44], [45], [59].

6. Fixed point results for various classes of generalized metric spaces. Probabilistic metric spaces [19], [63], [117]; quasi - metric spaces [44], [45], [59]; other generalizations [121], [134], [143].

7. Fixed point results for some classes of topological spaces metric spaces. [6], [9], [12], [18], [25], [145].

8. Ishikawa iterative process and Accretive operators. [54], [60], [67], [69 - 71], [78], [92-93], [101], [107], [137].

Great recognition (to his research results) from the international scientific community are two special volumes published in the top international *Journal of Nonlinear Science and Applications*. The first special volume was published in 2012 under the title: "The legacy of Professor Lj. B. Ćirić" and contains 32 papers. The second volume was published in 2015 under the title: "On Ćirić's type fixed point theorems" and contains 32 papers.

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