

## Solution of a Recursive Sequence of Order Ten <sup>1</sup>

E. M. Elsayed

### Abstract

We obtain in this paper the solutions of the following rational non-linear difference equations

$$x_{n+1} = \frac{x_{n-9}}{\pm 1 \pm x_{n-4}x_{n-9}}, \quad n = 0, 1, \dots,$$

where initial values are non zero real numbers.

**2000 Mathematics Subject Classification:** 39A10.

**Key words and phrases:** recursive sequence, periodicity, solutions of difference equations.

## References

- [1] M. Aloqeili, *Dynamics of a rational difference equation*, Appl. Math. Comp., 176(2), 2006, 768-774.
- [2] A. M. Amleh, J. Hoag, G. Ladas, *A difference equation with eventually periodic solutions*, Comput. Math. Appl., 36 (10–12), 1998, 401–404.
- [3] C. Cinar, *On the positive solutions of the difference equation  $x_{n+1} = \frac{x_{n-1}}{1 + x_n x_{n-1}}$* , Appl. Math. Comp., 150, 2004, 21-24.

---

<sup>1</sup>Received 14 March, 2009

Accepted for publication (in revised form) 30 September, 2009

- [4] C. Cinar, *On the difference equation*  $x_{n+1} = \frac{x_{n-1}}{-1 + x_n x_{n-1}}$ , Appl. Math. Comp., 158, 2004, 813-816.
- [5] C. Cinar, *On the positive solutions of the difference equation*  $x_{n+1} = \frac{ax_{n-1}}{1 + bx_n x_{n-1}}$ , Appl. Math. Comp., 156, 2004, 587-590.
- [6] C. Cinar, R. Karatas and I. Yalcinkaya, *On solutions of the difference equation*  $x_{n+1} = \frac{x_{n-3}}{-1 + x_n x_{n-1} x_{n-2} x_{n-3}}$ , Mathematica Bohemica, 132(3), 2007, 257-261.
- [7] M. Douraki, M. Dehghan and M. Razzaghi, *The qualitative behavior of solutions of a nonlinear difference equation*, Appl. Math. Comp., 170(1), 2005, 485-502.
- [8] E. M. Elabbasy, H. El-Metwally and E. M. Elsayed, *On the difference equation*  $x_{n+1} = ax_n - \frac{bx_n}{cx_n - dx_{n-1}}$ , Adv. Differ. Equ., Volume 2006, 2006, Article ID 82579,1-10.
- [9] E. M. Elabbasy, H. El-Metwally and E. M. Elsayed, *On the difference equations*  $x_{n+1} = \frac{\alpha x_{n-k}}{\beta + \gamma \prod_{i=0}^k x_{n-i}}$ , J. Conc. Appl. Math., 5(2), 2007, 101-113.
- [10] E. M. Elabbasy, H. El-Metwally and E. M. Elsayed, *Qualitative behavior of higher order difference equation*, Soochow Journal of Mathematics, 33 (4), 2007, 861-873.
- [11] E. M. Elabbasy, H. El-Metwally and E. M. Elsayed, *Global attractivity and periodic character of a fractional difference equation of order three*, Yokohama Mathematical Journal, 53, 2007, 89-100.
- [12] E. M. Elabbasy and E. M. Elsayed, *Global Attractivity and Periodic Nature of a Difference Equation*, World Applied Sciences Journal, 12 (1), 2011, 39-47.
- [13] E. M. Elsayed, *On the Difference Equation*  $x_{n+1} = \frac{x_{n-5}}{-1 + x_{n-2} x_{n-5}}$ , Int. J. Contemp. Math. Scie. , 3 (33), 2008, 1657-1664.
- [14] E. M. Elsayed, *Dynamics of a recursive sequence of higher order*, Communications on Applied Nonlinear Analysis, 16 (2), 2009, 37-50.

- [15] E. M. Elsayed, *Qualitative behavior of difference equation of order three*, Acta Scientiarum Mathematicarum (Szeged), 75 (1-2), 2009, 113–129.
- [16] E. M. Elsayed, *Qualitative behavior of  $s$  rational recursive sequence*, Indagationes Mathematicae, New Series, 19(2), 2008, 189–201.
- [17] E. M. Elsayed, *On the Global attractivity and the solution of recursive sequence*, Studia Scientiarum Mathematicarum Hungarica, 47 (3), 2010, 401-418.
- [18] E. M. Elsayed, *Qualitative properties for a fourth order rational difference equation*, Acta Applicandae Mathematicae, 110 (2), 2010, 589–604.
- [19] E. M. Elsayed, *Qualitative behavior of difference equation of order two*, Mathematical and Computer Modelling, 50 ,2009, 1130–1141.
- [20] E. M. Elsayed, *A Solution Form of a Class of Rational Difference Equations*, International Journal of Nonlinear Science, 8(4), 2009, 402-411.
- [21] E. M. Elsayed, *Expressions of Solutions for a Class of Difference Equation*, Analele Stiintifice ale Universitatii Ovidius Constanta, Seria Matematica, 18 (1), 2010, 99–114.
- [22] E. M. Elsayad, B. Iricanin and S. Stevic, *On The Max-Type Equation*, Ars Combinatoria, 95, 2010, 187–192.
- [23] E. M. Elsayed, *On the Global Attractivity and the Periodic Character of a Recursive Sequence*, Opuscula Mathematica, 30(4), 2010, 431–446.
- [24] E. M. Elsayed, *On the Solutions of a Rational System of Difference Equations*, Fasciculi Mathematici, 45, 2010, 25–36.
- [25] E. M. Elsayed, *Solution and Behavior of a Rational Difference Equations*, Acta Universitatis Apulensis, 23 ,2010, 233–249.
- [26] E. M. Elsayed, *Dynamics of Recursive Sequence of Order Two*, Kyungpook Mathematical Journal, 50, 2010, 483-497.
- [27] E. M. Elsayed, *On the solution of recursive sequence of order two*, Fasciculi Mathematici, 40, 2008, 5–13.
- [28] E. M. Elsayed, *Behavior of a Rational Recursive Sequences*, Studia Univ. " Babes — Bolyai ", Mathematica, In Press.

- [29] E. A. Grove and G. Ladas, *Periodicities in Nonlinear Difference Equations*, , Chapman & Hall / CRC Press, 2005.
- [30] E. A. Grove, G. Ladas, L. C. McGrath and C. T. Teixeira, *Existence and behavior of solutions of a rational system*, *Commu. Appl. Nonlin. Anal.* , 8, 2001, 1–25.
- [31] R. Karatas and C. Cinar, *On the solutions of the difference equation*  

$$x_{n+1} = \frac{ax_{n-(2k+2)}}{-a + \prod_{i=0}^{2k+2} x_{n-i}}$$
, *Int. J. Contemp. Math. Sciences*, 2 (31), 2007, 1505-1509.
- [32] V. L. Kocic and G. Ladas, *Global Behavior of Nonlinear Difference Equations of Higher Order with Applications*, Kluwer Academic Publishers, Dordrecht, 1993.
- [33] M. R. S. Kulenovic and G. Ladas, *Dynamics of Second Order Rational Difference Equations with Open Problems and Conjectures*, Chapman & Hall / CRC Press, 2001.
- [34] M. R. S. Kulenovic and G. Ladas, *On period two solutions of*  $x_{n+1} = \frac{\alpha + \beta x_n + \gamma x_{n-1}}{A\alpha + Bx_n + Cx_{n-1}}$ , *J. Difference Equ. Appl.*, 6 (5), 2000, 641–646.
- [35] D. Simsek, C. Cinar and I. Yalcinkaya, *On the recursive sequence*  $x_{n+1} = \frac{x_{n-3}}{1 + x_{n-1}}$ , *Int. J. Contemp. Math. Sci.*, 1 (10), 2006, 475-480.
- [36] S. Stevic, *On the recursive sequence*  $x_{n+1} = x_{n-1}/g(x_n)$ , *Taiwanese J. Math.*, 6 (3), 2002, 405-414.
- [37] X. Yang, L. Cui, Y. Tang and J. Cao, *Global asymptotic stability in a class of difference equations*, *Advances in Difference Equations*, Volume 2007, 2007, Article ID16249, 7 pages.
- [38] E. M. E. Zayed and M. A. El-Moneam, *On the rational recursive sequence*  $x_{n+1} = \frac{\alpha + \beta x_n + \gamma x_{n-1}}{A\alpha + Bx_n + Cx_{n-1}}$ , *Communications on Applied Nonlinear Analysis*, 12 (4), 2005, 15–28.
- [39] L. Zhang, G. Zhang and H. Liu, *Periodicity and attractivity for a rational recursive sequence*, *J. Appl. Math. & Computing*, 19 (1-2), 2005, 191-201.

- [40] Y. Zheng, *Periodic solutions with the same period of the recursion  $x_{n+1} = \frac{\alpha + \beta x_n + \gamma x_{n-1}}{A\alpha + Bx_n + Cx_{n-1}}$* , *Differential Equations Dynam. Systems*, 5, 1997, 51–58.

**Elsayed M. Elsayed**

King AbdulAziz University, Faculty of Science  
Department of Mathematics  
P. O. Box 80203, Jeddah 21589, Saudi Arabia.

Permanent address:

Mansoura University, Faculty of Science  
Department of Mathematics  
Mansoura 35516, Egypt.

e-mail: emelsayed@mans.edu.eg, emmelsayed@yahoo.com.