DESCRIPTION OF THE COURSE

Name of the course: **Building automation**	Code: **BpAICE16**	Semester: 7
Type of teaching: Lectures (L) Laboratory work (LW) Course work (CW)	Hours per semester: L – 33 hours LW – 18 hours	Number of credits: 5

LECTURER(S):
Assoc. Prof. Eng. Albena Taneva, PhD (FEA), tel.: 032 659 585, e-mail: altaneva@tu-plovdiv.bg
Technical University of Sofia

COURSE STATUS IN THE CURRICULUM: Mandatory for all students in the Automation Information and Control Engineering BEng program of the Faculty of Electronics and Automation at the Technical University of Sofia, branch Plovdiv. Professional orientation 5.2 Electrical engineering, electronics and automation, Field 5 Technical Sciences.

AIMS AND OBJECTIVES OF THE COURSE: The course "Building automation" gives knowledge of automation processes, mechanisms and machinery in modern buildings. Possibilities and solutions, of smart house, are observed.

DESCRIPTION OF THE COURSE: The subject of the course is focused and related to real solutions for building automation with integrated management system. 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 with software environment, which can be carried out in laboratory conditions, different types of processes. The integrated software and programmable devices – controllers are used for control, 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.

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: Lectures, using slides, case studies, laboratory works and course work for every student.

METHOD OF ASSESSMENT: Exam (70%), laboratories (30%).

INSTRUCTION LANGUAGE: in Bulgarian

BIBLIOGRAPHY: **1.** Per-Goran Person, William Morton, Control Handbook HVAC Systems, Malmo, Sweden,1994; **2.** Волов Г.Я., Моделирование работы систем отопления, вентиляции итеплоснабжения – 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, OperatingManual, TAC AB, Sep 2007, www.tac.com. https://new.siemens.com/bg/bg/products/buildings/sistemi-za-sgradna-avtomatizacia/desigo.html.

DESCRIPTION OF THE COURSE

Name of the course: **Intelligent Control Systems**	Code: **BpAICE17**	Semester: **7**
Type of teaching: Lectures (L) Laboratory work (LW))	Hours per semester: L – 34 hours LW – 18 hours	Number of credits: **6**

LECTURER(S):
Assoc. Prof. Eng. Nikola Shakev, PhD (FEA), tel.: 032/659 528, e-mail: shakev@tu-plovdiv.bg
Assoc. Prof. Eng. Sevil Ahmed-Shieva, PhD (FEA), tel. 032/659 583, e-mail: sevil.ahmed@tu-plovdiv.bg
Technical University of Sofia

COURSE STATUS IN THE CURRICULUM: Compulsory subject from the curriculum for training of students to obtain Bachelor's degree, specialty "Automation, Information and Control Systems", Professional orientation 5.2. Electrical Engineering, Electronics and Automation, Field 5 Technical Sciences.

AIMS AND OBJECTIVES OF THE COURSE: To acquaint students with modern applications of artificial intelligence approaches and tools in control systems. After completing the course, students should be able to apply methods and algorithmic concepts such as: artificial neural networks, fuzzy logic systems, evolutionary computations, etc. for information processing, decision-making, control and modeling of dynamic systems, design of learning algorithms.

DESCRIPTION OF THE COURSE: The course is built on the basis of modern views on combining artificial intelligence approaches with the design and implementation of control systems. Students become familiar with the main approaches and methods of the scientific field of artificial intelligence. Special attention is given to algorithms and tools related to the use of artificial neural networks, genetic algorithms and fuzzy logic systems. Applications related to the design of nonlinear models of dynamic systems, search in the space of possible solutions, design of nonlinear control algorithms for dynamic systems are considered.

PREREQUISITES: Programming, Mathematics, Programming and mathematical modeling tools, Artificial Intelligence and Robotics.

TEACHING METHODS: Lectures, using slides, case studies and laboratory, work in teams,.

METHOD OF ASSESSMENT: Achieving the set goal of learning in the discipline is controlled by a written exam that takes place in the exam session

INSTRUCTION LANGUAGE: Bulgarian

BIBLIOGRAPHY:

1. М. Петров, А. Топалов, А. Танева, Н. Шакев, Методи на изкуствения интелект в системите за управление, Част I. Размита логика и управление, Издателство на ТУ-София, 2009;
2. А. Топалов, М. Петров, Н. Шакев, А. Танева, Методи на изкуствения интелект в системите за управление, Част II. Приложение на невронните мрежи, Издателство на ТУ-София, 2010 ;
3. Д. Димитров, Д. Никовски. Изкуствен интелект. Второ преработено издание. Изд. ТУ-София, 1999;
4. S. Russel., P. Norvig. Artificial Intelelgence. A Modern Approach. Prentice Hall, 2010.;
5. Z. Michalewicz. Genetic Algorithms + Data Structures = Evolution Programs. Third Ed., Springer-Verlag, 1995.

DESCRIPTION OF THE COURSE

Name of the course: **Nonlinear Control Systems**	Code: **BpAICE18.1**	Semester: **7**
Type of teaching: Lectures (L) Laboratory work (LW)/Seminars (S) Course work (CW)	Hours per semester: L – 32 hours S – 0 hours LW – 19 hours	Number of credits: 4

LECTURER(S):
Assoc. Prof. PhD and DSc Borislav Penev, tel.: 032-659-527, e-mail: bpenev@tu-plovdiv.bg
Assist. Prof. Vasil Popov, PhD (FEA), tel.: 359 896282030, e-mail: vasil_popov@tu-sofia.bg
Technical University of Sofia

COURSE STATUS IN THE CURRICULUM: Compulsory elective subject from the curriculum for training of students to obtain Bachelor's degree, specialty "Automation, Information and Control Engineering", Professional orientation 5.2 "Electrical Engineering, Electronics and Automation", General Engineering, Field 5 Technical Sciences.

AIMS AND OBJECTIVES OF THE COURSE: At the end of the course the students are expected to be able to apply both classical and modern methods for analysis and synthesis of nonlinear control systems, which include the Lyapunov methods, the harmonic linearization, phase plane method, feedback linearization techniques, studying the absolute stability of the processes. The students are expected to be able to use MATLAB with SIMULINK at studying nonlinear systems.

DESCRIPTION OF THE COURSE: The main topics concern: Introduction into the theory of nonlinear systems; Lyapunov methods for studying the stability of the processes. Phase-plane method, Feedback Linearization, Absolute stability of the nonlinear control systems.

PREREQUISITES: Automatic Control Theory, Linear Control Systems.

TEACHING METHODS: Lectures, classical and using slides, laboratory works, work in teams, protocols' preparation and defence.

METHOD OF ASSESSMENT: Written exam (80%), laboratory work (20%).

INSTRUCTION LANGUAGE: Bulgarian

BIBLIOGRAPHY: 1. Khalil, H. K., Nonlinear systems, 2nd ed., Prentice Hall, 1996; 2. Бесекерский, В. А., Попов, Е. П., Теория систем автоматического управления, Профессия, Москва, 2003; 3. Воронов, А. А., Ким, Д. П., Лохин, В. М., Теория автоматического управления. Ч. II Теория нелинейных и специальных систем автоматического управления, Высшая школа, Москва, 1986; 4. Мишков Р., Нелинейни системи за управление, Лабораторни упражнения, Пловдив, 2006.

DESCRIPTION OF THE COURSE

Name of the course: **Dynamic Systems and Control**	Code: **BpAICE18.2**	Semester: **7**
Type of teaching: Lectures (L) Laboratory work (LW)/Seminars (S) Course work (CW)	Hours per semester: L – 32 hours S – 0 hours LW – 19 hours	Number of credits: **5**

LECTURER(S):
Assoc. Prof. PhD and DSc Borislav Penev, tel.: 032-659-527, e-mail: bpenev@tu-plovdiv.bg
Assist. Prof. Vasil Popov, PhD (FEA), tel.: 359 896282030, e-mail: vasil_popov@tu-sofia.bg
Technical University of Sofia

COURSE STATUS IN THE CURRICULUM: Compulsory elective subject from the curriculum for training of students to obtain Bachelor's degree, specialty "Automation, Information and Control Engineering", Professional orientation 5.2 "Electrical Engineering, Electronics and Automation", General Engineering, Field 5 Technical Sciences.

AIMS AND OBJECTIVES OF THE COURSE: At the end of the course the students are expected to be able to apply both classical and modern methods for study of dynamic systems, which include the Lyapunov methods, studying the absolute stability of the processes, as well as systems' robustness. The students are expected to be able to use MATLAB with SIMULINK at studying nonlinear systems.

DESCRIPTION OF THE COURSE: The main topics concern: Lyapunov methods for studying the stability of the processes; Absolute stability; Robust systems.

PREREQUISITES: Automatic Control Theory, Linear Control Systems.

TEACHING METHODS: Lectures, classical and using slides, laboratory works, work in teams, protocols' preparation and defence.

METHOD OF ASSESSMENT: Written exam (80%), laboratory work (20%).

INSTRUCTION LANGUAGE: in Bulgarian

BIBLIOGRAPHY: 1. Khalil, H. K., Nonlinear systems, 2nd ed., Prentice Hall, 1996; 2. Бесекерский, В. А., Попов, Е. П., Теория систем автоматического управления, Профессия, Москва, 2003; 3. Воронов, А. А., Ким, Д. П., Лохин, В. М., Теория автоматического управления. Ч. II Теория нелинейных и специальных систем автоматического управления, Высшая школа, Москва, 1986; 4. Мишков Р., Нелинейни системи за управление, Лабораторни упражнения, Пловдив, 2006.

DESCRIPTION OF THE COURSE

Name of the course: **Programming of robots and robotic systems**	Code: **BpAICE19.1**	Semester: **7**
Type of teaching: Lectures (L) Laboratory work (LW))	Hours per semester: L – 32 hours LW – 19 hours	Number of credits: 5

LECTURER(S):
Assoc. Prof. Eng. Nikola Shakev, PhD (FEA), tel.: 032/659 528, e-mail: shakev@tu-plovdiv.bg
Technical University of Sofia

COURSE STATUS IN THE CURRICULUM: Compulsory subject from the curriculum for training of students to obtain Bachelor's degree, specialty "Automation, Information and Control Systems", Professional orientation 5.2. Electrical Engineering, Electronics and Automation, Field 5 Technical Sciences.

AIMS AND OBJECTIVES OF THE COURSE: At the end of the course the students are expected to know the basic parameters and characteristics of industrial and mobile robots. They must be able to create programs for controlling the movements of an industrial robot, programing the input / output signals and robot interaction with other devices.

DESCRIPTION OF THE COURSE: The main topics concern: Mathematical formalization of the description of the robot's position; Kinematic models; Human-machine interface in industrial robots; RToolbox programming environment; Basic parameters and initializations for creating a project; Program commands for robot movement; Commands for working with digital inputs and outputs; Optimization of robot movements; Work in multitasking mode; Control of additional servo axes.

PREREQUISITES: Programming, Mathematics, Programming and mathematical modeling tools, Artificial Intelligence and Robotics.

TEACHING METHODS: Lectures, using slides, case studies and laboratory, work in teams,.

METHOD OF ASSESSMENT: Two assessments at mid and end of semester (70%), laboratories (30%),

INSTRUCTION LANGUAGE: in Bulgarian

BIBLIOGRAPHY:
1. Craig, John J. Introduction to robotics : mechanics and control. 3rd ed. Upper Saddle Hall: Pearson Educacion Internacional, 2005. ISBN 0201543613

2. RT ToolBox3 User's Manual, Mitsubishi Electric Industrial Robots, https://mitsubishielectric.com

3. R. Siegwart, I. Nourbakhsh. Introduction to Autonomous Mobile Robots. Massachusetts Institute of Technology, 2004..

DESCRIPTION OF THE COURSE

Name of the course: **Information sensor systems for robots**	Code: **BpAICE19.2**	Semester: 7
Type of teaching: Lectures (L) Laboratory work (LW)	Hours per semester: L – 32 hours LW – 19 hours	Number of credits: 5

LECTURER(S):

Assist. Prof. Vasil Popov, PhD (FEA), tel.: 359 896282030, e-mail: vasil_popov@tu-sofia.bg
Technical University of Sofia, branch Plovdiv

COURSE STATUS IN THE CURRICULUM Compulsory facultative subject from the curriculum for training of students to obtain Bachelor's degree, specialty Automation, Information and Control Systems, Professional orientation 5.2 Electrical Engineering, Electronic and Automation, Field 5 Technical Sciences.

AIMS AND OBJECTIVES OF THE COURSE: At the end of the course the students are expected to have basic practical engineering skills in the field of automation and control systems. Have the knowledge and ability to use sensors as input devices in robotic control systems; Have the knowledge and ability to analyze the properties of measurement devices based on their application; Be able to perform reliable data acquisition and processing.

DESCRIPTION OF THE COURSE: The main topics concern: Overview and categorization of sensor types, models and calibration; Data acquisition, data processing and statistical analysis; Sensor technologies; Measurement of operating parameters of robots and robotic devices; Measurement of various technological quantities in robots and robotic devices - temperature, speed, position, distance, effort, etc.

PREREQUISITES: Control Theory, Electrical Engineering, Electronics.

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

METHOD OF ASSESSMENT: Assessment at the end of semester (70%), laboratories (30%).

INSTRUCTION LANGUAGE: in Bulgarian

BIBLIOGRAPHY:
1. Morris, R. Langari, Measurement and Instrumentation – Theory and Applications, 2nd Edition, Academic Press, ISBN 978-0-12-800884-3, 2016; 2. S. Ruocco, Robot sensors and transducers, Springer, ISBN-13: 978-9401168748, 2013; 3. P. Regtien, Sensors for Mechatronics, Elsevier, ISBN 9780123914972, 2012; 4. T. Sobh, X. Xiong, Prototyping of Robotic Systems: Applications of Design and Implementation, IGI Global, USA, ISBN13 9781466601765, 2012; 5. J. Fraden, Handbook of Modern Sensors - Physics, Designs, and Applications, Springer, ISBN 978-1-4419-6466-3, 2010; 6. C. Silva, Mechatronics: An Integrated Approach, CRC Press, ISBN 9780849312748, 2004; 7. Keithley Instruments Inc., Data Acquisition and Control Handbook - A Guide to Hardware and Software for Computer-Based Measurement and Control, USA, ASIN B000VPSMPY, 2001; 8. I. Sinclair, Sensors and Transducers, 3rd Edition, Newnes Press, ISBN 0-7506-7932-1, 2001; 9. P. Smith, Active Sensors for Local Planning in Mobile Robotics, University of Oxford, UK, ISBN 978-981-02-4681-5, 2001.

DESCRIPTION OF THE COURSE

Name of the course: **Automation of Manufacturing Mechanisms**	Code: **BpAICE20.1**	Semester: 7
Type of teaching: Lectures(L) Laboratory work (LW) Course work (CW)	Hours per semester: L – 32 hours LW – 19 hours	Number of credits: 5

LECTURER(S):
Assoc. Prof. Eng. Radoslav Hrischev, PhD (FEA), tel:032659525, e-mail:hrischev@tu-plovdiv.bg
Technical University of Sofia

COURSE STATUS IN THE CURRICULUM: Mandatory course from the curriculum for training of students to obtain Bachelor's degree, specialty "Automation, Information and Control Systems", Professional orientation 5.2 Electrical Engineering, Electronics and Automation, Field 5 Technical Sciences.

AIMS AND OBJECTIVES OF THE COURSE: 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.

DESCRIPTION OF THE COURSE: 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.

PREREQUISITES: Electromechanical Devices, Control of Electro-Mechanical Systems, Electric Dives Theory and Electric Drives Control Systems.

TEACHING METHODS: Lectures, using slides, case studies and simulators, laboratory and course work, protocols and course work description preparation and defense..

METHOD OF ASSESSMENT: One-hour written test at the end of the semester (60%), laboratory work (20%), course work with research orientation (20%).

INSTRUCTION LANGUAGE: Bulgarian

BIBLIOGRAPHY: 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. Klyuchev V. I., Electric Drives Theory, "Tehnika", Sofia, 1989, page 545.

DESCRIPTION OF THE COURSE

Name of the course: **Information and control systems in the industry**	Code: **BpAICE20.2**	Semester: 7
Type of teaching: Lectures(L) Laboratory work (LW) Course work (CW)	Hours per semester: L – 32 hours LW – 19 hours	Number of credits: 5

LECTURER(S):
Assoc. Prof. Radoslav Hrischev, PhD(FEA), tel: 032659525, e-mail: hrischev@tu-plovdiv.bg
Technical University of Sofia

COURSE STATUS IN THE CURRICULUM: Mandatory elective course from the curriculum for training of students to obtain Bachelor's degree, specialty "Automation, Information and Control Systems", Professional orientation 5.2 Electrical Engineering, Electronics and Automation, Field 5 Technical Sciences.

AIMS AND OBJECTIVES OF THE COURSE: To introduce the basic knowledge of information and management systems in production. Particular attention is paid to integrated management systems, ERP systems, in particular - the most implemented management system in the industry - SAP.

DESCRIPTION OF THE COURSE: The main topics include: Information systems and control systems, definition, classification. Models of information systems. Production information systems - CRM, ERP, MES systems. Integrated information systems. Overview and description of the types of control systems, their place in automation systems. Bulgarian integrated management information systems in industry. Description of SAP as the number one ERP system worldwide. Consideration of the main modules of the system, their interconnection and significance. Detailed overview of the most important SAP modules and their connection to production. Practical skills for working with integrated information systems based on exercises in demonstration and test systems.

PREREQUISITES: Informatics, Control Systems.

TEACHING METHODS: Lectures, using slides, case studies and simulators, laboratory and course work, protocols and course work description preparation and defense.

METHOD OF ASSESSMENT: One-hour written test at the end of the semester (60%), laboratory work (20%), course work with research orientation (20%).

INSTRUCTION LANGUAGE: Bulgarian

BIBLIOGRAPHY:
1. Tudjarov H, Information Systems, 2007: http://tuj.asenevtsi.com/, 2. SAP University Alliances, Global Bike (GBI) curricula. 3. Open online courses and certification: https://open.sap.com/, 4. Business management system bgERP: https://bgerp.com/, 5. Hrischev R., Planning and implementation of the ERP system in packaging production, 2018, Plovdiv, ISSN Online: 2535-0048.

DESCRIPTION OF THE COURSE

Name of the course: **Control of Electric Drives**	Code: **BpAICE21.1**	Semester: **7**
Type of teaching: Lectures (L) Laboratory work (LW)/Seminars (S)	Hours per semester: L – 32 hours S – 0 hours LW – 19 hours	Number of credits: **4**

LECTURER(S):
Assoc. Prof. Ivan Kostov, PhD, (FEA), Phone: 032 659 526, e-mail: ijk@tu-plovdiv.bg
Technical University of Sofia

COURSE STATUS IN THE CURRICULUM: The course is compulsorily elective from a block of disciplines for full-time for full-time students of the Automation, Information and Control Engineering specialty at FEA TU-Sofia, Plovdiv Branch, Bachelor's degree, Professional orientation 5.2 Electrical Engineering, Electronics and Automation, Field 5 Technical Sciences.

AIMS AND OBJECTIVES OF THE COURSE: To study the principles of construction of the main types of closed control systems for electric drives. To clarify the general and specific methods for optimization 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 of Electromechanical Systems, Digital Circuitry, Control Theory, Mechanics and Electrical Machines.

TEACHING METHODS: Lectures, visually illustrated; laboratory exercises with preparation of protocols with presentation and defense.

METHOD OF ASSESSMENT: Written exam/test during the examinations session following the semester.

INSTRUCTION LANGUAGE: Bulgarian.

BIBLIOGRAPHY: 1. Mikhov, M.R., Control systems of electric drives, Technical University - Sofia, Sofia, 2009; 2. Bose, B.K., Power electronics and motor drives: advances and trends, Academic Press, London, 2006; 3. Leonhard W., "Control of electrical drives, Springer, 3rd ed., ISBN 3-540-41820-2, 2001, pp.600; 4. Kostov I., G. Ivanov, Manual of laboratory exercises in electric drive control, Plovdiv, 2014, p.100; 5. Kostov I., G. Ivanov, Guide for course project and seminars on electric drives control, Plovdiv, 2014, p.140; 6. I.Y. Kostov, Electric drives with DC, Asynchronous and Synchronous Motors, textbook, Plovdiv, 2016, ISBN 978-619-90128-0-2; 7. Vinogradov A., Vector control of AC electric drives, Ivanovo State Energy University, 2008, p.298; http://dox.bg/files/dw?a=949a238c888.

DESCRIPTION OF THE COURSE

Name of the course: **Computer vision and image recognition**	Code: **BpAICE21.1**	Semester: 7
Type of teaching: Lectures (L) Laboratory work (LW)/Seminars (S)	Hours per semester: L – 32 hours S – 0 hours LW – 19 hours	Number of credits: 4

LECTURER(S):
Assit. Prof. Eng. Vasil Popov, PhD (FEA), tel.: 359 896282030, e-mail: vasil_popov@tu-sofia.bg
Technical University of Sofia

COURSE STATUS IN THE CURRICULUM: Optional subject from the curriculum for training of students to obtain Bachelor's degree, specialty Automation, Information and Control Systems, Professional orientation 5.2 Electrical Engineering, Electronic and Automation, Field 5 Technical Sciences.

AIMS AND OBJECTIVES OF THE COURSE: At the end of the course the students are expected to know the theoretical and algorithmic basis for the basic methods of digital image processing; can implement programs for digital image processing and algorithms for classification and recognition of objects based on images..

DESCRIPTION OF THE COURSE: The field of application of image recognition covers a wide range of important theoretical and practical tasks, such as: analysis of spatial images and scenes, recognition of alphanumeric symbols, speech recognition, recognition of physiological signals, etc. The main topics concern: Definitions and classification of computer vision systems; Physical basics of computer vision; Image pre-processing; Linear filtration; Histogram of the brightness in the image; Median filtration; Design of filters in the field of spatial frequencies; Detect edges and borders for objects in the image; Morphological operations with images; Color image analysis; Separation of signs. Topologically distinct features; Image segmentation; Application of artificial neural networks for image recognition.

PREREQUISITES: Programming, Mathematics, Artificial Intelligence and Robotics.

TEACHING METHODS: Lectures, using slides, case studies, laboratory work, work in teams, protocols.

METHOD OF ASSESSMENT: Assessment during the examination session (80%), laboratories (20%).

INSTRUCTION LANGUAGE: in Bulgarian

BIBLIOGRAPHY: 1. R. C. Gonzalez, R. E. Woods, Digital Image Processing, Prentice Hall; 3 edition, 2007. 2. Г. В. Гочев, Компютърно зрение и невронни мрежи, Издателство на ТУ София, 1999. 3. D. Forsyth, J. Ponce, (2012). Computer vision: a modern approach. Pearson.

DESCRIPTION OF THE COURSE

Name of the course: **Multivariable control systems**	Code: **BpAICE23**	Semester: **8**
Type of teaching: Lectures (L) Laboratory work (LW)	Hours per semester: L – 23 hours LW – 10 hours	Number of credits: **4**

LECTURER(S):
Assoc. Prof. PhD and DSc Borislav Penev, (FEA), tel.:032 659 527, e-mail: bpenev@tu-plovdiv.bg
Technical University of Sofia

COURSE STATUS IN THE CURRICULUM: Compulsory subject from the curriculum for training of students to obtain Bachelor's degree, specialty Automation, Information and Control Engineering", Professional orientation 5.2 "Electrical Engineering, Electronics and Automation", Field 5 Technical Sciences.

AIMS AND OBJECTIVES OF THE COURSE: The students receive knowledge for application of methods and necessary tools for analysis and design of multivariable control systems. The obtained practical skills allow successful development of multivariable control systems for real world plants.

DESCRIPTION OF THE COURSE: The course considers the problems for analysis and design of systems for control and observation of linear and nonlinear continuous and discrete multivariable control systems. The additional practical knowledge helps the students in the self-solving of tasks for multivariable control systems design in practice.

PREREQUISITES: Programming and methods for mathematical modelling, Physics, Mathematics, Mechanics, Automatic control theory, Linear control systems, Nonlinear control systems.

TEACHING METHODS: Lectures, classical and using slides, laboratory work in teams, protocols preparation and defence.

METHOD OF ASSESSMENT: Written exam (80%), laboratory work (20%).

INSTRUCTION LANGUAGE: in Bulgarian

BIBLIOGRAPHY: 1. S. Skogesdat, I. Postlethwaite, (2005), Multivariable Feedback Control. Analysis and Design, John Wiley & Sons, ISBN-13 978-0-470-01167-6 (HB) 978-0-470-01168-3 (PBK); 2. P. Albertos, A. Sala, (2005), Multivariable Control Systems: An Engineering Approach. 2004 Springer-Verlag London Limited, ISBN 1-85233-738-9; 3. Yordanova S., E.Gadjeva. System Modelling and Simulation. Technical University of Sofia, Sofia, 2019, 143, ISBN 954-438-350-6; 4. MATLAB with SIMULINK, User's Guide. The Math Works Inc., 2012; 5. Chisman J. Introduction to Simulation Modeling using GPSS/PC. Prentice Hall, 2015. ISBN 0-13-473695 6 П. Петков, Многомерни системи за управление, 1997 изд. на Технически Университет София, ISBN 954-438-209-7.

DESCRIPTION OF THE COURSE

Name of the course: **Modern management methods in industry**	Code: **BpAICE24**	Semester: **8**
Type of teaching: Lectures (L) Laboratory work (LW)/Seminars (S)	Hours per semester: L – 23 hours S – 0 hours LW – 10 hours	Number of credits: **4**

LECTURER(S):

Assoc. Prof. Eng. Radoslav Hrischev, PhD, (FEA), tel:032659527,e-mail:hrischev@tu-plovdiv.bg
Technical University of Sofia

COURSE STATUS IN THE CURRICULUM: Mandatory course from the curriculum for training of students to obtain Bachelor's degree, specialty "Automation, Information and Control Systems", Professional orientation 5.2 Electrical Engineering, Electronics and Automation, Field 5 Technical Sciences.

AIMS AND OBJECTIVES OF THE COURSE: To introduce knowledge of modern management methods in the industry as a result of the Industry 4.0. Students acquire basic knowledge about the evolution of production management methods. The main aspects of Industry 4.0 and how they affect management methods are discussed.

DESCRIPTION OF THE COURSE: The main topics include: Management methods, definition, classification, evolutionary development; Industrial revolutions, characteristic features; Industry 4.0 - concept, content and standards; Influence of the requirements of Industry 4.0 on the management methods in the industry; Digital transformation of production, data collection methods, transmission and storage of information; Production information systems - ERP, MES systems; Internet of Things / IoT / and Industry 4.0; Acquisition of practical skills for working with ERP systems based on exercises in demonstration systems; Work with specialized software products for modeling and simulation of control systems. Simulators to acquire basic practical skills are presented.

PREREQUISITES: Computing, Control Theory

TEACHING METHODS: Lectures, using slides, case studies, demo systems and simulators, laboratory, protocols description preparation and defense, abstract with research orientation and presentation.

METHOD OF ASSESSMENT: One-hour written test at the end of the semester (70%l), laboratory work (20%), abstract with research orientation (10%).

INSTRUCTION LANGUAGE: in Bulgarian.

BIBLIOGRAPHY: 1. W. Shroeder, Germany's Industry 4.0 strategy. Rhine capitalism in the age of digitalization. FES London, 2016; Alp Ustundag, Emre Cevikcan, Industry 4.0: Managing The Digital Transformation, Springer Series in Advanced Manufacturing, 2019, 294; 4. Ch.Bartodziej, The Concept Industry 4.0. An Empirical Analysis of Technologies and Applications in Production Logistics, Springer Gabler, 2017, 158, ISBN 8-3-658-16501-7; 5. Alasdair Gilchrist, Industry 4.0. The Industrial Internet of Things, Apress, 2016, 259, ISBN-13 (pbk): 978-1-4842-2046-7 ISBN-13 (electronic): 978-1-4842-2047-4, Industrial strength simulation software for improving the performance of real systems Vensim, https://vensim.com/.

DESCRIPTION OF THE COURSE

Name of the course: **Logical Control**	Code: **BpAICE25**	Semester: 8
Type of teaching: Lectures (L) Laboratory work (LW)	Hours per semester: L – 23 hours S – 0 LW – 10 hours	Number of credits: 3

LECTURER(S):
Assoc. Prof. Tanya Titova-Kosturkova (FEA) tel.: 032 659526, e-mail: t.titova@tu-plovdiv.bg
Technical University of Sofia

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

AIMS 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, Electronics, Digital Circuitry.

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

METHOD OF ASSESSMENT: Written one-hour assessments in the end of 8th semester (80%), laboratories (20%)

INSTRUCTION LANGUAGE: in 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: **Virtual technologies in measuring technique**	Code: **BpAICE26**	Semester: **8**
Type of teaching: Lectures (L) Laboratory work (LW)/Seminars (S))	Hours per semester: L – 23 hours S –0 hours LW – 10 hours	Number of credits: **3**

LECTURER(S):
Assist. Prof. Eng. Nikolay Dimitrov Paunkov, PhD (FA), tel.: +359 896 847 308,
e-mail: nick123@tu-plovdiv.bg
Technical University of Sofia

COURSE STATUS IN THE CURRICULUM: A compulsory subject from the curriculum for Bachelor's degree students, majoring in Electrical Engineering; Electronics; Automation, information and control techniques, **Professional orientation 5.2. Electrical engineering, Electronics and Automation, Field 5. Technical Sciences**..

AIMS AND OBJECTIVES OF THE COURSE: The subject **Virtual technologies in measuring techniques** aims at acquainting the students with some of the basic hardware means and programming environments for creating virtual measuring instruments, as well as with their application. Special attention is paid to developing virtual means for automatic statistical processing of the data, collected during the conducted measurements..

DESCRIPTION OF THE COURSE: The skills, acquired by the student within their training in the subject, are related to working in various graphical software environments for developing programmes for control of different in their functionality measuring devices (DAQ modules – data collectors), as well as to developing virtual instruments for measuring both electrical and non-electrical quantities, such as current, voltage, power, temperature, thermal power, magnetic field, pressure measuring devices. The obtained knowledge and skills will be useful for the students for mastering other specialized subjects, related to measuring and accurate assessment of a given physical quantity or a process from a practical point of view.

PREREQUISITES: The prerequisites for studying the subject are Physics, Mathematics, Theoretical electrical engineering, Electrical measurements, Systems identification.

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

METHOD OF ASSESSMENT: Three hours final exam at the end of 8 th semester..

INSTRUCTION LANGUAGE: Bulgarian

BIBLIOGRAPHY:

1. . Кръстев, Г., Цв. Георгиев. Средства за автоматизация на научните изследвания, Русе 2002
2. https://www.slideshare.net/anjli/labview-introduction
3. John Bentley. Principles of Measurement Systems. Longman Scientific @ Technical. 1992.
4. https://research.iaun.ac.ir/pd/imanianold/pdfs/HomeWork_8460.pdf
5. Румен Йорданов, Сензорни устройства, материал в помощ на учебния процес 2015г
6. Радев Хр. Уреди за измерване на линейни и ъглови размери, София, Техника, 1989

DESCRIPTION OF THE COURSE

Name of the course: **Bioinformatics**	Code: **BpAICE27**	Semester: 8
Type of teaching: Lectures (L) Laboratory work (LW)	Hours per semester: L – 23 hours LW –10 hours	Number of credits: **3**

LECTURER(S):
Assist. Prof. Ph.D. Eng. Dobrinka Petrova (FEA), tel.: 032 659727
e-mail: dpetrova@tu-plovdiv.bg
Technical University of Sofia, Plovdiv Branch

COURSE STATUS IN THE CURRICULUM: Compulsory subject from the curriculum for training of students to obtain Bachelor's degree, specialty Automation, Information and Control Systems, Professional orientation 5.2 Electrical Engineering, Electronics and Automation, Field 5 Technical Sciences.

AIMS AND OBJECTIVES OF THE COURSE: The aim of the course is to introduce basic terms, concepts, algorithms and data sources in bioinformatics. At the end of the course the students are expected to know discussed algorithms and have experience in applying them on biological data using MATLAB Bioinformatics Toolbox.

DESCRIPTION OF THE COURSE: The main topics concern: Introduction to Bioinformatics. DNA, RNA, Proteins. Biological Databases and File Formats in Bioinformatics. Sequence Analysis. Sequence Alignment Algorithms – Global, Local and Multiple Sequence Alignment. Markov Models. Gene Finding. Phylogenetic Trees. Analysis of 3-D Structures of Biological Macromolecules.

PREREQUISITES: Good fundamental knowledge in Programming I and Programming and Tools for Mathematical Modelling.

TEACHING METHODS: Lectures, using multimedia presentations, laboratory work on main topics with individual and group tasks.

METHOD OF ASSESSMENT: Two ongoing assessments at mid and end of semester (80%), laboratory work (20%).

INSTRUCTION LANGUAGE: Bulgarian

BIBLIOGRAPHY:
1. P. A. Pevzner, R. Shamir, Editors. „Bioinformatics for Biologists“, Cambridge University Press, 2011, doi:10.1017/CBO978051198470; 2. Compeau Ph., P. Pevzner, „BIOINFORMATICS ALGORITHMS, 3th Edition“, Active Learning Publishers, 2018, ISBN: 978-0990374633; 3.Баев В., Апостолова Е., Даскалова Е., Г. Минков, „Ръководство по биоинформатика“, Университетско издателство „Паисий Хилендарски“, 2013, ISBN: 978- 954-423-835-3; 4. St. Attaway, "Matlab: A Practical Introduction to Programming and Problem Solving, 4th Edition" Butterworth - Heinemann, 2016, ISBN: 9780128045251;

5. MatLab: https://uk.mathworks.com/products/bioinfo.html 6. NCBI: https://www.ncbi.nlm.nih.gov/ 7. https://www.rcsb.org/.

DESCRIPTION OF THE COURSE

Name of the course: **Servo control and robot drive**	Code: **BpAICE28**	Semester: **8**
Type of teaching: Lectures (L) Laboratory work (LW)/Seminars (S)	Hours per semester: L – 23 hours S – 0 hours LW – 10 hours	Number of credits: **3**

LECTURER(S):
Assoc. Prof. Ivan Kostov, PhD, (FEA), Phone: 032 659 526, e-mail: ijk@tu-plovdiv.bg
Technical University of Sofia

COURSE STATUS IN THE CURRICULUM: Mandatory subject for full-time students of the Automation, Information and Control Engineering specialty at FEA TU-Sofia, Plovdiv Branch, Bachelor's degree, Professional orientation 5.2 Electrical Engineering, Electronics and Automation, Field 5 Technical Sciences.

AIMS AND OBJECTIVES OF THE COURSE: To provide knowledge of motion control of robotic systems and to acquire a combination of skills for programming, diagnostics and maintenance of robotic systems. The course focuses on the structures, specific feedback and technical implementation of the drive.

DESCRIPTION OF THE COURSE: The following main topics are considered: principles for design of servodrive control systems; blocks and elements of servo systems - controller, electronic gearbox, servo amplifier, motor, feedback; methods for adjustment and optimization of control loops; servo systems with cascade coordinate control; torque control; speed control; positioning and tracking systems; sensor information systems; specific drive protections.

PREREQUISITES: Control of Electromechanical Systems, Control of Electric Drives, Control Theory, Mechanics and Electrical Machines.

TEACHING METHODS: Lectures, visually illustrated; laboratory exercises with preparation of protocols with presentation and defense.

METHOD OF ASSESSMENT: Written test at the end of the semester.

INSTRUCTION LANGUAGE: Bulgarian.

BIBLIOGRAPHY: 1. Mikhov M., Electric drive systems, Technical University - Sofia, 2006; 2. Kostov I., Electric drives with direct current, asynchronous and synchronous motors, Plovdiv, 2016, ISBN 978-619-90128-0-2; 3. Bolton W., Programmable Logic Controllers, CRC Press, 2009, pp. 398, ISBN: 978-1-85617-751-1; 4. Bolton W., Mechatronics, Sixth Edition, Pearson, 2015, p.663, ISBN 978-1-292-08159-5; 5. Frank L. Lewis, Darren M. Dawson, Chauki T. Abdalla, Robot Manipulator Control: Theory and Practice (Automation and Control), 2nd Edition, CRC Press, ISBN-13: 978-0824740726; 6. Factory Automation: e-learning courses https://www.mitsubishielectric.com/fa/assist/e-learning/eng.html.

DESCRIPTION OF THE COURSE

Name of the course: **Sport**	Code: **SPR07**	Semester: 7
Type of teaching: Lectures (L) Laboratory work (LW)/Seminars (S) Self-Study (SS)	Hours per semester: L – 0 hours S – 0 hours SS – 30 hours	Number of credits: 1

LECTURER(S):
Sen. Lect. Daniel Vladimdirov, PhD (FEA), tel.: 032 659 646, e-mail: danielv@tu-plovdiv.bg
Sen. Lect. Petar Doganov, PhD (FEA), tel.: 032 659 648, e-mail: pdoganov@tu-plovdiv.bg
Sen. Lect. Boris Spasov, PhD (FEA), tel.: 032 659 647, e-mail: boris_spassov@tu-plovdiv.bg
Technical University of Sofia-Branch Plovdiv
Technical University of Sofia

COURSE STATUS IN THE CURRICULUM: Facultative subject from the curriculum for training of students to obtain Bachelor's degree, specialty "Automation, Information and Control Engineering", "Electrical Engineering", "Electronics" Professional orientation 5.2 Electrical Engineering, Electronics and Automation, Field 5 Technical Sciences.

AIMS AND OBJECTIVES OF THE COURSE: Targeted at further developing of students' physical activities, skills and hygiene habits through effective methods of physical education, improving their mental and physical performance.

DESCRIPTION OF THE COURSE: The knowledge and skills in Physical Education and Sports develop a wide range of motor skills and habits, help the hardening of the body and contribute to the moral development of students. The enhancement of physical skills is carried out through:

1. General Physical Preparedness (GPP) – in these seminars the students develop a wide range of motor skill and habits; work to improve strength, speed, endurance, flexibility, structure and skill; increase resistance to unfavourable environmental factors; develop their physical qualities and experience.

2. Sports-Specific Physical Preparedness (SPP) – students improve their sport skills and habits in a specific sport and gain experience through participation in competitions; work to improve strength, speed, endurance, flexibility, structure and skill; increase resistance to unfavourable environmental factors; develop their physical qualities and experience.

PREREQUISITES: The curricula presume the minimum of knowledge and skills acquired at secondary school.

TEACHING METHODS: Seminars in accordance with the curriculum in PE and Sport.

METHOD OF ASSESSMENT: Evaluation is based on functional tests at the end of semester. Lecturer's signature is required at the end of semester.

INSTRUCTION LANGUAGE: Bulgarian

BIBLIOGRAPHY: 1. Владимиров В. Туризъм и ориентиране. Методическо ръководство за студентите от ТУ София, филиал Пловдив. Издателство на ТУ - София. 2010.

DESCRIPTION OF THE COURSE

Name of the course: **Sport**	Code: **SPR08**	Semester: 8
Type of teaching: Lectures (L) Laboratory work (LW)/Seminars (S) Self-Study (SS)	Hours per semester: L – 0 hours S – 0 hours SS – 30 hours	Number of credits: 1

LECTURER(S):
Sen. Lect. Daniel Vladimdirov, PhD (FEA), tel.: 032 659 646, e-mail: danielv@tu-plovdiv.bg
Sen. Lect. Petar Doganov, PhD (FEA), tel.: 032 659 648, e-mail: pdoganov@tu-plovdiv.bg
Sen. Lect. Boris Spasov, PhD (FEA), tel.: 032 659 647, e-mail: boris_spassov@tu-plovdiv.bg
Technical University of Sofia-Branch Plovdiv
Technical University of Sofia

COURSE STATUS IN THE CURRICULUM: Facultative subject from the curriculum for training of students to obtain Bachelor's degree, specialty "Automation, Information and Control Engineering", "Electrical Engineering", "Electronics" Professional orientation 5.2 Electrical Engineering, Electronics and Automation, Field 5 Technical Sciences.

AIMS AND OBJECTIVES OF THE COURSE: Targeted at further developing of students' physical activities, skills and hygiene habits through effective methods of physical education, improving their mental and physical performance.

DESCRIPTION OF THE COURSE: The knowledge and skills in Physical Education and Sports develop a wide range of motor skills and habits, help the hardening of the body and contribute to the moral development of students. The enhancement of physical skills is carried out through:

1. General Physical Preparedness (GPP) – in these seminars the students develop a wide range of motor skill and habits; work to improve strength, speed, endurance, flexibility, structure and skill; increase resistance to unfavourable environmental factors; develop their physical qualities and experience.

2. Sports-Specific Physical Preparedness (SPP) – students improve their sport skills and habits in a specific sport and gain experience through participation in competitions; work to improve strength, speed, endurance, flexibility, structure and skill; increase resistance to unfavourable environmental factors; develop their physical qualities and experience.

PREREQUISITES: The curricula presume the minimum of knowledge and skills acquired at secondary school.

TEACHING METHODS: Seminars in accordance with the curriculum in PE and Sport.

METHOD OF ASSESSMENT: Evaluation is based on functional tests at the end of semester. Lecturer's signature is required at the end of semester.

INSTRUCTION LANGUAGE: Bulgarian

BIBLIOGRAPHY: 1. Владимиров В. Туризъм и ориентиране. Методическо ръководство за студентите от ТУ София, филиал Пловдив. Издателство на ТУ - София. 2010.