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| **Al-Farabi Kazakh National University****Syllabus****Differential games****Autumn, 2016-2017 years**  |
| **code** | **Course** | **type** | **hours** | **credits** | **ECTS** |
| **Lect** | **Semin** | **Lab** |
|  | Differential games |  | 2 | 0 | 1 | 3 |  |
| **Prerequisites** | Optimizations methods, numerical methods, differential equations  |
| **Lecturer**  | S. Serovajsky, doctor of science, professor | **Office yours** |  |
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| **Course description** | Analysis of solving practical methods of differential games and optimizations problems |
| **Aim of the course** | Analysis of the difficulties encountered in the practical solution of differential games and optimizations problems |
| **Results** | 1. Knowledge of the standard methods of differential games and optimizations control theory.
2. Ability of the practical solving of differential games and optimizations control theory.
3. Analysis of the difficulties encountered in the computer solution of differential games and optimizations problems
4. Knowledge of ways to overcome the difficulties encountered in the computer solution of differential games and optimizations problems
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| **References** | 1. Айзекс Р. Дифференциальные игры. Москва, Мир, 1967.
2. Serovajsky S. Practical Course of the Optimal Control Theory with Examples. – Almaty, Қазақ университеті, 2011.
3. Serovajsky S. Counterexamples in optimal control theory. – Utrecht-Boston, VSP, 2004.
4. Серовайский С.Я. Контрпримеры в теории оптимального управления. – Алматы, Қазақ университеті, 2001.
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| **Course organization** | The course includes an introduction to the theoretical part of the analysis and practical examples. Upon completion of analysis of each example is given the task as planned. |
| **Requirements** | Students must prepare for each lecture. In the course of the lecture held polls. At the seminars carried out an independent analysis of the examples of the course. After each class are given homework. |
| **Assessment of knowledge** |  |  |  |
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| Ваша итоговая оценка будет рассчитываться по формуле $$Итоговая оценка по дисциплине=\frac{РК1+РК2}{2}∙0,6+0,1МТ+0,3ИК$$Ниже приведены минимальные оценки в процентах:95% - 100%: А 90% - 94%: А-85% - 89%: В+ 80% - 84%: В 75% - 79%: В-70% - 74%: С+ 65% - 69%: С 60% - 64%: С-55% - 59%: D+ 50% - 54%: D- 0% -49%: F |
| **Discipline policy** | Appropriate timing of homework or projects may be extended in the event of extenuating circumstances (such as illness, emergencies, emergency, contingency, etc.) in accordance with the University's academic policies. Student participation in discussions and exercises in the classroom will be taken into account in its overall assessment of the discipline. Design issues, dialogue and feedback on the subject matter of discipline are welcomed and encouraged in the classroom, and the teacher in the derivation of the final grade will take into account the participation of each student in class  |
| **Graph of course** |
| week | subject | hours | marks |
| 1 | Lecture 1. Introduction. Pontyagin’s maximum principle. Numerical methods for necessary conditions of optimality. | 2 | 0 |
|  | Practical work 1. Pontyagin’s maximum principle. Example | 1 | 3 |
|  | Homework 1. Example of Pontyagin’s maximum principle. |  | 10 |
| 2 | Lecture 2. Sufficiently of the optimality conditions. Example of the insufficient conditions of optimality. | 2 | 1 |
|  | Practical work 2. Proof of the sufficiently of the optimality conditions. | 1 | 3 |
|  | Homework 2. Proof of the sufficiently of the optimality conditions. |  | 10 |
| 3 | Lecture 3. Sufficiently of the optimality conditions. Proof of the sufficiently of the optimality conditions. | 2 | 2 |
|  | Practical work 3. Proof of the sufficiently of the optimality conditions. | 1 | 3 |
|  | Homework 3. Proof of the sufficiently of the optimality conditions. |  | 10 |
| 4 | Lecture 4. Singular control. Examples. | 2 | 1 |
|  | Practical work 4. Examples of singular control. | 1 | 3 |
|  | Homework 4. Examples of singular control. |  | 10 |
| 5 | Lecture 5. Singular control. Kelly’s condition. | 2 | 2 |
|  | Practical work 5. Kelly’s condition. | 1 | 3 |
|  | Homework 5. Kelly’s condition. |  | 10 |
| 6 | Lecture 6. Existence and uniqueness of the optimal control. Example of the insolvable problem with sufficiently of the optimality condition.  | 2 | 1 |
|  | Practical work 6. Uniqueness of the optimal control. | 1 | 3 |
|  | Homework 6. Uniqueness of the optimal control. |  | 10 |
| 7 | Lecture 7. Existence and uniqueness of the optimal control. Example of the insolvable problem with sufficiently of the optimality condition. | 2 | 2 |
|  | Practical work 7. Existence of the optimal control. | 1 | 3 |
|  | Homework 7. Existence of the optimal control. |  | 10 |
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|  | Border control 1  |  | 100 |
| 8 | Lecture 8. Existence and uniqueness of the optimal control. II. Example of the insolvable problem without sufficiently of the optimality condition. | 2 | 1 |
|  | Practical work 8. Insolvable problem without sufficiently of the optimality condition. | 1 | 3 |
|  | Homework 8. Insolvable problem without sufficiently of the optimality condition. |  | 8 |
| 9 | Lecture 9. Existence and uniqueness of the optimal control. II. Example of the insolvable problem without sufficiently of the optimality condition. | 2 | 2 |
|  | Practical work 9. Insolvable problem without sufficiently of the optimality condition. | 1 | 3 |
|  | Homework 9. Insolvable problem without sufficiently of the optimality condition. | 0 | 8 |
| 10 | Lecture 10. Tihonov’s well-posed problem. Example of Tihonov’s ill-posed problem. Proof of Tihonov’s well-posedness. Regularization methods. | 2 | 1 |
|  | Practical work 10. Tihonov’s well-posed problem. | 1 | 3 |
|  | Homework 10. Tihonov’s well-posed problem. |  | 8 |
| 11 | Lecture 11. Hadamard’s well-posed problem. Example of Hadamard’s ill-posed problem. Proof of Hadamard’s well-posedness. | 2 | 2 |
|  | Practical work 11. Hadamard’s well-posed problem. | 1 | 3 |
|  | Homework 11. Hadamard’s well-posed problem. |  | 8 |
| 12 | Lecture 12. Optimization problems with isoperimetric conditions. Necessary conditions of minimum. Example. | 2 | 1 |
|  | Practical work 12. Necessary conditions of minimum for optimization problem with isoperimetric condition. | 1 | 3 |
|  | Homework 12. Necessary conditions of minimum for optimization problem with isoperimetric condition. |  | 8 |
| 13 | Lecture 13. Optimization problems with isoperimetric conditions. Nonuniqueness of the solutions for the boundary problem. | 2 | 2 |
|  | Practical work 13. Necessary conditions of minimum for optimization problem with isoperimetric condition. | 1 | 3 |
|  | Homework 13. Necessary conditions of minimum for optimization problem with isoperimetric condition. |  | 8 |
| 14 | Lecture 14. Bifurcation of extremals. Cheffey-Infante problem. | 2 | 1 |
|  | Practical work 14. Bifurcation of extremals. | 1 | 3 |
|  | Homework 14. Bifurcation of extremals. |  | 8 |
| 15 | Lecture 15. Bifurcation of extremals. Bifurcation of solutions and bifurcation of extremals. | 2 | 2 |
|  | Practical work 15. Bifurcation of solutions. | 1 | 3 |
|  | Homework 15. Bifurcation of solutions. |  | 8 |
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|  | Border control 2 |  | 100 |

Dean of the faculty M. Bektemesov

Head of the methodical department

Head of the DE&OT department S. Muhambetzhanov

Lecturer S. Serovajsky