**Kazakh National University Al-farabi**

**Faculty of Information Technology**

**Educationalprogram**

«6В07108 – Internet of Things and BigData»

**Syllabus**

**Line arautomatic control systems**

**Fall semester 2019-2020 academic year**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Disciplinecode | Name of the discipline | SIW | Hoursperweek | | | Numberofloans | | IWST |
| Лек | Практ | Лаб |
| OS | Linearautomaticcontrolsystems | 98 | 2 | 1 | 0 | 3 | | 74,10 |
| Lecturer | Master. Shortanbaeva A.T. | | | | Officeclock | | Scheduled | |
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| Practice teacher | Master. Shortanbaeva A.T. | | | |  | |  | |
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| --- | --- |
| AcademicCoursePresentation | **The purpose of the course:** the formation of skills in experimental research of linear automatic control systems (ATS). Theoretical information about the mathematical description. Stability and quality assessment of linear continuous ATS, about typical dynamic links. Methodology of measurements and processing of experimental data.  **As a result of studying the discipline, the student will be able to:**   1. Familiarization with the main directions of development of technical means. automation systems; the acquisition of practical skills in the design of devices and systems; automation, selection and calculation of automation tools and industrial devices of such systems, taking into account the characteristics of control objects and the features of the applied technical means; consolidation, expansion and deepening of knowledge on automation of technological processes. Acquaintance with the main directions of development of technical means; automation systems; the acquisition of practical skills in the design of devices and systems; automation, selection and calculation of automation tools and industrial devices of such systems, taking into account the characteristics of control objects and the features of the applied technical means; consolidation, expansion and deepening of knowledge on automation of technological processes. As a result of studying this discipline, students should: have an idea: - about the location of the theory of automatic control among technical disciplines; - the history of the development of the discipline; 2. Know: the role and place of automatic systems in automation tasks; technical facilities and industries; basic principles and schemes of automatic regulation, basic; types of automatic control systems, their mathematical description and the main objectives of the study; 3. 3. The role of the content and methods of the linear theory of systems, methods of analysis in the time and frequency domain; methods for describing automatic control systems in the form of transfer functions; construction of time and frequency characteristics of automatic control systems; methods for studying the stability of linear systems of automatic regulation and control; methods for assessing the quality of the regulatory process; 4. To be able to: - apply mathematical methods to analyze the general properties of linear systems, on this basis to own methods of analysis and correction of linear automatic control systems; - draw up structural diagrams and analyze stability and quality of systems, determine parameters and corrective links according to specified requirements for the quality of functioning of systems; acquire practical skills: - on the construction of single-loop linear ATS; - on analysis of the quality of work of the ATS. |
| PrerequisitesandCoreRequisites | Higher Mathematics I, II; Physics I, II; Theoretical foundations of electrical engineering. |
| LiteratureandResources | Main literature:KudinovYu.I. Theory of automatic control (using MATLAB - SIMULINK) [Electronic resource]: study guide / Yu. I. Kudinov, F. F. Pashchenko. - 2nd ed., Rev. and add. - The electron. text data - SPb. : Doe, 2018 .-- 312 p. E.lanbook.com access mode   Konovalov B. I., Lebedev Yu. M. Theory of automatic control [Electronic resource]: a training manual. 4th ed. - St. Petersburg: Publishing House "Lan", 2016. 224 p. E.lanbook.com access mode.  German-Galkin S. G. Virtual laboratories of semiconductor systems in the environment of Matlab Simulink [Electronic resource]: textbook. - St. Petersburg: Lan Publishing House, 2013.– 448 pp. E.lanbook.com access mode.  **Additional literature:**   Systems of automatic regulation and control [Electronic resource]: Part 1. Workshop / Comp .: V.M. Butakov, P.P. Pavlov. - KSEU, 2017 .-- 27 p. - Access mode: http // lib.kgeu.ru  Pogoditsky O.V., Malev N.A. Theory of automatic control: Textbook. - Kazan: KSEU, 2010 .-- 268 p.    Pogoditsky O.V. Digital control systems. Textbook - Kazan: KSEU, 2008.-188s.   Pogoditsky O.V., Malev N.A., Akhunov D.D., Tsvetkov A.N. Calculation and modeling of electric drives with regulators  various configurations: laboratory workshop. Kazan: KSEU, 2015 .--156 p.  **Internetresources:**  Additional training material, as well as documentation used to carry out homework and projects, will be available on your page on the website univer.kaznu.kz in the UMKD section (It is recommended to master the MOOC course on the subject of discipline). |
| Academic policy of the course in the context of university values | **Rules of academic conduct:** Mandatory attendance at classes, no lateness. Absence and being late for classes are estimated at 0 points.  Mandatory observance of the deadlines for the completion and delivery of tasks (according to the CDS, mid-term controls, control, laboratory, design work, etc.), the final exam. Incaseofviolationofthedeadlines, thecompletedtaskisevaluatedtakingintoaccountthedeductionofpenaltypoints.  **Academic values:** Academic honesty and integrity: autonomy in completing all tasks; the inadmissibility of plagiarism, forgery, the use of cheat sheets, cheating at all stages of the control of knowledge, deceiving the teacher and disrespectful attitude to the teacher and students.  Students with disabilities can receive counseling at the email address: mansurova.madina@gmail.com. |
| AssessmentandCertificationPolicy | **Criteriaassessment:**  During the acceptance of work performed and the final exam, the assimilation of theoretical material and the acquisition of theoretical and practical skills are checked in accordance with the descriptors (verification of the formation of competencies in midterm control and exams).  **Summative assessment:** assessment of active work in the audience; assessment of the completed task. The final grade is set according to the scale below. |

**GradeScale**

|  |  |  |  |
| --- | --- | --- | --- |
| Rating  bylettersystem | Digitalequivalent | Points (% Content) | Rating  according to the traditional system |
| А | 4,0 | 95-100 | Excellent |
| А- | 3,67 | 90-94 |
| В+ | 3,33 | 85-89 | Good |
| В | 3,0 | 80-84 |
| В- | 2,67 | 75-79 |
| С+ | 2,33 | 70-74 |
| С | 2,0 | 65-69 | Satisfactorily |
| С- | 1,67 | 60-64 |
| D+ | 1,33 | 55-59 |
| D- | 1,0 | 50-54 |
| FX | 0,5 | 25-49 | Unsatisfactory |
| F | 0 | 0-24 |

**Calendar (schedule) of the content of the training course**

|  |  |  |  |
| --- | --- | --- | --- |
| **Week** | **Topic Title** | **Hours** | **Maximum score** |
| 1 | Lecture 1. BASIC CONCEPTS OF ACS, CLASSIFICATION  AND PRINCIPLES OF CONSTRUCTION SPG | 2 | 1 |
| Practice 1 Drawing up functional diagrams according to the schematic diagrams of automatic control systems. | 1 | 11 |
| 2 | Lecture 2. LINEARIZATION OF DIFFERENTIAL EQUATIONS  AND FORMS OF SUBMISSION OF MATHEMATICAL MODELS OF ACS ELEMENTS | 2 | 1 |
| Practice 2 Mathematical description of automatic control systems. Forms of writing differential equations. Determination of transfer functions of individual elements of functional circuits. | 1 | 11 |
| 3 | Lecture 3. Forms of representation of mathematical models  elements of automatic control systems | 2 | 1 |
| Practice 3 Typical links. Differential equations, transfer functions, time and frequency characteristics of links | 1 | 11 |
| 4 | Lecture 4. Frequency characteristics.  Amplitude-phase frequency function.  Frequency response.  Phase frequency function.  Logarithmic frequency response | 2 | 1 |
| Practice 4 Basic rules for the compilation and transformation of structural schemes and the determination of the transfer functions of systems | 1 | 11 |
| **IWST.** 1. Elements of automatic control systems  2.. Basic concepts and definitions. | 1 | 20 |
| 5 | **Lecture 5.** Typical input influences. Single step  function, impulse function. Transient function, weight function | 2 | 1 |
| Practice. 5. The construction of the logarithmic frequency characteristics of links and systems. | 1 | 11 |
| **IWST.** Laws of regulation. Properties of automatic control systems |  | 20 |
| 6 | **MC 1** |  | **100** |
|  | **Lecture 6.** The concept of a dynamic link. Receiving temporary and  frequency characteristics of inertial, integrating and inertial links.  Dynamic Link Examples | 2 | 1 |
| Practical work 6. Implementation of semaphores and monitors. | 1 | 10 |
| 7 | **Lecture 7.**A study of the stability of linear systems using the Hurwitz criterion, Lienar-Shipar. | 2 | 1 |
| Practice 7. The study of the stability of stationary linear systems. | 2 | 10 |
| 8 | Lecture 8. Obtaining time and frequency characteristics  ideal differentiating link, forcing link of the 1st order, forcing link of 2nd order, link of delay | 2 | 1 |
| Practical work 8. The study of the stability of linear systems based on the construction of the hodograph of Mikhailov. | 1 | 10 |
| **ISWT** Frequency stability criteria  Regulatory Quality Assessment |  | 20 |
| 9 | **Lecture 9.** Definition of transfer functions open and  closed self-propelled guns according to a typical single-circuit structural scheme.  Rules for the transformation of structural schemes of self-propelled guns. | 2 | 1 |
| **Practical work 9.** The study of the stability of linear systems based on graphing the real and imaginary functions of Mikhailov | 2 | 10 |
| 10 | **Lecture 10.** Stability of continuous linear systems of automatic regulation. Routh-Hurwitz stability criterion | 1 | 1 |
| **IWST** Basic principles of regulation  “Study of the properties and characteristics of dynamic links” | 1 | 10 |
| **MC (МТ)** |  | 30 |
| 11 | **Lecture 11.** Stability of continuous linear systems of automatic regulation. Routh-Hurwitz stability criterion. | 2 | **100** |
| **Practical work 11.** Stability of continuous linear systems of automatic regulation. Criterion | 1 | 10 |
| 12 | **Lecture 12.** Investigation of the stability of a linear system by logarithmic frequency characteristics | 2 | 1 |
| **Practical work 12. Raus-Hurwitz sustainability** | 1 | 10 |
| **Practice 12** Investigation of the stability of a linear system by logarithmic frequency characteristics. | 2 | 10 |
| **Practice 12.** Identification of areas of stability by one or two parameters | 1 | 10 |
| **IWST**"The study of the stability of linear ATS"    “Study of the influence of the parameters of automatic regulators on the static characteristics of the ATS” | 1 | 10 |
| **Lecture 13.** Calculation of steady errors of astatic self-propelled guns.  Ways to improve the accuracy of self-propelled guns.  Transient Quality Analysis | 2 | 1 |
| 13 | **Practice 13.** Determination of system stability reserves by amplitude and phase based on plotting the amplitude phase frequency response of an open system. | 2 | 10 |
| **IWST** “The study of methods for improving the quality of ATS using corrective links”  "Basic laws of regulation in industrial ATS" | 1 | 10 |
| **Lecture 14.** The concept of correction systems.  Methods to improve the accuracy of systems in steady state.  Correction methods for the dynamic properties of systems.  Passive Correction Devices. | 2 | 20 |
| 14 | **Practice 14.** Determination of system stability reserves by amplitude and phase based on graphing of logarithmic frequency characteristics. | 2 | 10 |
| **Lecture 15.** Correction of the dynamic properties of the system using PKU.  Correction of the dynamic properties of the system using the OS.  General information on the synthesis of self-propelled guns and KU. KUS synthesis technique Standard settings and their application | 2 | 1 |
|  | **Practice 15:** using security tools in Windows | 1 | 10 |
| 16 | Practice 15. Determination of direct and indirect assessments of the quality of regulation by a linear system. | 2 | 10 |
| **SRSP.** Stability of linear automatic control systems.  Methods for assessing the quality of regulation of linear systems. | 1 | 10 |
| **MC 2** |  |  |
| **Final exam** |  | 30 |
| **TOTAL(MC1+МТ+MC2)×0,2+FE×0,4** |  | **100** |
|  |  | **100** |

Dean Urmashev B.A.

Chair Method Bureau Gusmanova F.R.

Head of Department Mansurova J.E.

Lecturer Shortanbaeva A.T.