The program of the final control in the discipline
« The Qualitative and asymptotic Theory of Differential Equations»

Specialty –7M05407 Mathematics
Course – 1
Language of study – Kazakh, language – English
2022, autumn semester

Form of final control – standard exam, oral, offline
Time to prepare an answer – 1 hour
Evaluation Policy – standard
Exam time – according to the schedule

List of questions submitted for the exam

Item № 1. Practical questions (Maximum score - 50 points)
Development of an algorithm for solving a concrete optimization problem described by differential equations.
1. Optimization problem for the concrete system with free final state.
2. Optimization problem for the concrete system with free fixed state.
3. Optimization problem for the concrete system with the isoperimetric condition.

Item № 2 Theoretical questions (Maximum score - 30 points)
General properties of optimal control problems for systems described by differential equations
1. Function minimization problems. Stationary condition.
2. Maximum principle for the standard optimization problem.
3. Convergence of the iterative method for the example of optimization problem.
4. Theorem of optimal control uniqueness.
5. Theorem of sufficiently of optimality conditions.
6. Singular controls.
7. Example of non-existence of optimal control for the system with free final state.
8. Theorem of optimal control existence.
9. Tihonov well-posedness of the problem.
10. Hadamard well-posedness of the problem.
11. Optimality conditions for the system with fixed final state.
12. Example of non-existence of optimal control for the system with fixed final state.
13. Optimality conditions for the system with isoperimetric condition.
14. Example of non-sufficient optimality condition for the system with isoperimetric condition.
15. Example of extremal bifurcation.

Item № 3. Additional questions. (Maximum score - 20 points).
Diagnosis of the situation in the practical solving of the problem.
1. It should indicate what effect is observed, what may be its causes and what should be done to overcome the difficulties encountered.
2. Algorithm divergence
3. Divergence of a sequence of controls under convergence of a sequence of functionals.
4. Obtaining different results with different initial approximations.

5. A large change in results with a small change in the parameters of the problem.