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## CONTENTS

### INVITED TALKS

On Biharmonic Legendre Curves in S-Space Forms and Generalized Sasakian Space Forms <b>C. Özgür</b>	1
Small Gaps between Primes <b>C. Y. Yıldırım</b>	2
On Generalized Sequence Spaces via Modulus Function and A- Statistical Convergence <b>E. Savaş</b>	3
Hidden Attractors in Dynamical Systems: Fundamental Problems and Applied Models <b>G. A. Leonov, N. V. Kuznetsov, S. M. Seledzhi</b>	5
Parseval Frame Wavelets <b>H. Šikić</b>	8
Geometric Modeling with Curves and Surfaces in Euclidean Spaces <b>K. Arslan</b>	11
Two Pillars of Probability Theory <b>N. H. Bingham</b>	12
Analogues of Some Tauberian Theorems for Bounded Variation <b>R. F. Patterson</b>	13
Fuzzy Logic Control in Perspective A 50-Year History <b>R. Langari</b>	14
Quaternionic and Clifford Analysis in Applications <b>W. Sproessig</b>	15

### ALGEBRA

A New Study on Generalized Intuitionistic Fuzzy Subhyperalgebras of Boolean Hyperalgebras <b>B. A. Ersoy, S. Onar, K. Hila, B. Davvaz</b>	16
Primitive Sets of $F_n/R$ Lie Algebras <b>C. Eskal, N. Ekici</b>	17
Crossed Modules of Commutative Algebras and Whiskered R-Algebroids <b>Ç. Ataseven, E. Ulualan</b>	18

Spectrum of a New Class Boundary Value Problems <b>K. Aydemir, O. Muhtaroglu, M. Çoğan</b>	173
Consistent Sampling <b>K. H. Kwon</b>	174
Symbolic Computing High-Accuracy Algorithm for the Separation of the Fractional-Rational Matrices <b>L.F. Agamalieva</b>	175
A New Metaheuristic Cricket-Inspired Algorithm <b>M. Canayaz, A. Karci</b>	176
A Comparative Analysis of Galerkin and Hybridizable Discontinuous Galerkin Method On Second Order Differential Equation <b>M. F. Karaaslan, F. Çeliker, M. Kurulay</b>	177
A Modified Piecewise Variational Iteration Method for Solving a Neutral Functional-Differential Equation with Proportional Delays <b>M. G. Sakar, F. Erdoğan</b>	178
Basins of Attraction of Equilibrium Points and Periodic Solutions of a Certain Rational Difference Equation with Quadratic Terms <b>M. Garić Demirović, M.R.S. Kulenović, M. Nurkanović</b>	179
Numerical-Analytical Method for Determining Points of Branching for Circular Corrugated Membranes <b>M. Karyakin, G. Mostipan, Y. A. Ustinov</b>	180
On Uniqueness Classes in Heat Conduction Problems <b>M. M. Amangaliyeva, M. T. Jenaliyev, M. T. Kosmakova, M. I. Ramazanov</b>	181
Stability "In the Large" of Movement of Models of Phase Systems on a Finite Interval of Time <b>M. N. Kalimoldayev, L. S. Kopbosyn</b>	182
Solution to the Problem of Global Asymptotic Stability of Dynamical Systems <b>M. N. Kalimoldayev, A. A. Abdildayeva, G. A. Amirhanova, A. S. Zhumalina</b>	183
Modified Trial Equation Method for Solving Some Nonlinear Evolution Equations <b>M. Odabaşı, E. Mısırlı</b>	184
On The Global Mass of Electro-Scalar Spacetimes <b>M. Scholtz</b>	185
Neumann Boundary Control in a Parabolic System <b>M. Subaşı, S. Ş. Şener, H. Durur</b>	186
Ill-Posed Problem for the Biharmonic Equation <b>M. T. Jenaliyev, K. B. Imanberdiyev, K. A. Aimenova</b>	187
Hermitian Determinantal Representations of Polyomial Curves <b>M. T. Chien</b>	188
Inverse Problem for Optimal Regulator over the Part of Phase Coordinate <b>N. I. Velieva</b>	189

## Stability "In the Large" of Movement of Models of Phase Systems on a Finite Interval of Time

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**Abstract.** In report sufficient stability conditions "in the large" of models of phase systems are obtained.

Consider the general model of phase systems:

$$\frac{d\delta_i}{dt} = s_i, \quad \frac{ds_i}{dt} = w_i - D_i s_i - f_i(\delta_i) - \psi_i, \quad w_i = c_i^* x_i, \quad (1)$$

$$\frac{dx_i}{dt} = A_i x_i + q_i s_i + b_i u_i, \quad i = \overline{1, l}, \quad t \in [t_0, T], \quad (2)$$

where  $\delta_i$  is angular coordinate;  $S_i$  is angular velocity;  $x_i$  is  $n_i$ - vector of the state regulator;  $u_i$  is feedback control. Let  $f_i(\delta_i)$  – nonlinearity in the control object, is  $2\pi$  – continuously differentiable periodic function. In a specific power system the function  $\psi_i(\delta_i)$  defines the interaction of the  $i$ -th generator with other generators in the system.

The task is to study the stability "in the large" of the system (1), (2).

**Theorem.** Let the following conditions hold: 1) function  $f_i(\delta_i)$  satisfies condition

$$f_i(\delta_{i0}) = \frac{1}{T_i} [P_{ij} \sin(\delta_{i0} + \delta_{j0}) - P_i \sin \delta_{i0}], \quad i = \overline{1, l}; \quad 2) \text{ function } P_{ij}(\lambda) d\lambda \text{ satisfies conditions}$$

$$P_{ij}(\lambda) d\lambda = P_{ij}(\lambda), \quad P_{ij}(\lambda) = -P_{ij}(-\lambda), \quad P_{ij}(\delta_{ij}) \delta_{ij} \geq 0; \quad 3) \text{ constants } \alpha_i, D_i > 0 \text{ such that}$$

$$a) \alpha_i = \frac{K}{D_i}, \quad 0 < K < \min\{D_1, \dots, D_l\}, \quad b) f_i'(0) \neq \alpha_i D_i^2 (1 - \alpha_i). \text{ Then the zero equilibrium } T_0$$

is asymptotically stable in the Lyapunov sense and internal evaluation of the domain of attraction of a singular point  $T_0$  is determined by the area bounded by the surface  $V(\delta, s) = T$ , where  $T = \min_{1 \leq i \leq N} V(T_i)$ , if  $T_i, i = \overline{1, N}$  are unstable singular points of the system (2).

A concrete example of system "the synchronous generator – the steam turbine" is reviewed.

**Keywords.** Model, phase systems, stability, control.

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