Abstracts of CSc. theses in mathematics

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ABSTRACTS OF THESES* IN MATHEMATICS

defended recently at Charles University, Prague

RELIABILITY OF BINARY SYSTEMS

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(February 14, 1995; supervisor V.Dupač)

Binary (two-state) systems belong to basic models which are studied in reliability theory. The fact that the interest is focused on systems composed of a finite number of components is comprehensible from the point of view of practical applications. Nevertheless, such a restriction does not allow to make use of certain powerful tools developed in measure theory and probability theory. The aim of the thesis is a presentation of a general model of binary systems and its investigation using set theory, measure theory and probability theory techniques.

This model covers both finite and infinite binary systems and it is described in Chapter I. In Chapter II, two relations an a set of probability measures are defined and studied — they may be useful for description of a time development of components of systems. Reliability of binary systems is studied in Chapter III. Some necessary and sufficient conditions for the existence of a monotone or non-monotone binary system with a given reliability function are presented. These results are, for example, used to obtain optimal bounds for reliability functions of monotone structures and a general criterion for S-shapedness intersection property. Chapter IV is devoted to binary systems with two dual modes of failure. A general model of such systems is described (it also includes systems composed of dependent components), a necessary and sufficient condition for the existence of an arbitrarily reliable system composed of a finite number of given components is presented and an asymptotic behaviour of expected lifetime of the optimal systems is studied.

SOLUTION OF THE PROBLEM IN LINEAR THEORY OF COUPLED THERMOELASTICITY

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(March 30, 1995; supervisor I. Hlaváček)

The thesis presents investigations of the solvability of the special problem in linear theory of coupled thermoelasticity. This problem represents bending of the thermoelasticity or plate.

The variational (weak) formulation of the thermoelastic model problem is obtained by using the theory of abstract vector function and Sobolev spaces in the form of abstract integral identity.

*An equivalent to PhD.

Rothe method of time discretization is used for searching semidiscrete solution set, and for creating a sequence of Rothe vector functions. A priori estimates of Rothe functions and their time derivatives are shown. Then by using the standard procedure of choosing convergent subsequent of Rothe functions, the existence of solution of the weak formulation of the problem is proved. Uniqueness of the solution and some consequences like strong convergence of the whole sequence of Rothe functions and continuous dependence of the solution on problem data have also been proved.

COMBINATORIAL ASPECTS OF DAVENPORT-SCHINZEL SEQUENCES

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(April 3, 1995; supervisor J. Nešetřil)

We consider the following extremal problem generalizing Davenport-Schinzel sequences (for them $k = 2$ and $u = aba, abab, ababa, \dots$).

For a finite sequence u over k symbols (u uses all of them) and a positive integer n, what is the maximum length $Ex(u, n)$ of a k-regular sequence v over n symbols which does not contain u.

The k-regularity means that any contiguous segment of v of length k has no repetition. v contains u means that there is a (not necessarily contiguous) subsequence of v which can be identified, after an injective renaming of symbols, with u.

Some results. **1.** Simple general properties of $Ex(u, n)$ and its generalization $Ex(u, n, l)$. **2.** $Ex(u, n)$, for any fixed u, grows almost linearly with $n \to \infty$. The inverse to the Ackermann function is involved in the bound. **3.** Suppose u is built up from u_1 and u_2 in a certain way and good upper bounds on $Ex(u_i, n)$ are available. These bounds can be transformed to a good upper bound on $Ex(u, n)$. **4.** Applying 3. many sequences u such that $Ex(u, n) = O(n)$ can be generated. **5.** Some enumerative results concerning sequences not containing $abba$ are given. **6.** A natural restriction forcing the containment to be a well quasiordering is given. **7.** The constant in the bound $Ex(ababa, n) = O(n\alpha(n))$ due to Hart and Sharir is improved to $4 + \varepsilon$. **8.** A possible generalization of the problem to colored trees is proposed. **9.** A sequence u_0 not containing $ababa$ for which $Ex(u_0, n) = \Omega(n\alpha(n))$ is presented.

NAVIER-STOKES EQUATIONS WITH DIFFERENT BOUNDARY CONDITIONS

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The thesis deals with qualitative properties of mathematical models of two-

and three- dimensional motion of viscous incompressible fluid in a channel. The main difference between models studied in the thesis and models which appear frequently in the literature is in boundary conditions. The author uses a homogeneous Dirichlet boundary condition on those parts of the boundary of the channel which correspond to fixed walls and a so called natural boundary condition on the remaining part of the boundary of the channel. Models of four types of flows are treated: steady flows with constant viscosity, unsteady flows with constant viscosity, time-periodic flows with constant viscosity and steady flows of a heat-conductive fluid with viscosity depending on the temperature. Using the theorem about the local difeomorphism in the neighbourhood of the zero solution, the existence and uniqueness of solutions for "sufficiently small" input data is proved.