

# MIHAIL MEGAN - RESEARCHER AND MENTOR IN MATHEMATICS

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## Abstract

The present volume is dedicated to Professor Mihail Megan on the occasion of his 70th anniversary, as a tribute to his outstanding achievements and to his contributions to the development of the Romanian School of Mathematics. Professor's Megan career in Mathematics and in Higher Education is remarkable and represents a strong landmark for future generations. This is a story about vocation for Mathematics, devotion to Profession and Science and, most of all, about high performance at academic level.

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Mihail Megan graduated the Faculty of Mathematics-Mechanics from University of Timișoara in 1969 as excellent student with a special passion for Mathematics and a rare talent for solving difficult problems. In the same year, he became Teaching Assistant and started his journey in research by preparing his PhD thesis under the scientific coordination of Professor Mircea Reghiș. His PhD thesis entitled *Comportări asimptotice și controlabilitate la ecuații diferențiale liniare* (Asymptotic Behavior and Controllability of Linear Differential Equations) was defended on December 22, 1977, and represented a first (but major) step in a career devoted to the study of the asymptotic properties of dynamical systems and to the qualitative theory of control systems.

Mihail Megan successfully climbed the stairs of the academic career, being Lecturer (1977-1990), Associate Professor (1990-1992) and Professor (1992-2012). He taught lectures of Mathematical Analysis, Real Analysis, Structures Theory, Convex Analysis, Linear Control Systems, Stability and Control. Professor Megan published 23 lecture notes and collections for students, at the Typography of (West) University of Timișoara, 11 books and collections for students from the faculties of mathematics, in national publishing houses, 13 mathematics books for teachers and college students, at national publishers, and many articles and methodic papers for high school teachers. In particular, two books were devoted to master students, PhD students and postdoctoral students (see [22], [25]). His lecture notes and books devoted to students were excellently written (see e.g. [11]-[13]). Megan's books of Mathematical Analysis, Real Analysis or Topology were masterpieces which supported the individual study of tenths generations of undergraduate students.

Professor Megan has spent all his academic life at Faculty of Mathematics and Computer Science from West University of Timișoara, being a legendary figure of our university. Megan's lectures have been emblematic for Faculty of Mathematics from Timișoara: he gave memorable lectures, he was always very exigent with his students, teaching them the most delicate details of difficult theories. Moreover, he knew how to recruit the best students in his research group.

His students were always fascinated by the accuracy and the elegance of his exposure. It is well known that when we meet a former student of our faculty, in Romania or abroad, his/her first thoughts and memories are about Professor Megan and his lectures. Professor Megan has a very special talent as a teacher and that he has succeeded to turn his students into

disciples, admirers or in modern terms: in fans.

In 1990, Mihail Megan started coordinating PhD theses in Mathematics. Over the past 27 years, more than 35 PhD students successfully finalized their theses under his coordination, two of the PhD theses being in cooperation with universities from France. In his capacity of PhD coordinator, Professor Megan was a mentor not only for his PhD students, but for many gifted mathematicians who joined his research group.

Professor Megan was invited in more than 45 PhD Commissions and he was member in 7 Habilitation Commissions. He was invited in more than 45 commissions for evaluating the candidates for permanent positions of Associate Professor and Professor at public universities from Timișoara, Cluj-Napoca, Bucharest, Iași and Craiova.

His research activity is remarkable, being internationally recognized and appreciated within some of the most prestigious research groups activating in dynamical systems and in control theory. Megan's major research interests are devoted to the qualitative theory of dynamical systems in infinite dimensional spaces, control theory and inequalities theory. He published over 180 papers in pure and applied mathematics (55 of them can be found on Web of Science - Clarivate Analytics), cumulating hundreds of citations in prestigious publications worldwide. The impact of his research is certified also by the fact that his works were cited by L. Barreira, E. Braverman, C. Chicone, R. Conti, R. Curtain, D. Hinrichsen, A. Ilchmann, J. Klamka, S. G. Krein, Y. Latushkin, H. Leiva, K. Lu, T. Naito, K. J. Palmer, L. Pandolfi, C. Pötzsche, A. J. Pritchard, C. Valls, J. Zabczyk, W. Zhang.

Megan's early mathematical career debuted with some significant results in control theory, which established various connections between stability behaviours and controllability properties of systems (see [3], [6]-[9] and the references therein). One of his famous results was obtained for autonomous control systems in Hilbert spaces (see [6]). Mainly, the central result states that if the homogeneous part of the control system is described by the infinitesimal generator of a  $C_0$ -group, then the complete stabilizability of the system is a sufficient condition for its exact controllability. Megan's theorem was extended for autonomous systems in reflexive Banach spaces by Zabczyk in [34] (see also [35]) and respectively by Przyluski in [32] - the last article being published in the prestigious *International Journal of Control*. Control theory remained after years one of his greatest passions and Megan used many times the control techniques to investigate various asymptotic properties of evolution equations and dynamical systems (see e.g. [14], [17]-[20],

[23] and the references therein).

A substantial part of Megan's work was devoted to stability properties of dynamical systems. These topics were treated from various points of view, among the most significant being the following methods: Perron type techniques (see [17]), the use of diverse trajectories and functionals on function spaces (see [15], [16]), Datko type methods and Rolewicz-Zabczyk techniques (see [4], [26], [30], [33]), nonuniform approaches (see [29]). A beautiful part of his research studies was focused on instability and expansiveness properties of dynamical systems; for those studies Megan implemented inedit methods, pointing out that instability and expansiveness had to be treated distinctly and with different techniques compared with those used in the stability case (see [16], [20], [21], [24], [31]).

One of the most fascinating class of properties of dynamical systems is represented by the dichotomic behaviours. This is a very interesting area in the field of the asymptotic properties of dynamical systems, whose study requires complex techniques of functional analysis, spectral theory, control methods, bifurcation theory and not only. A representative segment of Megan's work was devoted to the study of various dichotomy properties in the uniform setting (see [5], [18], [19], [23]) and also to the investigation of nonuniform concepts of exponential dichotomy (see [1], [2], [10], [14]). A true challenge was to investigate the properties related to the exponential trichotomy and respectively to the exponential splitting of dynamical systems (see e.g. [28] and [27] and the references therein). Actually, regarding his research activity, it is clear that the work of Professor Megan is an entire collection of new challenges and proves a continuous interest in new and interesting open problems.

Professor Megan attended more than 45 international conferences in Romania and abroad and he participated at more than 50 national conferences, where he disseminated his results obtained as unique author or in collaboration. He was invited at various research visits among we mention those from Varna (Bulgaria, 1977), Katowice and Warsaw (Poland, 1978), Oran (Algeria, 1985), Bordeaux (France, 1996), Madrid (Spain, 1996), Lyon (France, 2003), Clermont Ferrand (France, 2005), Trento (Italy, 2006), Nisa (France, 2013), Covilho (Portugal, 2016). Professor Megan is a very active researcher, always ready to learn and to study new topics, he has a special talent to "contaminate" his collaborators with his passion for Mathematics and with his enthusiasm in discovering new research topics and solving new problems.

In this spirit, in 1994, Mihail Megan founded *The Seminar of Mathematical Analysis and Applications in Control Theory*. Since 1994, Professor Megan led this seminar, which is organized each Monday, bringing together novices and experts, colleagues and disciples, friends and collaborators from Romania and from abroad. The seminar is a "fixed point" of the academic activity at Department of Mathematics from West University of Timișoara, being a model of team work, friendship, collaboration. Each Monday morning, Professor Megan is right there, in the seminar room, always surrounded by raising stars in Mathematics: PhD students and master students. It is impossible not to be amazed by the energy created around him and by his joy to share ideas with his younger collaborators.

Professor Megan was a member of the Research Center in Analysis and Geometry from West University of Timișoara (2004-2010). He is a member of the Research Center in Qualitative Theory of Systems with Applications in Control Problems (2010-present). The Seminar led by Professor Megan is one of the flagships of the Research Center and is the place where he continues day by day to create fascination among his students and to discover new talents in Mathematics, with great enthusiasm and passion for research.

Professor Mihail Megan was deeply involved in the leading structures of the university, having a relentless energy in supporting the development of the faculty and of the university. He was Vice Dean of the Faculty of Natural Sciences from University of Timișoara from 1981 to 1990. From 1996 to 2004 Mihail Megan was the Dean of the Faculty of Mathematics from West University of Timișoara. In 2004 he became Vice Rector in charge with the academic curricula and served university's major projects from this position until 2008. From 2008 to 2012 he was the Director of Department of Mathematics from Faculty of Mathematics and Computer Science. He was respected in the academic community for his progressive-minded leadership and for the ascendant evolution of our faculty, under his coordination.

Professor Megan represented West University of Timișoara at national level with great devotion. He was a member of the Commission of Mathematics and Natural Sciences of The National Research Council in Higher Education (Romanian acronym: CNCSIS) from 1997 to 2006. He was a member of the Commission of Mathematics within CNATDCU (The National Council for Attestation of Academic Titles, Diplomas and Certificates) at Ministry of National Education and Scientific Research in the

period 2013-2016. Since 2006, Professor Megan is a member of the Commission of Permanent Experts, Section Exact Sciences and Natural Sciences within Romanian Agency for Quality Assurance in Higher Education (Romanian acronym: ARACIS). For more than a decade numerous Romanian institutions and a large number of study programs have benefited from the expertise offered by Professor Megan.

Professor Megan was project leader/principal investigator at 3 research grants (CNCSIS projects type A) in the periods 1999-2001, 2002-2004, 2005-2007, at one "PN-II-IDEI" project in the period 2009-2011 and respectively he was in charge on behalf of the West University of Timișoara for one "POSDRU" type project.

Professor Mihail Megan is a titular member of the Academy of Romanian Scientists (Romanian acronym: AOSR), Section Mathematics, since 2007. He is also a member of the Romanian Mathematical Society (Romanian acronym: SSMR) since 1970, receiving "The Excellence Diploma of Romanian Mathematical Society" in 2006 and The Jubilee Medal "Centenary of Romanian Mathematical Society" in 2010. The Eight National Conference on Mathematical Analysis and Applications (CAMA 2006) was organized in honour of Professor Megan on the occasion of his 60th anniversary.

In recognition of his achievements, in the past 25 years, Professor Megan was honoured with many awards and distinctions, among we mention: The Silver Medal on the occasion of 100 years of existence of Mathematics Gazette (in Romanian: Gazeta Matematică) in 1995 and the Diploma "110 years of publication of Mathematics Gazette" in 2005, the Honorary Diploma with Golden Medal on the occasion of the 65th anniversary of West University of Timișoara. The most important distinction is the one received from Babeș-Bolyai University in Cluj-Napoca: the title *Professor Honoris Causa of Babeș-Bolyai University*, awarded in March 2017.

Professor Megan has had a very active editorial activity. In 1994 he founded and became the Editor of the preprint series: *Seminar of Mathematical Analysis and Applications in Control Theory* from West University of Timișoara. He was a member of the Editorial Boards of the following journals: Annals of West University of Timișoara - Mathematics and Computer Science, Annals of the Academy of Romanian Scientists - Series on Mathematics and Its Applications, Studia Mathematica, Carpathian Journal of Mathematics, Journal of Advanced Mathematical Studies, Didactica Matematica (University of Bucharest), Annals of University of Craiova, Annals of the Tiberiu Popoviciu Seminar of Functional Equations, Approxi-

mation and Convexity. He acted as referee for many prestigious journals in the areas of mathematical analysis, differential equations, dynamical systems and control theory. Professor Megan was a member of the scientific committee of important international and national conferences over the past 40 years, answering with great enthusiasm each time he was invited to join a scientific board.

Starting with 2012, Mihail Megan is Professor Emeritus at West University of Timișoara. Every day, with tenacity and joy, Professor Megan keeps following his ideals, pursuing his dreams and accomplishing his mathematical projects at Department of Mathematics from Faculty of Mathematics and Computer Science and also within the Research Center in Qualitative Theory of Systems with Applications in Control Problems. He continues to enrich the lives of his collaborators, of his friends, of his students and of anyone who works with him. Megan's charisma as mathematician, his energy as researcher, his special enthusiasm as mentor attract more and more disciples every year and maintain them on his mathematical orbit forever.

Through his notable professional activity carried on over more than 48 years, through his hard work and his remarkable achievements, through his creative spirit and his endless energy to convert ideas into results, through his love for Mathematics, Professor Megan remains for all of us and for the next generations, an excellent Researcher and very special Mentor, and most of all the creator and the supporter of a strong School of Mathematics at West University of Timișoara.

## References

- [1] M. G. Babuția, M. Megan, Nonuniform exponential dichotomy for discrete dynamical systems in Banach spaces, *Mediterr. J. Math.* 13 (2016), 1653-1667.
- [2] J. G. A. Bento, N. Lupa, M. Megan, C. M. Silva, Integral conditions for nonuniform  $\mu$ -dichotomy on the half-line, *Discrete Contin. Dyn. Syst. Ser. B* 22 (2017), 3063–3077.
- [3] V. Hiriș, M. Megan, Remarks on hyperstability of infinite-dimensional systems, *Internat. J. Control* 35 (1982), 739-747.
- [4] N. Lupa, M. Megan, I. L. Popa, On weak exponential stability of evolution operators in Banach spaces, *Nonlinear Anal.* 73 (2010), 2445-2450.

- [5] N. Lupa, M. Megan, Exponential dichotomies of evolution operators in Banach spaces, *Monatsh. Math.* 174 (2014), 265-284.
- [6] M. Megan, On the stabilizability and controllability of linear dissipative systems in Hilbert spaces, *Sem. Ec. Funct. Univ. Timișoara* 32 (1975), 1-15.
- [7] M. Megan, V. Hiriș, Hyperstability of linear control systems in Hilbert spaces, *Internat. J. Control* 32 (1980), 63-72.
- [8] M. Megan, Hyperstability of control evolution processes in Hilbert spaces, *Internat. J. Control* 45 (1987), 2133-2145.
- [9] M. Megan, Propriétés qualitatives des systèmes lineaires contrôlés dans les espaces de dimension infinie, *Colecția Monografii Matematice, Universitatea din Timișoara* 32 (1988).
- [10] M. Megan, On (h,k)-dichotomy of evolution operators in Banach spaces, *Dynam. Systems Appl.* 5 (1996), 189-196.
- [11] M. Megan, *Bazele Analizei Matematice vol. I*, Editura Eurobit 1996.
- [12] M. Megan, *Bazele Analizei Matematice vol. II*, Editura Eurobit 1997.
- [13] M. Megan, *Bazele Analizei Matematice vol. III*, Editura Eurobit 1998.
- [14] M. Megan, B. Sasu, A. L. Sasu, On nonuniform exponential dichotomy of evolution operators in Banach spaces, *Integral Equations Operator Theory* 44 (2002), 71-78.
- [15] M. Megan, A. L. Sasu, B. Sasu, On uniform exponential stability of linear skew-product semiflows in Banach spaces, *Bull. Belg. Math. Soc. Simon Stevin* 9 (2002), 143-154.
- [16] M. Megan, A. L. Sasu, B. Sasu, A. Pogan, Exponential stability and unstability of semigroups of linears operators in Banach spaces, *Math. Inequal. Appl.* 5 (2002), 557-568.
- [17] M. Megan, A. L. Sasu, B. Sasu, Stabilizability and controllability of systems associated to linear skew-product semiflows, *Rev. Mat. Complut.* 15 (2002), 599-618.
- [18] M. Megan, A. L. Sasu, B. Sasu, Discrete admisibility and exponential dichotomy for evolution families, *Discrete Contin. Dyn. Syst.* 9 (2003), 383-397.

- [19] M. Megan, A. L. Sasu, B. Sasu, Theorems of Perron type for uniform exponential dichotomy of linear skew-product semiflows, *Bull. Belg. Math. Soc. Simon Stevin* 10 (2003), 1-21.
- [20] M. Megan, A. L. Sasu, B. Sasu, Perron conditions for uniform exponential expansiveness of linear skew-product flows, *Monatsh. Math.* 138 (2003), 143-157.
- [21] M. Megan, A. Pogan, On exponential h-expansiveness of semigroups of operators in Banach spaces, *Nonlinear Anal.* 52 (2003), 545-556.
- [22] M. Megan, A. L. Sasu, B. Sasu, *The Asymptotic Behaviour of Evolution Families*, Editura Mirton, 2003.
- [23] M. Megan, A. L. Sasu, B. Sasu, Perron conditions for pointwise and global dichotomy of linear skew-product flows, *Integral Equations Operator Theory* 50 (2004), 489-504.
- [24] M. Megan, L. Buliga, Functionals on normed function spaces and exponential instability of linear skew-product semiflows, *Bull. Belg. Math. Soc. Simon Stevin*, 14 (2007), 355-362.
- [25] M. Megan, A. L. Sasu, B. Sasu, *Modelări matematice și comportări asimptotice ale sistemelor cu control*, Editura Politehnica, 2008.
- [26] M. Megan, T. Ceașu, A. A. Minda, On Barreira-Valls polynomial stability of evolution operators in Banach spaces, *Electron. J. Qual. Theory Differ. Equ.* 33 (2011), 1-10.
- [27] M. Megan, I. L. Popa, Exponential splitting for nonautonomous linear discrete-time systems in Banach spaces, *J. Comput. Appl. Math.* 312 (2017), 181–191.
- [28] C. L. Mihiț, M. Megan, T. Ceașu, The equivalence of Datko and Lyapunov properties for (h,k)-trichotomic linear discrete-time systems, *Discrete Dyn. Nat. Soc.* 2016 (2016), Article ID 3700262, 1-8.
- [29] A. A. Minda, M. Megan, On (h,k) - stability of evolution operators in Banach spaces, *Appl. Math. Lett.* 24 (2011), 44-48.
- [30] I. L. Popa, T. Ceașu, M. Megan, On exponential stability for linear discrete-time systems in Banach spaces, *Comput. Math. Appl.* 63 (2012), 1497-1503.

- [31] I. L. Popa, T. Ceaşu, M. Megan, Nonuniform power instability and Lyapunov sequences, *Appl. Math. Comput.* 247 (2014), 969-975.
- [32] K. M. Przyluski, On a theorem of Megan and Zabczyk, *Internat. J. Control* 48 (1988), 2329-2332.
- [33] A. L. Sasu, M. Megan, B. Sasu, On Rolewicz - Zabczyk techniques in the stability theory of dynamical systems, *Fixed Point Theory* 13 (2012), 205-236.
- [34] J. Zabczyk, Complete stabilizability implies exact controllability, *Sem. Ec. Funct. Univ. Timișoara* 38 (1976), 1-10.
- [35] J. Zabczyk, *Mathematical Control Theory: An Introduction*, Birkhäuser, 1995.