Національний технічний університет України
«КИЇВСЬКИЙ ПОЛІТЕХНІЧНИЙ ІНСТИТУТ
імені ІГОРЯ СІКОРСЬКОГО»

Department of Automation of Electromechanical Systems and Electric Drive FEA

Course project on control and automation of technical systems

Work program of the discipline (Syllabus)

Details of the discipline	
Level of higher education	***Second (educational and scientific)***
Branch of knowledge	*14 "Electrical Engineering"*
Specialty	*141 "Electric power, electrical engineering and electromechanics"*
Educational program	*ELECTRIC POWER ENGINEERING, ELECTRICAL ENGINEERING AND ELECTROMECHANICS*
Discipline status	*Normative*
Form of study	*Eye (day)*
Year of preparation, semester	*1st course, the autumn semester*
The scope of discipline	*45 hours / 1.5 ECTS credits*
Semester control / control measures	*Test*
Timetable	*http://rozklad.kpi.ua*
Language of instruction	*Ukrainian / English*
Information about the course leader / teachers	Lecturer:*Ph.D. Korol Serhii Viktorovich, 0981708081* Practical:*Ph.D. Korol Serhii Viktorovich, 0981708081*
Course placement	https://classroom.google.com/u/0/c/MTQ2MzQ4ODExOTMy?hl=en

Curriculum

1. Description of the discipline, its purpose, subject of study and learning outcomes

The program of the discipline "Course project on control and automation of technical systems" is made according to the educational program "Electric power, electrical engineering and electromechanics" of preparation of the doctor of philosophy of a specialty 141 - Electric power, electric engineering and electromechanics.

The purpose of the discipline *there is a formation in students of the following abilities:*

perform original research, achieve scientific results that create new knowledge in electrical engineering and related interdisciplinary areas and can be published in leading scientific journals in electrical engineering and related fields; orally and in writing to present and discuss the results of research and / or innovative developments in Ukrainian and English, a deep understanding of English-language scientific texts in the field of research; apply modern information technologies, databases and other electronic resources, specialized software in scientific and educational

activities; identify, pose and solve research problems in the field of electrical engineering and digital automation, evaluate and ensure the quality of research.

The subject of the discipline - *Subject of the discipline: methods of solving theoretical and practical problems of design, programming and debugging of technical automation systems.*

Program learning outcomes:

Competences:(LC1) the ability to search, process and analyze information from various sources, (LC3) the ability to use information and communication technologies; (LC6) the ability to learn and master modern knowledge; (LC7) the ability to identify and assess risks; (FC2) the ability to develop and implement measures to improve the reliability, efficiency and safety in the design and operation of equipment and facilities of electricity, electrical engineering and electromechanics; (FC3) the ability to analyze technical and economic indicators and examination of design decisions in the field of power engineering, electrical engineering and electromechanics; (FC8) Ability to demonstrate awareness and ability to use regulations, norms, rules and standards in power engineering, electrical engineering and electromechanics; (FC9) the ability to use software for computer modeling, computer-aided design, automated production and automated development or design of elements of electrical, electrical and electromechanical systems; (FC11) ability to design robust and adaptive control algorithms for electromechanical automation systems and electric drives, to develop optimal and intelligent control laws using identification and observation methods; (FC13) the ability to develop electromechanical vehicle automation systems using the latest environmentally friendly technologies. electrical and electromechanical systems; (FC11) ability to design robust and adaptive control algorithms for electromechanical automation systems and electric drives, to develop optimal and intelligent control laws using identification and observation methods; (FC13) the ability to develop electromechanical vehicle automation systems using the latest environmentally friendly technologies. electrical and electromechanical systems; (FC11) ability to design robust and adaptive control algorithms for electromechanical automation systems and electric drives, to develop optimal and intelligent control laws using identification and observation methods; (FC13) the ability to develop electromechanical vehicle automation systems using the latest environmentally friendly technologies.

Skills:(PH01) to reproduce processes in electric power, electrotechnical and electromechanical systems at their computer modeling; (PH02) to outline the plan of measures for increase of reliability, safety of operation and prolongation of a resource of the electric power, electrotechnical and electromechanical equipment and the corresponding complexes and systems; (PH04) to reconstruct existing electrical networks, stations and substations, electrical and electromechanical complexes and systems in order to increase their reliability, operational efficiency and resource life; (PH06) to search for sources of resource support for additional training, research and innovation; (PH11) to communicate freely orally and in writing in state and foreign languages on modern scientific and technical problems of electric power, electrical engineering and electromechanics; (PH14) to master new versions or new software designed for computer modeling of objects and processes in electrical, electrical and electromechanical systems; (PH15) to synthesize algorithms of robust and adaptive, vector control, tracking and program control of movement.

2. Prerequisites and postrequisites of the discipline (place in the structural and logical scheme of education according to the relevant educational program)

To successfully master the discipline, the student must have a "Foreign language for scientific activities", as much of the latest technology is described in the scientific literature in English, and it is desirable to master the disciplines "Computer Science and Programming", "Automatic Control Theory", "Logical Synthesis" , "Automation systems", "Fundamentals of microprocessor technology", "Control of electric drives", "Course work on automation systems". Competences, knowledge and skills acquired in the process of studying the credit module are necessary for the quality of research on the topic of the master's thesis.

3. The content of the discipline

Execution of the course project is structurally divided into 5 sections:

1. *Formulation of the task for work and its detailing.*
2. *Development of the Functional diagram of the control system and description of input and output signals.*
3. *Synthesis of logical functions and control algorithms.*
4. *Selection of equipment for technical implementation of the control system and development of the scheme of internal connections of the control cabinet.*
5. *Development and testing of a program for PLC.*

4. Training materials and resources

Basic

1. Petrov IV Programmable controllers. Standard languages and methods of applied design / Ed. Prof., VP Dyakonova. - M .: SOLON-Press. - 2004. - 256 p.

2. Elperin IV Industrial controllers: Textbook. The method. - K: Nucht. - 2003. - 320p.

3. Demenkov NP Programming languages of industrial controllers: Textbook / Ed. K.A. Pupkova. - M .: Izd-vo MSTU im. N.E. Bauman. - 2004. - 172p.

4. Michel J., Lorjo K., Espio BM Programmable controllers. M .: Mechanical Engineering. - 1986. - 176p.

5. Karpov Yu. G. Theory of automata. SPb .: Peter. - 2002. - 224 p.

6. Control and automation of technical systems - 2. Course project: Methodical instructions to the course project. [Electronic edition]. - 2106. - 42 p.

7. Programmable logic controllers: Text of lectures for the direction of training 6.050702 - "Electromechanics", specialties 7.05070204, 8.05070204 - "Electromechanical automation systems and electric drive" full-time / Uklad. S.V. King. - K .: NTUU "KPI", 2013. - 124 p.

8. Programmable logic controllers a practical approach to IEC 61131-3 using Codesys.Doug H. Hanssen- 2015. - 416p. ISBN 9781118949245

9. Minaev IG, Samoilenko VV Programmable logic controllers: a practical guide for a novice engineer. Stavropol: AGRUS. - 2009. - 100p.

10. Programmable controllers: a guide for the engineer / E. Parr. Per. 3rd English Ed. - M .: BINOM. Knowledge laboratory. - 2007. - 516p.

11. Shalyto AA Logical control. Methods of hardware and program implementation of algorithms. SPb .: Nauka. - 2000. - 780 p.

12. Baskakov SI Radio circuits and signals. M .: Higher school. - 2000. - 462 p.

13. Dyakonov VP Computer mathematics. Theory and practice. M .: Knowledge. - 2001. - 1296 p.

14. Programmable controllers: theory and implementation / LA Bryan, EA Bryan. Second edition. - 1997. - 1035p. ISBN 0-944107-32-X.

15. Hugh Jack. Automating Manufacturing Systems with PLCs. Version 4.7. - 2005. - 845p.

Auxiliary:

16. Michel J. Programmable controllers: architecture and application. M .: Mechanical Engineering. - 1992. - 498p.

17. John Karl-Heinz, Tiegelkamp M. IEC 61131-3: Programming Industrial Automation Systems. Concepts and Programming Languages, Requirements for Programming Systems, Decision-Making Tools. Springer-Verlag Berlin Heidelberg, 2001

18. Lewis RW, Programming industrial control systems using IEC 1131-3 / Revised ed. The Institution of Electrical Engineers. London, United Kingdom, 1998.

19. Monari PD, Bonfatti F., Sampieri U., IEC 1131-3: Programming methodology. Software engineering methods for industrial automated systems., CJ International, France, 1999.

20. User Manual for PLC Programming with CoDeSys 2.2, 3S - Smart Software Solutions GmbH. Kempten, 2002.

21. IEC DIS 1131-3 Programmable Controllers - Programming Languages, Draft International Standard, International Electrotechnical Commission. February 14, 1992

22. Besekersky VA, Izrantsev VV Automatic control systems with microcomputers. M .: Science. - 1987. - 320 p.

23. Kahaner D., Mouler K., Nash S. Numerical methods and software. M .: Mir, 2001. - 575 s.

24. Steven W. Smith, The Scientist and Engineer's Guide to Digital Signal Processing., California Technical Publishing, 1997.

25. Structuring Program Development with IEC 61131-3. Eelco van der Wai, Managing Director of PLCopen (www.plcopen.org).

26. MULTIPROG wt Manual, English release 2.0, 1998, Klopper und Wiege Software GmbH.

27. Bernd Pelzer, Realtime Extensions for Windows NT: ProConOS NT - Realtime Software PLC on Windows NT. Klopper und Wiege Software GmbH.

28. OpenPCS Programming System Short Introduction, Version 4.0 English, 2000, Infoteam Software GmbH.

29. SoftControl V2.3 PLC Programming System, Help, Softing GmbH.

30. iCon-L Open Programming System for Industry Automation V3.0, Help, MPS & AT / ProSign GmbH.

31. Programming with STEP 7 V5.0, Release 02, 1999, Siemens AG.

32. Working with STEP 7 V5.0, Release 02, 1999, Siemens AG.

33. G. Frey, L. Litz (Eds.). Formal Methods in PLC Programming IEEE SMC 2000, Nashville, TN, 8-11 October 2000.

34. Konrad Etschberger, Controller Area Network. Basics, Protocols, Chips and Applications, IXXAT Press. Germany, 2001.

35. A2 Simple Application Controller Programming Guide. Manual number: jy992d97101b, Oct., - 2003

36. Phillips C., Harbor R. Feedback control systems. M .: Laboratory of Basic Knowledge, - 2001 - 616 p.

37. Microprocessor System of Technical Means (MTSS). Programming guide. Smolensk: JSC NPO "Technopribor".

38. Norton P., Yao P. Borland C ++ programming in Windows. K .: Dialektika, - 1993.

39. S.V. King Programmable logic controllers-1: Methodical instructions to laboratory works– K .: NTUU «KPI», 2011, - 68 p.

Information resources

40. http://iadt.siemens.ru/assets/files/infocenter/catalogs_and_brochures/as/catalogs/ST70/02_LOGO_2013_ru.pdf

41. http://iadt.siemens.ru/assets/files/infocenter/catalogs_and_brochures/as/catalogs/ST70/03_S7-200_2013_r.pdf

42. http://iadt.siemens.ru/assets/files/infocenter/catalogs_and_brochures/as/catalogs/ST70/05_S7-300_2013_ru_small.pdf

43. http://iadt.siemens.ru/assets/files/infocenter/catalogs_and_brochures/as/catalogs/ST70/06_S7-400_2013_ru.pdf

Educational content

5. Methods of mastering the discipline (educational component)

Execution of a course project on topics (variants of initial data)

1. Automation of transport and storage system.

2. Automation of elevators.

3. Automatic control of the mobile conveyor.

4. Automatic control of power supplies of welding posts.

6. Independent work of student

Week of the semester	*Name of the stage of work*	*Training time*
		IWS
2	*Getting the topic and task.*	
3-4	*Formulation of the task for work and its detailing.*	*6*
5-6	*Development of the Functional diagram of the control system and description of input and output signals.*	*10*
7-8	*Synthesis of logical functions and control algorithms.*	*8*
9-10	*Selection of equipment for technical implementation of the control system and development of the scheme of internal connections of the control cabinet.*	*10*
11-12	*Development and testing of a program for PLC.*	*8*
13-14	*Registration of the course project.*	*10*
15	*Submission of a course project for review*	
16	*Course project defense.*	*2*

Policy and control

7. Course policy (educational component)

The system of requirements that the teacher puts before the student:

- *rules of attendance: in accordance with Order 1-273 of 14.09.2020, it is prohibited to assess the presence or absence of the applicant in the classroom, including the accrual of incentive or penalty points. According to the RSO of this discipline, points are awarded for the relevant types of educational activity in lectures and practical classes.*
- *rules of conduct in the classroom: the student has the opportunity to receive points for the relevant types of educational activities in lectures and practical classes provided by the RSO discipline. The use of means of communication to search for information on the teacher's Google drive, on the Internet, in a distance course on the Sikorsky platform is carried out under the guidance of the teacher;*
- *rules of defense of individual tasks: defense of the abstract on the discipline is carried out individually in the form of a presentation to the audience at the last practical lesson;*
- *policy of deadlines and rearrangements: if the student did not pass or did not appear at the MCR (without good reason), his result is estimated at 0 points. Interpretation of MCR results is not provided;*
- *Academic Integrity Policy: Code of Honor of the National Technical University of Ukraine "Kyiv Polytechnic Institute" https://kpi.ua/files/honorcode.pdf establishes general moral principles, rules of ethical conduct of persons and provides a policy of academic integrity for people who work and study at the university, which they should be guided in their activities, including the study and preparation of control measures in the discipline "Advanced technologies in electric drive and electromechanical systems-1";*
- *when using digital means of communication with the teacher (mobile communication, e-mail, correspondence on forums and social networks, etc.) it is necessary to adhere to generally accepted ethical norms, in particular to be polite and limit communication during the teacher's working hours.*

8. Types of control and rating system for evaluation of learning outcomes (RSO)

***Current control**: delivery of sections of the course project, defense.*
***Calendar control**: conducted twice a semester as a monitoring of the current state of compliance with the requirements of the syllabus.*
***Semester control:** test.*
***Conditions of admission to semester control**: semester rating more than 25 points.*
Table of correspondence of rating points to grades on the university scale:

Scores	Rating
95-100	Perfectly
85-94	Very good
75-84	Fine
65-74	Satisfactorily
60-64	Enough
Less than 60	Unsatisfactorily
Less than 30	Not allowed

The overall rating of the student after the end of the semester consists of points obtained for:

- *starting component (execution of sections of the course project);*
- *course project defense;*

1. Starting component (r1):
- timely execution of the calendar plan for the course project - 3-6 points for each stage of the calendar schedule (a maximum of 30 points for all 5 stages), for each week of delay penalty points for each item are 2 points;

- quality of registration, fulfillment of requirements of regulatory documents - 5-10 points;
- quality of graphic material and compliance with the requirements of DSTU - 5-10 points.
2. Component of the course project defense (r2):
- degree of mastery of theoretical material (2 theoretical questions on the course project) - 10-20 points;
- degree of mastery of practical skills (demonstration of the program, the ability to determine the compliance of a fragment of the algorithm to the program, to explain the applied theoretical and technical solutions) - 10-20 points;
- completeness of conclusions on the work done and recommendations for their application - 5-10 points.

9. Additional information on the discipline (educational component)

Certificates of distance or online courses on the subject can be credited subject to compliance with the requirements set out in Order № 7-177 of 01.10.2020 On approval of the provisions on recognition in the KPI. Igor Sikorsky learning outcomes acquired in non-formal / informal education

Work program of the discipline (syllabus):

Folded Associate Professor of Automation of Electromechanical Systems and Electric Drive FEA, Ph.D. Korol S.V.

Approved Department of Automation of Electromechanical Systems and Electric Drive FEA (protocol № ___ dated _____2021)

Agreed Methodical commission of the faculty[1] (Minutes № __ of _____)

[1]Methodical council of the university - for general university disciplines.