DESCRIPTION OF THE COURSE

Name of the course: **Building Automation**	Code: **BpAICE46**	Semester: **7**
Type of teaching: Lectures (L) Laboratory work (Lab.)	Lessons per week: L – **2** hours Lab. – **2** hours	Number of credits: **5**

LECTURER:

Assoc. Prof. PhD. Ivan Kostov (FEA) – tel.: +35932659526, email: ijk@tu-plovdiv.bg
Technical University - branch Plovdiv.
prof. Ph.D. Michail Petrov (FEA), tel.: 659 585, email: mpetrov@tu-plovdiv.bg (FEA),
Control Systems Department ,Technical University - Sofia, Branch Plovdiv

COURSE STATUS ON THE CURRICULUM: Compulsory for the students specialty "Automation, Information and Control Engineering" Faculty "Electronics and Automatics", TU-Sofia, Plovdiv Branch, degree "Bachelor."
AIMS AND OBJECTIVES OF THE COURSE: The course "Building automation" gives knowledge of automation processes, mechanisms and machinery in modern buildings

DESCRIPTION OF THE COURSE: Using of hardware and software tools for creating highly automated buildings. Students receive practical knowledge in the choice of technical means for automation and methods of implementation of management programs and integrated building control. Laboratory exercises are conducted on 4 similar stands, which can be carried out in laboratory conditions, different types of managed processes. In the implementation of management using real sensors, actuators and control devices - controllers, which implement advanced systems for building automation. Course work targets the creation of student skills in self-design, tuning and simulation of a subsystem of building automation systems.

PREREQUISITES: The course is based on “Electromechanical Devices”, “Control theory”, “Measurement of non-electric Quantities”, “Control of electromechanical systems”, “Technical devices of automation”, “Logical control of electromechanical systems”.

TEACHING METHODS: Three forms are used: Lectures, Laboratory works on physical and computerised models and course work for every student. Written materials on the laboratory works are handed up to the students.
METHOD OF ASSESSMENT: A written exam in the end of VII semester is carried out.

INSTRUCTION LANGUAGE: Bulgarian.

BIBLIOGRAPHY:

1. Per-Goran Person, William Morton, Control Handbook HVAC Systems, Malmo, Sweden,1994; **2**. Волов Г.Я., Моделирование работы систем отопления, вентиляции и теплоснабжения – теоретические основы, Минск, Энерговент, 2007; **3**. Фальков, А.И., Д. В. Сузан, Что такое LON – краткий обзор технологии LonWorks, Москва, 2006; **4.** TAC Menta, Technical Manual, TAC AB, Sep 2007, www.tac.com; **5.** TAC Vista Webstation, Operating Manual, TAC AB, Sep 2007,

COURSE DESCRIPTION

Name of the course: **Intelligent Control Systems**	Code: **BpAICE47**	Semester: 7
Type of the education: Lectures, Laboratory exercises.	Hours during the week: Lectures – 2 hours, Lab. exercises – 2 hours.	Credits: **5**

INSTRUCTORS:
Prof., PhD, Andon V. Topalov (FEA), phone: +359 32 659 528, email: topalov@tu-plovdiv.bg
Prof., PhD, Michail G. Petrov (FEA), phone: +359 32 659 585, email: mpetrov@tu-plovdiv.bg
Technical University – Sofia, branch at Plovdiv

STATUTE OF THE COURSE IN THE CURRICULUM: Compulsory course for the students from the specialization "Automation, information and control engineering", qualification degree in education "bachelor".

GOALS OF THE COURSE: The course is built on the contemporary concepts for merging the computational intelligence approaches with the control system design end implementation methods. It introduces students to the basic principles of computational intelligence and intelligent control. At the end of this course, students will be able to design simple neural and fuzzy control systems, solve optimization problems using evolutionary computation approaches, read and understand constantly emerging technical literature about the subject.

COURSE DESCRIPTION: Different technical and technological problems leading to the design of specialized expert systems which can help for the achievement of the control systems goals are discussed. Students are introduced to the methods and algorithms for system identification and controller design by means of, or containing in their structure, neural networks, fuzzy systems, or hybrid structures. Such architectures in their predominant part are also characterized with the existence of adaptive and learning properties The discussed intelligent (neural, fuzzy and hybrid) controllers are capable in many cases to guarantee high and approximately constant performance of the system under control which is optimal in the sense of a preliminary adopted criterion. Simultaneously with these properties intelligent control schemes are also supposed to be robust with respect to the changes in the working environment or with respect to the existing uncertainties and ambiguities in the plant dynamic model (non-stationary parameters, lack of acceptable and precise analytically derived model of the plant dynamics, etc.).

PREREQUISITES: "Automatic control theory - part I and II", "System identification".

TEACHNG METHOD: Lectures, laboratory exercises with written reports.

GRADING: An exam at the end of the semester (82%), laboratory exercises (18%).

LANGUAGE OF TEACHING: Bulgarian

REFERENCE TEXTS: **1.** Petrov M., A. Topalov, A. Taneva, N. Shakev. Lecture notes in Artificial Intelligence Methods in Control Systems. Part I. Fuzzy Logic and Control (in Bulgarian). Edition of theTechnical University - Sofia , 2009, p. 168. ISBN 978-954-438-801-0. **2.** A. Topalov, Petrov M., N. Shakev, A. Taneva. Lecture notes in Artificial Intelligence Methods in Control Systems. Part II. Application of Neural Networks (in Bulgarian). Edition of theTechnical University - Sofia , 2010 **3**. F. O. Karray, C. de Silva. Soft Computing and Intelligent Systems Design. Theory, Tools and Applications, Addison Wesley, 2004. **4**. J. C. Principe, N. R. Euliano, W. C. Lefebvre. Neural and Adaptive Systems. Fundamentals Through Simulations. John Wiley & Sons, Inc., 2000. **5**. Z. Michalewicz. Genetic Algorithms + Data Structures = Evolution Programs. Third Ed., Springer-Verlag, 1995. **6**. O. Castillo, P. Melin. Soft Computing for Control of Non-Linear Dynamical Systems, Physica-Verlag, 2001.

DESCRIPTION OF THE COURSE

Name of the course **Nonlinear Control Systems**	Code: **BpAICE48.1**	Semester: **7**
Type of teaching: Lectures and laboratory work	Lessons per week: L – 2 hours; LW – 1 hour	Number of credits: **4**

LECTURER:
Prof. Ph.D. B. Penev (FEA), Assist. prof. Ph.D V. Petrov Technical University Sofia, Branch Plovdiv, Faculty of Electronics and Automatics (FEA), Control Systems Department

COURSE STATUS IN THE CURRICULUM: Compulsory discipline for regular Bachelor students in the specialty "Automatics, Informatics and Control Engineering" (BAICE) of FEA, Technical University Sofia, Branch Plovdiv.

AIMS AND OBJECTIVES OF THE COURSE: To give the students knowledge and skills in analysis and design of nonlinear control systems necessary for solving nonlinear control tasks, necessary for the other disciplines in the studying period, in the course and diploma work, as well as in their work as control engineers after graduation.

DESCRIPTION OF THE COURSE: In the course "Control theory III" the students study nonlinear control theory including analysis and design of nonlinear control systems by the methods of describing functions, the phase plane method, the Lyapunov methods, the theorems of La Salle and invariant sets, absolute stability, feedback linearization, feedback linearization of Hamiltonian systems, nonlinear observer design by canonical forms. Central are the concepts of motion stability and the related problems.

PREREQUISITES: The course uses knowledge from the following disciplines: "Mathematics I, II, III, IV", "Theoretic Electrotechnics I, II", Technical mechanics", "Physics I, II", "Control theory I", "Control theory II".

TEACHING METHODS: Lectures including case studies, laboratory work with transactions, course work, team work, private work. In the laboratory and course work the students acquire skills in analysis, design and investigation of nonlinear control systems. The course work includes analysis, design and simulation of a definite nonlinear system using computers with Microsoft Windows, Microsoft Office, MATLAB, SIMULINK and MATLAB TOOLBOXES.

METHOD OF ASSESSMENT: Laboratory work transactions (20%) and written examination at the end of 7th semester including a task and two topics from the syllabus (80%).

INSTRUCTION LANGUAGE: Bulgarian

BIBLIOGRAPHY: 1. Майзель М. М., Автоматика, телемеханика и системы управления производствеными процессами, Высшая школа, Москва, 1972; 2. Наплатанов Н. Д., Гунчев Л. А., Стойчев И., Теория на автоматичното регулиране, Нелинейни системи, Том 2, Техника, София, 1975; 3. Чаки Ф., Современная теория управления, Нелинейные, оптимальные и адаптивные системы, Мир, Москва, 1975; 4. Hahn Wolfgang., Stability of motion, Springer-Verlag, Berlin, 1967; 5. Khalil H. K., Nonlinear Systems, 2nd Edition, Prentice-Hall, New Jersey, 1996; 6. Slotine J., W. Li., Applied Nonlinear Control, Prentice-Hall International, 1991; 7. Vidyasagar M., Nonlinear systems analysis, Prentice-Hall International, 1993;

Description of the course

Name of the course: **Electric Dives Theory**	Code:**BpAICE49.1**	**Semester: 7**
Type of teaching: **Lectures and Laboratory work**	Lessons per week:L-2 hours; LW- 1 hours	**Number of credits: 4**

LECTURER:

Assoc. Prof. Ph. D. Krum Kutryanski Technical University of Sofia, Branch at Plovdiv

COURSE STATUS IN THE CURRICULUM:

The subject is compulsory for students regular course specialty "Automatics, Information and Control Engineering" for educational- qualification level "bachelor".

AIMES AND OBJECTIVES OF THE COURSE:

The aim of the course is to give students practice in making project and operation with electric drive systems which requires knowledge in particularity and characteristics of electric motors as an object of the control.

DESCRIPTION OF THE COURSE:

Main topics concern: Mathematical description on the process of the electromechanical transformation of energy in the generalized electric machine. Electro mechanical coupling and its characteristics. Structure and characteristics of linear electro mechanical transformer. Regime of working and restrictions, imposed on its elapse. Equations of movement of electromechanical systems. Types of resistance and moments of productions mechanisms Basic indicators for regulation on the speed of the electric drive. Mathematic description of the process of transforming energy in the engine for constant current. Mathematic description of the process of transforming energy into induction motor.

PREREQUISITES:

Control theory, Electrical Engineering, Technical means for automation, Electromechanical mechanisms.

TEACHING METHODS:

Lectures, laboratory works with reports.

METHODS OF ASSESSMENTS:

Two current written marks one in the middle and one in the end of the semester.

NSTRUCTION LANGUAGE:

Bulgarian

BIBLIOGRAPHY:

1. Ключев В. И., Теория на електрозадвижването, "Техника", София, 1989, с. 545.
2. Даскалов Г., И. Костов, К. Кутрянски, Електрозадвижване, ръководство за лабораторни упражнения, Технически университет - Пловдив, 2002, с. 136, ISBN 954-8779-36-6.
3. Даскалов Г., И. Костов, К. Кутрянски, И. Ганчев, Основи на електрозадвижването (теоретично и експериментално изследване с ЕИМ), ръководство за лабораторни упражнения, Технически университет - филиал Пловдив, 1992, с. 120.
4. Чиликин М. Г. и колл., Основû автоматизированного электропривода, "Энергия", Москва, 1979, с. 616. 5. Елисеев В. А. и колл., Справочник по автоматизированному электроприводу, "Энергоатомиздат", Москва, 1983, с. 616.

DESCRIPTION OF THE COURSE

Name of the course **Process Control - II**	Code: **BpAICE50.1**	Semester: **7**
Type of teaching: Lectures and laboratory work	Lessons per week: L – 2 hours; LW – 1 hour	Number of credits: **4**

LECTURERS:

Assoc. Prof. Ivan Ganchev, Ph.D., (FEA), Control Systems Department
Phone.: 659 525, e-mail: ganchev@tu-plovdiv.bg
Technical University - Sofia, Plovdiv Branch

COURSE STATUS IN THE CURRICULUM: Elective for the BEng level students, speciality AICE of the Faculty of Electronics and Automation.

AIMS AND OBJECTIVES OF THE COURSE: After studying this course the students should

- know how to control the basic technological quantities – temperature, level, pressure, flow, ratio, pH, etc.,
- understand variety of technological processes and
- be able to choose and design the control systems.

DESCRIPTION OF THE COURSE: The main topics concern: Automatic control of temperature, Automatic control of level, Automatic control of pressure, Automatic control of flow, Ratio control, pH control. Essentials and control system design of processes of distillation, drying, crystallisation, evaporation, continuous and portion dosage, burning and heat generation, granulation, etc.

PREREQUISITES: Control Theory, Instrumentation for Control, System Identification, Computer Simulation, Process Control I.

TEACHING METHODS: Lectures, handouts, laboratory work using industrial process controllers and PLCs. Students prepare written reports on the laboratory work.

METHOD OF ASSESSMENT: Two exams on the two parts of the course – one in the middle of the semester and second in the end of the semester.

INSTRUCTION LANGUAGE: Bulgarian

BIBLIOGRAPHY:

1. Dragotinov I., I.Ganchev, Process Control, University of Food Technologies, Plovdiv, 2003.

2. Hinov H., K.Naplatarov, Process Control, Technika, Sofia, 1987.

3. Hadjiiski M., Process Control in Metallurgy and Chemistry, Technika, Sofia, 1992.

4. Hadjiiski M., K.Velev, G.Sotirov, I.Kalaykov, Process Control - Methods and Algorithms, Technika, Sofia, 1992.

5. Astrom K-J, T. Hagglund, PID Controllers: Theory, Design, and Tuning, Instrument Society of America, Research Triangle Park, 1995.

6. Golten J., A.Verwer, Control System Design and Simulation, McGraw-Hill, 1991,

7. Luyben W., M.Luyben, Essentials of Process Control, McGraw-Hill, 1997,

DESCRIPTION OF THE COURSE

Name of the course **Control of Electric Drives**	Code: **BpAICE51.1** **BpAICE52**	Semester: **7**
Type of teaching: Lectures (L) Tutorials (Tut.) Laboratory work (Lab.) Semester projects (SP)	Lessons per week: L – 3 hours Tut. – 1 hour Lab. – 2 hours	Number of credits: **7+1**

LECTURER: Assoc. Prof. PhD. Ivan Kostov (FEA) – tel.: +35932659526, email: ijk@tu-plovdiv.bg , Technical University - branch Plovdiv.

COURSE STATUS IN THE CURRICULUM: Optional for students in the Automation, Information and Control Engineering, Bachelor's degree, Faculty of Electronics and Automation, TU-Sofia, Plovdiv Branch.

AIMS AND OBJECTIVES OF THE COURSE: To learn the design principles of main types of electric drive control systems. To develop understanding about the specific optimization methods of the respective control loops.

DESCRIPTION OF THE COURSE: Topics covered include: mathematical description methods of electric drives; structures of electric drive control systems; methods for optimization and tuning of control loops in electric drive systems; cascade control structures; torque control systems; speed control systems (one-zone and dual-zone regulation); position control systems; tracking control systems; control of electric drives with elastic joints; vector control of induction and synchronous motors.

PREREQUISITES: Control Theory, Control of Electromechanical Systems, Electric Drive Theory.

TEACHING METHODS: Lectures visually illustrated, Seminars, Laboratory work with protocols preparation, Course project.

METHOD OF ASSESSMENT: Final written exam.

INSTRUCTION LANGUAGE: Bulgarian.

BIBLIOGRAPHY: 1. Михов, М.Р., Системи за управление на електрозадвижванията, Технически университет - София, София, 2009; 2. Башарин, А. В., В. А. Новиков, Г. Г. Соколовский, Управление электроприводами, Энергоиздат, Ленинград, 1982; 3. Ключев, В.И., Теория на електрозадвижването, Техника, София, 1989; 4. Bose, B.K., Power electronics and motor drives: advances and trends, Academic Press, London, 2006; 5. Leonhard W.,"Control of electrical drives, Springer, 3rd ed., ISBN 3-540-41820-2, 2001, pp.600; 6. Mohan, N., Advanced electric drives, MNPERE, Minneapolis, 2001. 7. Костов И., Г. Иванов, Ръководство за лабораторни упражнения по управление на електрозадвижванията, Пловдив, 2014, с.100. 8. Костов И., Г. Иванов, Ръководство за курсово проектиране и семинарни упражнения по управление на електрозадвижванията, Пловдив, 2014, с.140. 9. Виноградов А., Векторное управление электроприводами переменного тока, Ивановский государственны энергетический университет, 2008, 298с. 10. И. Й. Костов, ЕЛЕКТРОЗАДВИЖВАНИЯ С ПОСТОЯННОТОКОВИ, АСИНХРОННИ И СИНХРОННИ ДВИГАТЕЛИ, учебно пособие, Пловдив, 2016, ISBN 978-619-90128-0-2. 11. http://dox.bg/files/dw?a=949a238c888

COURSE DESCRIPTION

Name of the course: **Computer vision and image recognition**	Code: **BpAICE53.1**	Semester: **8**
Type of the education: Lectures, Laboratory exercises.	Hours during the week: Lectures – 2 hours, Lab. exercises – 2 hours	Credits: **4**

INSTRUCTOR:

Assoc. Professor Nikola Shakev (FEA), phone: 659 528, email: shakev@tu-plovdiv.bg

Technical University – Sofia, branch at Plovdiv

STATUTE OF THE COURSE IN THE CURRICULUM: Elective course for the students from the specialization "Automation, information and control engineering", qualification degree in education "bachelor".

GOALS OF THE COURSE: The aim of the course is to introduce students into the existing methods and technical means for monitoring, automation and control of different industrial processes using computer vision in the loop and to acquire practical knowledge in programming such systems.

COURSE DESCRIPTION: The application area of pattern recognition includes a group of important theoretical and practical tasks like: analysis of spatial images and scenes, optical character recognition, speech recognition, recognition of physiological signals, analysis and recognition of aerial images and seismological signals, recognition of different situations in the industrial processes. The theory and practice of pattern recognition is widely applied in many important areas of the modern science and technology: medical and technical diagnosis, robotics etc. It is impossible, for example, to build advanced robots without including in their control system a subsystem for analysis and recognition of the environment. **PREREQUISITES:** "Control theory", „Measurement of non-electrical quantities", „Processing of data and signals", „Microprocessor-based systems", and „Artificial intelligence and robotics".

TEACHNG METHOD: Lectures, laboratory exercises with written reports.

GRADING: Two one hour written tests in the middle and at the end of the semester (82%), laboratory exercises (18%).

LANGUAGE OF TEACHING: Bulgarian

REFERENCE TEXTS: 1. R. C. Gonzalez, R. E. Woods, Digital Image Processing, Prentice Hall; 3 edition, 2007. 2. G. V. Gotchev, Computer vision. Methods and systems, TU Sofia, 1993, (in Bulgarian). 3. M. Nadler, E. P. Smith, Pattern Recognition Engineering, John Willey & sons Ltd., 1993. 4. G. Gluhchev, P. Venkov, D. Mutafov and M. Iancheva, Elements of the pattern recognition theory, Bulgarian Academy of Sciences, Sofia, 1982 (in Bulgarian). 6. A. L. Gorelik, V. A. Skripkin , Methods for recognition, Visshaia shkola, Moscow, 1989 (in Russian).

COURSE DESCRIPTION

Name of the course: **Information and Sensor Systems for Robots**	Code: **BpAICE53.2**	Semester: **8**
Type of the education: Lectures, Laboratory exercises.	Hours during the week: Lectures – 2 hours, Lab. exercises – 2 hours	Credits: **4**

INSTRUCTOR:
Assoc. Professor Nikola Shakev (FEA), phone: 659 528, email: shakev@tu-plovdiv.bg
Technical University – Sofia, branch at Plovdiv

STATUTE OF THE COURSE IN THE CURRICULUM: Elective course for the students from the specialization "Automation, information and control engineering", qualification degree in education "bachelor".

GOALS OF THE COURSE: At the end of the course the students are expected to be able to choose and apply transducers and sensor systems for robots with autonomous behavior in a dynamic environment. They have to know the characteristics of the transducers and the architecture of the sensor systems and how to use it in solving the problems for analysis and recognition of the objects and situation in the environment.

COURSE DESCRIPTION: The main topics concern: TV cameras with CCD, CMOS, CID, SSPhD transducers and standard or digital output. Frame Grabbers, USB 2.0, IEEE 1394b, GigE, Camera Link Interface Modules, Pipeline and Matrix Architecture of Image Analysers, Laser and Ultrasound Rangefinders, Tactile Sensors, Force and Torque Sensors, Speech Recognition Devices.

PREREQUISITES: Physics, Computer Engineering, Electronics, Measurement Systems.

TEACHNG METHOD: Lectures, laboratory exercises with written reports.

GRADING: Two hours assessment at the end of semester (82%), laboratory exercises (18%).

LANGUAGE OF TEACHING: Bulgarian

REFERENCE TEXTS:
1.П. Венков, Информационно-сензорни системи за роботи; изд. на Т. У. - София, 2000.

2. П.Венков, Избор на видео-преобразователи в системите за техническо зрение, Списание "Автоматика и информатика", София, 2010, кн.1, ISSN 0861 – 7562.

3. П.Венков, М.Младенов, Приложения на сензори, моделиращи човешки възприятия, Списание "Автоматика и информатика", София, 2010, кн.1, ISSN 0861 – 7562.

4. S. Ruocco, Robot sensors and transducers. Open University Press and Wiley, UK, 1987.

5. G. Asch, Les capteurs en instrumentation industrielle, Dunod, Paris, 1991.

6. К. Фу, Р.Гонсалес, К. Ли, Робототехника, Москва, "Мир", 1989.

7. R. Horaud, O. Monga, Vision par ordinateur – outils fondamentaux, Hermes, Paris, 1993.

8. Б. Хорн, Зрение роботов, Москва, изд." Мир", 1989.

SUBJECT OVERVIEW

Subject name: **Automation of Manufacturing Mechanisms**	Code: **BAICE54.1**	Semester: 8
Type of training: Lectures and Laboratory exercises	Hours per week: L – 2 hours LE – 2 hours	Number of credits: 3

LECTURER: Assoc. Prof. Dr. Krum Kutryanski, Dipl. Eng., Chief Assist. Prof. Dr. Radoslav Hrischev, **Dipl. Eng.,** from TU-Sofia, Plovdiv Branch, FEA, Control Systems Department

STATUS OF SUBJECT IN SYLLABUS:

The subject is selective from a block of subjects for full-time students from the Automation, Information and Control Systems major at the FEA of TU-Sofia, Plovdiv Branch, Bachelor's degree.

SUBJECT GOALS:

The goal of the course in Automation of Manufacturing Mechanisms is to introduce students to the requirements to electromechanical systems and automation focusing on each class of problems and summarizing their possible solutions.

SUBJECT DESCRIPTION:

The course of lectures on the subject of Automation of Production Mechanisms gives students knowledge of: specific requirements to electromechanical and automation systems for the basic classes of production mechanisms; a mathematical description of such mechanisms' significant values and processes; emphasis on the specific problems for each class and systematizes the possible solutions. To illustrate up-to-date solutions of relevant problems, typical schemes of assemblies and devices are given.

REQUIRED ACADEMIC BACKGROUND:

The subject builds upon knowledge from the following courses: Electromechanical Devices, Control of Electro-Mechanical Systems, Electric Dives Theory and Electric Drives Control Systems.

TEACHING METHOD:

Lectures, including multimedia methods, and laboratory exercises concluding with assessed presentation of experimental protocols. Exercises are carried out on physical models and computers and are problem-oriented. They mostly represent computer-assisted calculation experiments during which parametric optimization is performed based on investigation into the dependencies in function on the type and parameters of the electric drive system and the actual operational regime.

EXAMINATION AND GRADING METHODS:

Written exam (test) during the examination session following the eighth semester.

LANGUAGE OF TEACHING:

Bulgarian

RECOMMENDED READING:

1. Yordanov S., Kr. Kutryanski, Automation of Production Mechanisms, Sofia, Technical University, 2001. 2. Yordanov S., G. Daskalov, Automation of Production Mechanisms (computation experiments and optimisation), Laboratory Exercises Manual, Plovdiv, Technical University, 1991. 3. Yordanov S., R. Raynov, Laboratory Exercises Manual in Automation of production mechanisms, Sofia, Technical University, 1989. 4. Yordanov S., R. Raynov, D. Kraychev, Selection of optimal parameters for reversive electric dives, Sofia, "Tehnika", 1980. 5. Klyuchev V. I., The limitation of the dynamic loads of the electric drive, Moscow, "Energy",1971. 6. Klyuchev V. I., Electric Drives Theory, "Tehnika", Sofia, 1989, page 545.

DESCRIPTION OF THE COURSE

Name of the course: **Energy efficiency in industry**	Code: **BpAICE54.2**	Semester: **8**
Type of teaching: Lectures (L) Laboratory work (Lab.)	Lessons per week: L – **2** hours Lab. – **2** hours	Number of credits: **3**

LECTURER:

Ass. , Ph.D., Zachary Kavroshilov, Phone: 659 529
(FEA), Control Systems Department ,Technical University - Sofia, Branch Plovdiv

COURSE STATUS ON THE CURRICULUM: Eligible subject for full-time students of the "Automation, Information and Control Engineering" Faculty "Electronics and Automatics", TU-Sofia, Plovdiv Branch, degree "Bachelor."

AIMS AND OBJECTIVES OF THE COURSE: The aim of the course is to teach students to effectively receive and use of energy in industry and establish appropriate information and control systems.

DESCRIPTION OF THE COURSE: Students get acquainted with modern theoretical methods and approaches for the realization of autonomous and centralized management using local or generalized criteria - energy efficiency (thermal efficiency, minimum energy consumption , etc.). For this purpose, energy efficiency is considered by using a system approach in which processes are represented by a combination of twelve separate power systems: power distribution , lighting, electric, fluid dynamics, compressed air, steam, thermal processes, process cooling, industrial refrigeration systems, heating, ventilation and air conditioning; combined heat and power, and renewable energy systems. For various systems and their combination given approaches and methods that are limited to solutions and the application of modern algorithms and control systems. In this direction have been developed and laboratory exercises involving some of the common and accessible processes that emulate, simulate and (or) natural implemented through appropriate stands.

PREREQUISITES: The course builds on the knowledge obtained from courses in Control Theory, Process Automation, System Identification, Building automation.

TEACHING METHODS: Lectures using multimedia equipment and laboratory exercises - Complete protection protocols. These include calculation and experimental determination of the objects and systems as well as evidence from monitoring the available simulators and real systems.

METHOD OF ASSESSMENT: Written examination in the session after the end of the semester.

INSTRUCTION LANGUAGE: Bulgarian.

BIBLIOGRAPHY:

1.Tim Raffio, Hang Zhang and Kelly Kissock., Integrated Systems Plus Principles Approach to Industrial Energy Efficiency, ACEEE Summer Study on Energy Efficiency in Industry,2013, p.1-12; 2. Шински Ф. Управление процессами по критерию экономии энергии, Москва, Мир1981г; 3.Наплатаров К.Хр. Енергоикономично управление на процеси, С. ТУ, 1997 г.; 4. Стыркович М.А,Э.Э. Шпильрайн, Энергетика, проблемы и перспективы.М. Энергетика, 1981.

DESCRIPTION OF THE COURSE

Name of the course: **Systems Design**	Code: **BpAICE55.1**	Semester: **8**
Type of teaching: Lectures (L) Laboratory Work (LW)	Lessons per week: L – 2 hours LW – 2 hours	Number of credits: **3**

LECTURER: prof. Ph.D. Michail Petrov, tel.: 659 555, email: mpetrov@tu-plovdiv.bg
assoc. prof. Ph.D. Albena Taneva, tel.: 659 585, email: altaneva@tu-plovdiv,.bg
(FEA) Technical University of Sofia, branch Plovdiv

COURSE STATUS IN THE CURRICULUM: Optional for the students specialty Automation, Information and Control Engineering, BEng program, Faculty of Electronics and Automation.

AIMS AND OBJECTIVES OF THE COURSE:

Aims of this course is basic foundations of systematic project research for building control systems.At the end of the course the students are expected to be able to apply the systematic methodology for investigation, system aanalysis and design of continuous, discrete time and discrete-event processes and systems in the field of industry, management and social service, and to have basic knowledge to create aims and criteria using in control systems projects. They must have a skills in using software for building models, verification, analysis and validation of the control systems projects.

DESCRIPTION OF THE COURSE:

Study the process of projection of the control systems like human doing activities to create under technological, economical, social psychological and law authorities' limitations. Investigation, exploration, systematic methodology techniques for idea descending project and ascending verification of project decisions is acquire. Criteria, methods and tools for project optimization, planning and financial management of team groups researchers and organization is consider. The main topics concern: Systems Analysis and Design, Information Management Systems and applications to distributed systems, dynamical systems from engineering (electrical, thermal, hydraulic, mechanical, control, etc.), from economy (market-inventory-plant), from ecology (population, epidemics and pray-predator problems).

PREREQUISITES: Control Theory, System Identification, Process Control Automation.

TEACHING METHODS: Lectures, using slides, case studies, laboratory work from laboratory manual, work in teams, protocols preparation and defence.

METHOD OF ASSESSMENT: Two one-hour assessments at mid and end of semester (75%), laboratories (25%)

INSTRUCTION LANGUAGE: Bulgarian.

BIBLIOGRAPHY:
1. Awad, Elias M., Systems Analysis and Design, IRWIN, Homewood, Illinois, 1985; **2.** Hills, Philip J., Information Management Systems (implication for the human-computer interface), ELLIS HORWOOD, London, 1990; **3.** Morris Peter W. G., George H. Hough, The Anatomy of Major Projects (a study of the reality of project management), JOHN WILEY & SONS, Chichester, 1990; **4.** Живков Д., Г.Сотиров, Б.Кирилов, Проектиране на системи за автоматизация, ВМЕИ, София, 1983; **5.** Капитално строителство (правилници, наредби, норми, инструкции), Наука и изкуство, София, 1981; **6.** Клюев А.С., Б.В.Глазов, А.Х.Дубровский, Проектирование систем автоматизации технологических процессов, Энергия, Москва, 1980; **7.** Боэм Б.У., Инженерное проектирование программного изделия, Москва, Радио и связь, 1985.

DESCRIPTION OF THE COURSE

Name of the course: **Information and control systems in the field of environmental protection**	Code: **BpAICE55.2**	Semester: **8**
Type of teaching: Lectures (L) Laboratory work (Lab.)	Lessons per week: L – **2** hours Lab. – **2** hours	Number of credits: **3**

LECTURER:

Ass. , Ph.D., Zachary Kavroshilov, Phone: 659 529
(FEA), Control Systems Department ,Technical University - Sofia, Branch Plovdiv

COURSE STATUS ON THE CURRICULUM: Eligible subject for full-time students of the "Automation, Information and Control Engineering" Faculty "Electronics and Automatics", TU-Sofia, Plovdiv Branch, degree "Bachelor."

AIMS AND OBJECTIVES OF THE COURSE: The aim of the course is to acquaint students with the existing interconnection between human activity and environmental pollution and the role of control systems for its conservation.

DESCRIPTION OF THE COURSE: The main topics related to the use of control systems and management in industry, where the environment is essential. In structural terms, the program is built by grouping related tasks: prevent or minimize emissions and effects (optimal keeping processes) management technology modules and devices designed for functional ecology (filters, water treatment plants), management process of disposal of waste and hazardous products (biogas, incineration of plastics, etc.): continuous monitoring of emissions at the level of process, production unit regional level. Thoroughly analyze major pollutants such as emphasis is made on the combustion processes. Referred to is the role of the specialist in automation in the implementation of approaches to management of environmental protection.

PREREQUISITES: The course builds on the knowledge obtained from courses in Control Theory, Process Automation, System Identification, Applied methods of production management.

TEACHING METHODS: Lectures using multimedia equipment and laboratory exercises - complete protection protocols. These include calculation and experimental determination of the objecjs and systems as well as evidence from monitoring and management of available simulator and industrial distributed system.

METHOD OF ASSESSMENT: Written examination in the session after the end of the semester.

INSTRUCTION LANGUAGE: Bulgarian.

BIBLIOGRAPHY:

1. Наплатаров К.Хр. Управление на околната среда. С., ТУ, 2009; 2. Захаринов Б., Здр. Гъргаров. Екологичен мониторинг и опазване на околната среда. С. 2001; 3. Станев С. Инженерна защита на околната среда. С., Техника 1989. 4. Gustaf Olsson, Instrumentation, Control and Automation in Wastewater Systems, IWA Publishing, 2005. 5. Pernille Ingildsen, Realising Full-Scale Control in Wastewater Treatment, Lund University, 5,2002

DESCRIPTION OF THE COURSE

Name of the course: **Power and Control Electronics in Electric Drives**	Code: **BpAICE56.1**	Semester: **8**
Type of teaching: Lectures (L) Laboratory work (Lab.)	Lessons per week: L – 2 hours Lab. – 2 hours	Number of credits: **3**

LECTURER: Assoc. Prof. PhD. Ivan Kostov (FEA) – tel.: +35932659526, email: ijk@tu-plovdiv.bg , Technical University - branch Plovdiv; Assoc. Prof. Ph.D Sevil Aptula Ahmed (FEA), Technical University - branch Plovdiv, tel.:+35932659585, sevil.ahmed@tu-plovdiv.bg.

COURSE STATUS IN THE CURRICULUM: Optional for students in the Automation, Information and Control Engineering, Bachelor's degree, Faculty of Electronics and Automation, TU-Sofia, Plovdiv Branch.

AIMS AND OBJECTIVES OF THE COURSE: Students acquire the knowledge needed for the operation of semiconductor converters, learn new solutions in this area and build skills to create custom solutions.

DESCRIPTION OF THE COURSE: Students acquire knowledge about the transformation of electricity and process controls in the elements and blocks of semiconductor converters of electromechanical automation systems, implementation of control loops of currents and voltages, control circuitry and protect as necessary and linear models and their structural schemes.

PREREQUISITES: Knowledge on the fields of Mathematics, Physics, Electro-techniques, Semiconductor devices, Pulse and digital techniques, Electrical Measurement, Electromechanical devices, Control theory.

TEACHING METHODS: Lectures assisted with multimedia; laboratory works on physical and computer modeling. Materials about the lectures and laboratory works are handed up to students.

METHOD OF ASSESSMENT: Continuous assessment based on two tests.

INSTRUCTION LANGUAGE: Bulgarian

BIBLIOGRAPHY:
1. http://dox.bg/files/dw?a=feb1815a344; 2. Irving Gottlieb, Power Supplies, Switching Regulators, Inverters and Converters, TAB Books, 1994; 3. Hirshmann Walter, Schaltnetzteile: Konzepte, Bauelemente, Anwendungen, Berlin und Muenchen, 1990; 4. MUHAMMAD H. RASHID, Power electronics handbook, ACADEMIC PRESS, 2001; 5. Keith H. Sueker, Power Electronics Design : A Practitioner's Guide, 2005; 6. Prabha Kundur, Power System Stability and Control, 2007. 7 Личев Р.П**.,** Проектиране на полупроводникови електрозадвижвания, Технически университет - София, 2005, с.208, ISBN 954-438-527-4. 8 Костов И., Г. Даскалов, Проектиране на полупроводникови електрозадвижвания, ръководство за проектиране (решени примери и задачи), Технически университет – Пловдив, 2001, с.106, ISBN 954-8779-27-7.

DESCRIPTION OF THE COURSE

Name of the course: **Electrical Drives with Synchronous Motors**	Code: **BpAICE56.2**	Semester: **8**
Type of teaching: Lectures, Laboratory work and Course project/ coursework	Lessons per week: L – 2 hours; LW – 2 hours. none	Number of credits: **3**

LECTURER: Assoc. Prof. PhD. Ivan Kostov (FEA) – tel.: +35932659526, email: ijk@tu-plovdiv.bg , Technical University - branch Plovdiv.

COURSE STATUS IN THE CURRICULUM: Elective subject for full-time students in the curriculum in the major of Electronics at the Faculty of Electronics and Automation in TU-Sofia, Plovdiv Branch, from the Bachelor's degree of Science plan.

AIMS AND OBJECTIVES OF THE COURSE: The ease of controlling electrical drives is an important aspect for meeting the increasing demands by the user with respect to flexibility and precision, caused by technological progress in industry as well as the need for energy conservation. The control of electrical drives provided strong incentives to control engineering in general, leading to the development of new control structures and their introduction to other areas of control systems. The purpose of the acquired knowledge is to prepare engineers for the graduation thesis design and for the practice.

DESCRIPTION OF THE COURSE: The course Electrical Drives with Synchronous Motors (EDSM) examines the dynamic properties: BLAC motors, BLDC motors, SRM and hybrid step motors. Mathematical models and dynamic behaviour of a Synchronous motors, "sensorless" and optimal vector control systems. Laboratory work is conducted on physical and mathematical models. They provide for acquiring practical skills and abilities for adjustment of some of the most common control structures in addition to better learning of the lecture material.

PREREQUISITES: The course is conducted on the basis of knowledge from the courses: BpAICE42, BpAICE49.1, BpAICE51.1.

TEACHING METHODS: Board panels have been prepared for visualization of the lecture material, for conducting the laboratory work a manual and models for the exploration of mathematical description of various EDSM, protocols, preparation and presentation.

METHOD OF ASSESSMENT: Written test during 10^{th} academic week on the subject matter. Test duration – two hours. Lectures (73%), laboratories (27%).

INSTRUCTION LANGUAGE: Bulgarian.

BIBLIOGRAPHY: **Виноградов, А. Б.**, Векторное управление электроприводами переменного тока. ГОУВПО-ИГЭУ. Иваново, 2008, с. 321. **Gieras J. F., Wing M.**, Permanent magnet motor technology, Marcel Dekker Inc., 2002, p. 590. **Miller, T. J. E.**, Brushless permanent-magnet and reluctance motor drives., Oxford, 1989, p. 207. **Krishnan, R.**, Permanent magnet synchronous and brushless DC motor drives. CRC Press, 2010, p. 564. **Krishnan, R.**, Switched reluctance motor drives: modeling, simulation, analysis, design, and applications. CRC Press, 2001, p. 416.

Description of the course

Name of the course: **Logical Control**	Code:**BAICE57.1**	**Semester:8**
Type of teaching: **Lectures and Laboratory work**	Lessons per week:L-2 hours; LW- 2 hours	**Number of credits:3**

LECTURER:

Assoc. Prof. Ph. D. Krum Petkov Kutryanski Technical University of Sofia, Branch at Plovdiv /FEA/

COURSE STATUS IN THE CURRICULUM:
The subject is compulsory for students regular course specialty "Automatics, Information and Control Engineering" for educational- qualification level "bachelor".

AIMES AND OBJECTIVES OF THE COURSE:
The aim of the course is to give students knowledge, which will be useful for dealing with the current control systems, for realization the logical control based on discrete- mechanical contact or electronic scheme technique, or with help of programming logical controller.

DESCRIPTION OF THE COURSE:
The main topics concern: Discrete (relay) control. Axioms and laws of Boole's algebra used in the Logical Control. Logical Functions. Functional fully systems. Logical elements and devices in the control systems. Combination Logical schemes and schemes with memory. Design of Logical control systems.

PREREQUISITES:
Control Theory, Electrical Engineering, Semi-conductors elements.
Impulse and digital schemes technique. Technical means for automation.

TEACHING METHODS:
Lectures, laboratory works with reports.

METHODS OF ASSESSMENTS:
Written exam (continuous assessment) based on the studied subjects in the end of the eighth semester.

INSTRUCTION LANGUAGE: Bulgarian

BIBLIOGRAPHY:

1. Petruzella F., Programmable Logic Controllers, Fifth Edition, McGraw-Hill Education, 2017
2. Charles H. Roth, Jr. and Larry L. Kinney, Fundamentals of Logic Design, Seventh Edition, Cengage Learning, 2014
3. К. Павлитов, Логическо управление на електромеханични ситеми, София 2007
4. Тодоров А., С. Йорданова, С. Джиев, В. Сгурев. Логическо управление на процеси. С.,Технически Университет, 2001

Description of the course

Name of the course: **Control of discrete-continuous processes**	Code:**BpAICE57.2**	**Semester:8**
Type of teaching: **Lectures and Laboratory work**	Lessons per week:L-2 hours; LW- 2 hours	**Number of credits:3**

LECTURER:

Assoc. Prof. Ph. D. Krum Petkov Kutryanski Technical University of Sofia, Branch at Plovdiv /FEA/

COURSE STATUS IN THE CURRICULUM:
The subject is compulsory for students regular course specialty "Automatics, Information and Control Engineering" for educational- qualification level "bachelor".

AIMES AND OBJECTIVES OF THE COURSE:
The aim of the course is to provide students with knowledge that will be useful in solving issues related to modern discrete or continuous-flow control systems and working consistently over time with a rigid and flexible control.

DESCRIPTION OF THE COURSE:
Main themes: Discrete and discrete-continuous processes. Automic motion control of working mechanisms connected in a single process. Program control systems. Digital program control systems. Systems for positional numerical control. Open and closed systems for functional-program control. Control of objects with a rigid and flexible control beat. Control of objects from a conveyor type.

PREREQUISITES:
Control Theory, Electrical Engineering, Semi-conductor elements.
Impulse and digital electronics. Technical devices for automation.

TEACHING METHODS:
Lectures, laboratory works with reports.

METHODS OF ASSESSMENTS:
Written exam in the end of the eighth semester.

INSTRUCTION LANGUAGE: Bulgarian

BIBLIOGRAPHY:

1. Petruzella F. , Programmable Logic Controllers, Fifth Edition, Publisher: McGraw-Hill Education, 2017
2. Тодоров А., С. Йорданова, С. Джиев, В. Сгурев. Логическо управление на процеси. С.,Технически Университет, 2001
3. UnityPro, Ръководство за програмиране на Schneider, 2012
4. FPWIN Pro, Ръководство за програмиране на Panasonic, 2012

DESCRIPTION OF THE COURSE

Name of the course: **Information and control systems in the industry**	Code: **BpAICE58.2**	Semester: **8**
Type of teaching: Lectures Laboratory Works	Lessons per week: L – 2 hours; LW – 2 hour.	Number of credits: 3

LECTURER: Chief Assistant Professor Ph.D Radoslav Nikolov Hrischev, Technical University - branch Plovdiv, tel.:+359 32 659 525, hrischev@tu-plovdiv.bg

COURSE STATUS IN THE CURRICULUM: Optionally for the bachelor's degree students, specialty Automation, Information and Control Systems, Faculty of Electronics and Automation.

AIMS AND OBJECTIVES OF THE COURSE: To introduce knowledge of information and control systems in the industry and basic knowledge of the ERP systems. Students acquire basic skills in ERP systems and most popular ERP system - SAP.

DESCRIPTION OF THE COURSE: The main topics concern: Information systems and control systems, definition, classification. A Models of information systems. Production information systems - CRM, ERP, MES. Overview and description of ERP systems, their place in control systems. Main modules of the SAP. Detailed overview of the most important modules of SAP. Practical skills in ERP systems based on exercises and demonstration.

PREREQUISITES: IT, Control Systems

TEACHING METHODS: Lectures, presentations, demos, films, case studies, laboratory work, protocol description preparation and defence for each lab.

METHOD OF ASSESSMENT: Two one-hour assessments at mid and end of the semester (75%) and laboratories 25%).

INSTRUCTION LANGUAGE: Bulgarian

BIBLIOGRAPHY:

1. Tudzharov H., Information Systems, 2007
2. SAP University Alliances, Global Bike (GBI) curricula.
3. SAP University Alliances, Introduction to Industry 4.0.
4. Open Online Courses: https://open.sap.com/