Materials of Conferences

METHODS OF TECHNOLOGY IN THE TESTBOOK «PROGRAMMING TECHNOLOGIES»

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On the foundation of system analysis a new concept of specialists' training has been developed. It is oriented for mastering way of thought, engineer training of future specialists from the second year of their education. Some chapters of the textbook are also useful for non-programmers.

Intelligence level is defined first of all by a degree of structuring and generality of a man's world model and the degree of mastering this model in his operations. A man's knowledge is not a sum, but a system. Creation of such system that provides for a successful activity in nonstandard situations is the main goal of an education. It isn't enough to read about the system approach in order to master it. It is necessary to solve problems.

Methods and materials. Training for system approach and deductive thinking starts with mastering practical work with functions and structures at examples of creations texts of ordinary instructions, for example, «How to cross a street?». A good text description is: unerring, well-defined, short, its essence must be apprehended quickly. It is formed from general to specific with usage of special sentence constructions – typical elements (typical structures). There is a positive experience of educating non-programmers in accordance with the described method, for example, in development of instructions for employees on carrying out their duties, actions in case of emergency.

As we master the description of a system functioning, we proceed to development of structure of systems. For it there are business games within practical lessons and development of an educative project.

Further we study problems of carrying out early stages of data structures, algorithms and large programmes with usage of analogy methods, morphological synthesis, synthesis on OR-AND graphs, heuristic methods. These methods proved to be effective in generation of ideas of constructing large programmes and program complexes. Approbation of these methods was carried out on tens of projects and program systems that were developed by both authors and graduate year students who worked under their authors' supervision.

Resume. Thus, on the foundation of system analysis a new concept of specialists' training has been developed. It is oriented for mastering way of thought, engineer training of future specialists from the second year of their education. Some chapters of the textbook are also useful for non-programmers.

References

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THE DESIGN PROCEDURE FOR THE TURBINE ROTORS' VIBRATORY CHARACTERISTICS

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The vibrating process, having arisen at the mechanisms' and the machines' operation, is quite able to be told very much on their technical condition. So, properly and competently conducted vibration measurements are allowed to diagnose all these mechanisms' state, sparingly and promptly to be removed many defects produced. The simplified theoretical models knowledge are allowed to the operating engineer to define the units' and the aggregates' individual parts vibratory characteristics, and to judge on the accident – free operation of the unit and the aggregate, or the entire mechanism, as a whole. Let us consider one of such models.

We assume the individual components of the electric motor by the deformable bodies, having united into one mechanical system of the different and the various connections: the rigid, the elastic, and the dissipative ones. For all this, the system's rigid elements and the rigid structures are not allowed the relative linear and the angular displacements and the movements between the bodies, and the elastic connections are allowed the bodies' small movements in one or more directions. For all this, only the geometric dimensions of the units may be changed. We will define the electric motor model by the separate bodies' constant masses and their moments of inertia, and the unchangeable coefficients of rigidity c, and the damping μ, having entered the elements, the structures, and their connections into it. We will consider the vibrations, having arisen in the electric motor's bearings, as the simple linear system forced oscillations, having happened in the vertical plane. Exactly such oscillations, regardless of the others, are made the maximum contribution into the aggregate's vibration state. So, we suppose, that the turbine rotor mass m is possessed the two stages of the freedom, all the other its displacements and the movements are prohibited. For all this, the lubricating layer can be presented itself the swing in the sliding bearing, the rigidity of which c, and the damper with the coefficient μ. So, the damper is the non-conservative element in this system. It is not possessed neither the mass, nor the elastic force; the damping force is arisen in it, only when the relative movement is being observed between the both ends of the damper. The heating system, e.g. the energy dissipation will be taken its place under this force action.

While the electric motor is well – balanced, and the gaps in the bearing units are small, the unbalance ratio is small, that is $E = P_0/Q_0 < 1$. Here, P_0 and Q_0 – are the dynamic and the static forces, having acted upon the sliding bearing. For all this, the turbine rotor shaft is made the oscillatory motion along the circular arc, the radius of which is equal to the half of the radial clearance in the bearing. So, the shaft is made the oscillatory motion inside the bearing. The differential equation, having described the small free vertical oscillations of the turbine rotor, will be the following:

$$\ddot{z} + k^2 z = 0,$$

where $k = \sqrt{c/a}$ – is the natural vibration frequency, a and c – the generalized system's inertia factors and the coefficients of the rigidity, correspondingly. As, here, we consider the impact upon one bearing, then a – is the turbine rotor's half mass. Then, we are quite able to evaluate the generalized coefficient of the rigidity, having supposed the system's static deformation, which is equal to the bearing clearance, that is $c = mg/f_{\text{ст}}$. Then, the allowable range of the values of the natural vibration frequency k and the natural vibrations period $T = 2\pi/k$ of our system will be defined by the permissible values of the bearing clearances. The natural vibrations frequency in the hertzs is the reciprocal value from the period, that is $\nu = k/2\pi$. Then, we will have to find out the amplitude and the initial phase α of the oscillations, for the particular solution of the differential equation finding out, having supposed at the initial moment of time $z(0) = 0$, and the center of mass velocity at this moment $V_C = \omega \cdot f_{\text{ст}}$, where ω – is the turbine rotor's rotational velocity. Then, the following equation

$$z = \sqrt{\left(\omega^2 f_{\text{ст}}^3 / g\right)} \sin\left(\sqrt{g/f_{\text{ст}}} \cdot t\right)$$

will be described our system's oscillations, where g – is the free fall acceleration.

The natural oscillations will be changed their main characteristics, as the turbine rotor's unbalance. Let us suppose, that the turbine rotor's center of mass shifting has been taken its place for some value e. Then, the center of mass velocity and the system's rigidity will already be changed, as the static deformation for the turbine rotor's eccentricity e value is being increased: $V_{Ce} = \omega \cdot (f_{\text{ст}} + e)$ and $c_e = \text{mg}/(f_{\text{ст}} + e)$. In addition, it is quite able to be occurred the turbine rotor's axis deflection, for example, for the value ρ, then $V_{C\rho} = \omega \cdot (f_{\text{ст}} + e + \rho/2)$ and $c_\rho = \text{mg}/(f_{\text{ст}} + e + \rho/2)$. Thus, the special tendency on the natural oscillations frequency reduction and their amplitude increase at the turbine rotor's constant unbalance is being observed. At this stage of the electric motor's operation, the liner material erasure in the one place is taken its place.

Gradually, the clearance increase in the bearing assemblies, the engine unbalance are taken their place in the process of the electric motor's operation, and, thus, the dynamic forces further increase $\overline{P}_0$. As soon as the unbalance ratio in the plane of the bearing is become to be equal to the unity, the additional periodic force R is arisen, having resulted in the system's forced oscillations. Then, let us consider, as it is being appeared. The turbine rotor is sliding on the liner, while the shaft center is located below the bearing's central axis. So, the shaft is separated from the bearing, when the shaft center is raised above this axis, as the static forces are appeared to be equal to the dynamic ones. So, the shaft center free movement is taken its place, as long as the shaft does not hit the pad. The shaft will be slided along the liner, during some time after the impact, but once again its center will be come to the bearing's central axis, the shaft will be come off, and the whole phenomenon is persisted. Thus, the turbine rotor's periodic impacts and the attacks on the liner with the turbine rotor's rotating frequency ω will be taken their place in this mode, and the arising additional periodic force will be changed by the harmonic law $R = 0{,}5Mg\cos\omega t$. And, it is necessary to be solved another differential equation by us: $m\ddot{z} + c\,z = R_0 \cos\omega t$. So, its solution is consisted in the general solution of the corresponding homogeneous equation $z_{\text{од}}$ and the particular $\tilde{z}$ solution of the inhomogeneous equation of the oscillations: $z = z_{\text{од}} + \tilde{z}$. Thus, the first one – is described the oscillations with the natural frequency k, which, in the presence of the resistance, are quite able to be subsided. Then, the second one – is defined the purely forced oscillations, which are taken their place with the driving force frequency, and they are not subsided even, at the presence of the strong resistance.

At the calculations of the СТДП – 12,500 – 2УХЛ4 turbine motor forced oscillations characteristics, having taken into account the resistance forces, we have used the well – known solution, which is the following:

$$z = A\,e^{-bt}\sin\left(k_1 t + \alpha\right) + \\ + B\cdot\sin\left(pt + \gamma\right),$$

where

$$A = \sqrt{\omega^2 f_{\text{ст}}^3 / g},\quad b = \mu/2m,\quad k \approx k = \sqrt{c/m},$$

$$\alpha = 0,\quad B = h\Big/\sqrt{\left(k^2 - p^2\right)^2 + 4\cdot b^2 p^2},$$

$$h = R_0/m,\quad p = \omega,\ \gamma = \operatorname{arctg}\left(2bp/\left(k^2 - p^2\right)\right).$$

For all this, it has been appeared that the turbine rotor free oscillations' damping is taken its place very slowly, because of the turbine oil's technical properties. And, moreover, the turbine rotor oscillations design characteristics are satisfactorily agreed with the experimental tendencies and the trends, despite of the considered, here, model simplicity.

So, the magnitude of the force $\bar{R}$ is quite able to be changed from the $\left(\bar{P}_0 - \bar{Q}_0\right)$ up to $\left(\bar{P}_0 + \bar{Q}_0\right)$ value, in the direction, having coincided with $\bar{P}_0$, at the third mode of the electric motor operation ($E > 1$). For all this, the bearing shell erasure is taken its place around the whole circumference, and the shaft journal is worn out unilaterally, having increased the distance between the turbine rotor mass center and its rotation axis. So, the shaft journal contact point is moved around the whole circumference, and the shaft journal is always turned to the one side of the bearing. The regime of the shaft journal's progressive wear out and the bearing shell is come.

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TO THE PROBLEM OF MODELING OF ACTIVITY OF THE COMPANY FOR PRODUCTION AND SALE OF COMPUTER ENGINEERING

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Methods of mathematical modeling are well acknowledged tool for scientific analysis of complex objects of different nature with a number of internal and external relations. These methods allow formalizing the regularities attributed to these objects at the model level through development of their qualitative abstract form, which offers great opportunities in improving efficiency of generated control actions, as such experiments can be lead on the mathematical model instead of the «live» system.

In turn, the important stage in creating of mathematical model of any company activity, particularly, the one that produce and sell the computer equipment, is development of general model specification, that at the formal level connects the end results of such activity (performance index that define model output) with factors, that affect them (input of the model).

To the input variables we'll attribute: effectiveness, economy, quality, profitability, productivity, operating conditions, introduction innovations.

To the input factors, alongside with resource ones, we'll also include expert information on such variables, as: existence of stable connections with distributors, existence of own warehouses, net assets, abilities to attract credit assets, number of branch offices, number of advertising acts and some other.

In the report detailed model constructions will be presented, realizing mentioned specifications.

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