DESCRIPTION OF THE COURSE

Name of the course **Optimal Control**	Code: **MpAICE01**	Semester: 1
Type of teaching: Lectures and laboratory work	Lessons per semester: L – 30 hours; LW – 30 hours	Number of credits: **4**

LECTURER: Assoc. Prof. Ph.D. Sevil Ahmed (FEA) – tel.: 659 585,
email: sevil.ahmed@tu-plovdiv.bg Technical University of Sofia, Branch at Plovdiv

COURSE STATUS IN THE CURRICULUM: Compulsory for the students specialty "Automatics, Information and Control Engineering" MEng programme of the Faculty of Electronics and Automatics

AIMS AND OBJECTIVES OF THE COURSE: The aim of the course is to make students familiar with the optimal control theory, the design methods and the properties of the optimal control systems (linear, non-linear, and stochastic). The following courses – Robust Control, Robotics, and etc, use the knowledge obtained in the course Optimal Control.

DESCRIPTION OF THE COURSE: The main topics concern: Introduction in Optimal Control – definitions, problem formulation, classification of optimal control problems; Design of optimal linear system with quadratic cost – problem formulation, numerical solution of Riccati's equation; Linear system quadratic cost regulator (LQR) under constant disturbances; Stochastic optimal control system. Dynamical Programming (DP) – Bellman's Principle of Optimality, DP for discrete-time systems, DP for continuous-time systems, Combinatorial task; Maximun (Minimum) Principle – formulation, relationship between the Maximun Principle and DP; Application of the Minimum Principle for design of: time optimal control systems, minimum fuel and minimum energy control systems; Design of a time optimal feedback control system by combining the Maximum Principle and the Phase Plane method – optimal switching line of the second order non-oscillating object and oscillating one, examples; Quasi time optimal control systems – design methods, Sliding mode, design of S-control architecture. Feedback linearization of SISO and MIMO systems; Intuitive and mathematical approach.

PREREQUISITES: Higher Mathematics, Computer Simulation, Control Theory I, II, Nonlinear Control Systems, Identification.

TEACHING METHODS: Lectures using slides; laboratory work using MATLAB/SIMULINK simulation environment, work in teams, protocols.

METHOD OF ASSESSMENT: One two-hour examine

INSTRUCTION LANGUAGE: Bulgarian

BIBLIOGRAPHY:
1. Voronov, A.A., *Automatic Control Theory*, vol.2, Moscow, 1986 (in russian); 2. Gunchev, L., Optimal Control. In: *Bases of Technical Cybernetics* (ed. N.Naplatanov), vol.5, Sofia, Technics, 1989 (in bulgarian); 3. Kwakernaak, H., and R. Sivan, *Linear Optimal Control Systems*, Moscow, 1977 (in russian); 4. Tomov, I., Design. In: *Introduction in Modern Control Theory*: vol.2, Sofia, Technics, 1984 (in bulgarian); 5. Tsankova, D., M. Petrov, Optimal Control. In: *Introduction in Modern Control Theory* (Handbook for laboratory and seminar exercises), vol.1, TU-Sofia, Branch Plovdiv, 2003 (in bulgarian); 6. Tsankova, D., Optimal Control. In: *Feedback linearization* (Handbook for laboratory and seminar exercises), vol.2, TU-Sofia, Branch Plovdiv, 2003 (in bulgarian); 7. Lewis, F.L., V.L. Syrmos. *Optimal Control*. John Wiley & Sons, New York, 1995; 8. Vincent, Th. L., W. J. Grantham. *Nonlinear and Optimal Control Systems*. John Wiley & Sons, Inc. New York, 1997.

COURSE DESCRIPTION

Name of the course: **Adaptive control**	Code: **MpAICE02**	Semester: 1
Type of teaching: Lectures (L) Laboratory work (Lab.)	Hours during the semester: Lectures – 30 hours, Lab. exercises – 30 hours.	Credits: **4**

INSTRUCTORS:
Professor Andon V. Topalov (FEA), phone: 659 528, email: topalov@tu-plovdiv.bg
Technical University of Sofia, branch at Plovdiv
Assoc. Prof. Ivan K. Ganchev (FEA), email: ganchev@tu-plovdiv.bg
Technical University of Sofia, branch at Plovdiv

STATUTE OF THE COURSE IN THE CURRICULUM: This is a compulsory course for the students from the specialization "Automation, information and control engineering", qualification degree in education "master".

GOALS OF THE COURSE: The course belongs to the group of courses contributing to the theoretical background of the students from the master degree program of the specialization "Automation information and control engineering". During the lectures and laboratory exercises students are learning how to design and maintain adaptive control systems for different plants and processes.

COURSE DESCRIPTION: The course material is prepared taking into consideration that the students attending it have basic knowledge in the control theory of continuous as well as discrete time linear systems. Preliminary knowledge on system identification and process control methods is also required. Input-output relations as well as state space descriptions are used for the analysis and synthesis of the adaptive systems

During the lecture course the principal methods for analysis and synthesis of different classes of adaptive control systems are explained and discussed. The successful application of a particular adaptive control scheme depends on the existing operational conditions of the plant, the amount of the information which is accessible for the controller and on the existing different concepts for the design of the system. The course program is oriented towards active usage of the available contemporary software packages for analysis, synthesis and simulation of control systems.

PREREQUISITES: „Automatic control theory - part I, II and III", "System identification" and „Automation of technological processes".

TEACHNG METHOD: Lectures, laboratory exercises with written reports.

GRADING: Two hours written exam during the examinations (82%), laboratory exercises (18%).

LANGUAGE OF TEACHING: Bulgarian

REFERENCE TEXTS: 1. Velev K. D., Adaptive systems, Sofia, 1995 (in Bulgarian). 2. Garipov M., Case studies on the design of control systems in MATLAB and SIMULINK, TU Sofia, 1997 (in Bulgarian). 3. Astrom K. J., Wittenmark B., Adaptive Control, Addison-Wesley, 1995, 2nd ed. 4. Ioannou P. A., Sun J., Robust Adaptive Control, Prentice-Hall, Inc., 1996. 5. Iserman R., Lachmann K. H., Matko D., Adaptive Digital Control Systems, Prentice-Hall, 1992.

DESCRIPTION OF THE COURSE

Name of the course**: Intelligent Measurement Systems**	Code: **MpAICE03**	Semester: 1
Type of teaching: Lectures and Laboratory exercises	Hours per semester: L - 30 hours; LE - 15 hours.	number of credits: **4**

LECTURERS: Assistant Prof. Ms.Sc. **Yanka Nikolova Ivanova**, PhD, tel. (032) 659 686, e-mail: yankakiss777@abv.bg ,Technical University of Sofia, Branch Plovdiv, Faculty of Electronics and Automation; Department "Electrical engineering".

COURSE STATUS IN THE CURRICULUM:

Compulsory course for the students with specialty "Automation, Information and Control Engineering of the Faculty of Electronics and Automation of TU-Sofia, Branch Plovdiv for Master Degree.

AIMS AND OBJECTIVES OF THE COURSE:

The purpose of this course is to give knowledge and skills to the students for the methods and meaning for construction of intelligent measurement systems (IMS), for the architecture and programming of these systems.

DESCRIPTION OF THE COURSE:

Main topics: Main characteristics of IMS. Architecture of the microprocessor control of IMS. IMS with duplicated structures-principles of construction, efficiency and reliability. Interpretative models of the cumulative error of the measurement process. Models of measurement transducers. Analog to digital convertors and methods for analog to digital conversion. Expert systems in IMS. Purpose and structure of the intelligent sensors. Virtual measurement devices – main characteristics and design principles.

PREREQUISITES:

The lectures and laboratory exercises are based on the knowledge from the Bachelor Degree - Physics, Electrical Measurement, Control Theory, Measurement of Non-electrical Quantities.

TEACHING METHODS:

Lectures are given with visual materials, posters and slides. Laboratory exercises is organized according to the laboratory manual with reports made by the students and defended in front of the lecturer.

METHOD OF ASSESSMENT:

Written examination after the end of the semester (80%) and a mark from the laboratory exercises (20%).

INSTRUCTIONAL LANGUAGE: Bulgarian.

BIBLIOGRAPHY:

1. Калчев, Ив., Интелигентни измервателни системи, ТУ-София, 2006.
2. Арнаудов, Р., Р. Динов, Измервания в комуникациите, ТУ-София, 2007.
3. Пенчев, П., Измервания в електрониката и комутационната техника, УИ „В. Априлов", Г., 2006.
4. Шевчук, В., Расчет динамических погрешностей интеллектуальных измерительных систем, М., Физматлит, 2008.
5. Mazda, F., Electronic Instruments and Measurement Techniques, Cambridge University Press, 1990.
6. Doebelin, E. and oth., Measurement Sistems – Application and Design, Mc Graw-Hill Book Co, 1990.

Description of the course

Name of the course: **Energetic of Electrical drives**	Code:**MAICE 04.1**	Semester**:1**
Type of teaching: **Lectures and Laboratory work**	Lessons per semester: L-30 hours; LW- 30 hour	Number of credits**: 4**

LECTURER:

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

COURSE STATUS IN THE CURRICULUM:

Compulsory for students regular course specialty "Automatics, Information and Control Engineering" of /FEA/- Technical University –Sofia, Branch – Plovdiv for educational- qualification level "master degree".

AIMES AND OBJECTIVES OF THE COURSE:

The aim of the course is to introduce students with methods and ways of dealing with numerous engineering tasks in the sphere of electrical drives as well as introducing students with specific peculiarity in this area, with ways and means for getting necessary figures and using computer programs to apply studied methods.

DESCRIPTION OF THE COURSE:

Basic topics: Define necessity data of motor, working machine and their rates of work for accounting of consumed energy. Define the dependency of the power of losses in the induction motor of the speed and the torque. Account of the warming up of the motor when starts, stops and reverse. Consumed energy of mechanisms with continuous and cyclic actions. Account the consumption energy in different laws of movement and laws of distribution loading. Methods and equipment to define laws of distribution in typical exploitation conditions.

PREREQUISITES:

Elements of electromechanical systems, Control of electromechanical systems, Control systems of electrical drives, Automation of production mechanisms.

TEACHING METHODS: Lectures, laboratory works with reports.

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

INSTRUCTION LANGUAGE: Bulgarian

BIBLIOGRAPHY:

1. Йорданов С., К. Кутрянски, Автоматизация на производствените механизми, Технически университет-София, 2001.
2. Джагаров Н., Електрозадвижване, Технически университет-Варна, 2011.
3. SEW Eurodrive, Project Planning for Controlled and Non-Controlled Drives, Edition 06/2019
4. Михов, М., Системи за управление на електрозадвижванията, Технически университет-София, 2007.
5. Ключев В. И., Теория на електрозадвижването, "Техника", София, 1989.
6. Kutryanski K., Information Issues in the Design of High Performance Electric Drives, International Summer School - CEEPUS SK-46, Artificial Intelligence in Control and Measurement, 21 August – 1 September, 2000, pp 56-61
7. Кутрянски К., Програмно осигуряване за изследване на асинхронни електрозадвижвания, Национална конференция с международно участие "Компютърни системи и технологии", 22-23 юни 2000, София. с. V.11-1 – V.11-5.

Description of the course

Name of the course: **Engineering Methods in Electro Mechanics**	Code:**MAICE 04.2**	Semester**:1**
Type of teaching: **Lectures and Laboratory work**	Lessons per semester:L-30 hours; LW- 30 hour	Number of credits**: 4**

LECTURER:

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

COURSE STATUS IN THE CURRICULUM:

Compulsory for students regular course specialty "Automatics, Information and Control Engineering" of /FEA/- Technical University –Sofia, Branch – Plovdiv for educational- qualification level "master degree".

AIMES AND OBJECTIVES OF THE COURSE:

The aim of the course Engineering Methods in Electro Mechanics is to introduce students with methods and ways of dealing with numerous engineering tasks in electromechanics area. Experience of computer based problem solving will be acquired.

DESCRIPTION OF THE COURSE:

Basic topics: Define necessity data of motor, working machine and their rates of work for accounting of consumed energy. Account of the warming up of the motor when starts, stops and reverse. Account the consumption energy in different laws of movement and laws of distribution loading.

PREREQUISITES:

Elements of electromechanical systems, Control of electromechanical systems, Control systems of electrical drives, Automation of production mechanisms.

TEACHING METHODS: Lectures, laboratory works with reports.

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

INSTRUCTION LANGUAGE: Bulgarian

BIBLIOGRAPHY:

1. Райнов Р., Христов Вл., Формиране на механичните характеристики на асинхронен двигател в режим на кондензаторно спиране, Международна юбилейна научна сесия 30 години факултет "Автоматика", ТУ – София, 2004г. 2. Йорданов С., Р.Райнов, Д.Крайчев, Избор на оптимални параметри на реверсивни електрозадвижвания, "Техника", 1980, с.202. 3. Райнов Р., Особености на механичните характеристики на асинхронен двигател в режим на кондензаторно спиране, сп. "Електроника и електротехника", кн.3-4, 1996г., с.37-40. 4. Йорданов С., К. Кутрянски, Автоматизация на производствените механизми, Технически университет-София, 2001.

DESCRIPTION OF THE COURSE

Name of the course: **Management information systems**	Code: **MpAICE05.1**	Semester: **1**
Type of teaching: Lectures, Laboratory Works, Course Work	Semester hours: L – 30 hours; LW – 30 hours.	Number of credits: 4

LECTURER: Assoc. Prof. PhD Nikola Shakev, Phone: +359 32 659 556,
e-mail: shakev@tu-plovdiv.bg; Chief Assistant Professor PhD Radoslav Hrischev, Phone: +359 32 659 525, hrischev@tu-plovdiv.bg, Technical University - branch Plovdiv

COURSE STATUS IN THE CURRICULUM: Optionally for the master'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 systems 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, definition and classification. Models of information systems. Production information systems - CRM, ERP, MES systems. Overview and description of ERP systems. Description of the SAP as the number one ERP system worldwide. Detailed overview of the most important modules of SAP. Practical skills in working in systems based on exercises and demonstration systems.

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: Current Assessment /CA/, formed by a written test at the end of the semester - 75% and protocols from laboratory exercises - 25%. The Course Work is developed and assessed individually.

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/
5. Lectures and materials: http://dox.bg/files/dw?a=61f7458a19

DESCRIPTION OF THE COURSE

Name of the course **Industrial control systems**	Code: Mp**AICE05.2**	Semester: 1
Type of teaching: Lectures (L) Laboratory work (LW) Course work (CW)	Lessons per week: L – 30 hours; LW – 30 hours	Number of credits: **4**

LECTURER:
prof. Ph.D. Michail Petrov – tel.: 659 585, 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 in Plovdiv

COURSE STATUS IN THE CURRICULUM: Elective course for the students of specialty "Automatics, Information and Control Engineering", 'master' degree of qualification of the Faculty of Electronics and Automatics.

AIMS AND OBJECTIVES OF THE COURSE: The purpose of the course is to introduce students to the basic information related to the networked process control systems, the principles of their building and implementation. The students should acquire knowledge in hardware and software engineering of industrial systems.

DESCRIPTION OF THE COURSE: The course covers the basic information about industrial control systems. This is one of the modern trends in the complex control systems, integrating contemporary system technique with modern methods and approaches of control in hierarchical systems. The subject is devoted to typical structures. The various subsystems and components in the structural analysis of the systems are presented. Special attention is focused on information assurance of the systems and their technical and algorithmic performance. A significant part of the course is devoted to the theoretical grounds of a number of contemporary methods and approaches for solution of different system algorithms: data acquisition, optimal control, control decision-taking tasks, tasks from the theory of mass servicing and so on.

PREREQUISITES: The main prerequisites for the present course are the following courses: Automation of Technological Processes, Computer Control Systems, Automation of Production Mechanisms, System Design and other course from the Bachelor of Science academic plan.

TEACHING METHODS: Lectures. The laboratory work visualizes the lecture material, expands the knowledge and focuses on acquiring practical knowledge and skills.

METHOD OF ASSESSMENT: Outgoing examine (80%), Laboratory works (10%), Course work defence (10%)

INSTRUCTION LANGUAGE: Bulgarian

BIBLIOGRAPHY:
1.Хаджийски М., К. Велев, Г. Сотиров, И. Калайков., Автоматизация на технологични процеси. Методи и алгоритми за управление., С,Техника,1992. 2.Тодоров А., С. Йорданова, С. Джиев, В.Сгурев. Логическо управление на процеси. С.,Технически Университет, 2001. 3.Петров М., И.Ганчев, Промишлени приложения на микропроцесорите, Учебни записки ТУ София, Филиал Пловдив,1997. 4.Petruzella F., Programmable Logic Controllers, Publisher: McGraw-Hill College, 2004. 5.Polke M., U. Epple and M. Heim, Process Control Engineering, VCH Verlagsgesellschaft mbH, D-69451 Weinheim (Federal Republic of Germany), 1994. 6. Джиев Ст. Индустриални мрежи за комуникация и управление. ТУ - София, 2002. **Additional sources:** 1.OMRON, "Operation Manual – DeviceNet Slaves", 2003 г. 2.OMRON, "Programming Manual – Programmable controllers for CS/CJ Series", 2003 г. 3.OMRON, "CX-Programmer 6.1 Operation Manual", 2005 4. Clarence T Jones, STEP 7 Programming Made Easy in LAD, FBD, and STL: A Practical Guide to Programming S7300/S7-400 Programmable Logic Controllers, 2013.

DESCRIPTION OF THE COURSE

Name of the course **Distributed Control Systems**	Code: Mp**AICE06.1**	Semester: 1
Type of teaching: Lectures, Laboratory work, Course Project	Lessons per week: L – 30 hours; LW – 15 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 in Plovdiv

COURSE STATUS IN THE CURRICULUM: Elective course for the students of specialty "Automatics, Information and Control Engineering", 'master' degree of qualification of the Faculty of Electronics and Automatics.

AIMS AND OBJECTIVES OF THE COURSE: The purpose of the course is to introduce students to the basic information related to the distributed process control systems, the principles of their building, implementation and hierarchical architecture design. The students should acquire knowledge in hardware and software engineering of distributed systems and SCADA design.

DESCRIPTION OF THE COURSE: The course covers the basic information about distributed control systems (DCS). This is one of the modern trends in the complex control systems, integrating contemporary system technique with modern methods and approaches of control in hierarchical systems. The subject is devoted to: fieldbus, control and information levels. Special attention is focused on practical cases with network environment. A significant part of the course is devoted to a number of network implementation in control systems for data acquisition, visualisation and alarms events by using companies' software. There are Individual Course Project assignments.

PREREQUISITES: The main prerequisites for the present course are the following courses: Automation of Technological Processes, Communications in networked Control Systems, Programmable logic controllers, System Design and other course from the Bachelor degree curriculum.

TEACHING METHODS: Lectures. The laboratory work visualizes the lecture material, expands the knowledge and focuses on acquiring practical knowledge and skills.

METHOD OF ASSESSMENT: Outgoing examine at the end of the semester.

INSTRUCTION LANGUAGE: Bulgarian

BIBLIOGRAPHY:1. Djiev St., Industrial Networks for Communication and Control (book in Bulgarian), ISBN 954-438-360-3, TU Sofia, 2002 (Джиев, Ст., Индустриални мрежи за комуникация и управление, София, 2003); Хаджийски М. К. Велев, Г. Сотиров, И. Калайков. Методи и алгоритми за управление. София, Техника, 1992; Дренска, С., В. Цочев, Информационни технологии, TEMPUS - IB_JEP-14354-1999 Training in Standards on Quality Control and Management, ХТМУ, Записки, 2000;Petruzella F., Programmable Logic Controllers, Publisher: McGraw-Hill College, 2004;Фирмено Ръководство OMRON CX- Supervisor, 2003;OMRON, User Manual and "Getting Started with CX-Supervisor" 2013; IDC Technologies 2012. Practical Distributed Control Systems for Engineers and Technicians. www.idc-online.com; Фирмено Ръководство OMRON, "Operation Manual – DeviceNet Slaves", 2003;OMRON, "Programming Manual – Programmable controllers for CS/CJ Series", 2003; OMRON, "CX-Programmer 6.1 Operation Manual", 2005;Фирмено Ръководство SIMATIC S7 Exercises, Siemens AG, 2013; Фирмено Ръководство - MAPS SCADA Introductory CourseTraining Manual, pdf, , Mitsubishi Electric Europe B.V, 2017

Internet links:

- https://automation.omron.com/en/us/products/family/CXSUPV
- https://c4b.gss.siemens.com/resources/images/articles/dffa-b10338-01-7600.pdf
- https://www.mapsscada.com/mitsubishi-adroit-process-suite-maps/
- https://www.mapsscada.com/maps-smart-scada/

DESCRIPTION OF THE COURSE

Name of the course **Predictive Control**	Code: **MpAICE06.2**	Semester: 1
Type of teaching: Lectures and laboratory work	Lessons per semester: L – 30 hours; LW – 15 hours	Number of credits: **3**

LECTURER: Prof. Ph.D. Michail Petrov, e-mail: mpetrov@tu-plovdiv.bg; Assoc. Prof. Ph.D. Sevil Ahmed, e-mail: sevil.ahmed@tu-plovdiv.bg; Faculty of Electronics and Automation, Control Systems Department; tel.: +359 32 659 585, Technical University of Sofia, Branch in Plovdiv

COURSE STATUS IN THE CURRICULUM: Elective course for the students specialty "Automatics, Information and Control Engineering", 'master' degree of qualification of the Faculty of Electronics and Automatics.

AIMS AND OBJECTIVES OF THE COURSE: The purpose of the course is to introduce students to the basic information related to model predictive control, the principles of design and analysis. The student should acquire knowledge in the building of algorithms for predictive control.

DESCRIPTION OF THE COURSE: The course covers the basic information about model predictive control (MPC). This is one of the modern trends in the complex control systems, integrating contemporary system technique with modern methods and approaches of control in hierarchy systems.

The subject is devoted to typical structures of model predictive control systems. The various subsystems and components in the model predictive control systems are presented including predictive mathematical models and predictive optimizers. Special attention is focused on stability and robustness of the systems and their algorithmic performance.

A significant part of the course is devoted to the theoretical grounds of a number of contemporary methods and approaches for solution of different predictive algorithms: generalized predictive control, linear quadratic control, standard predictive control etc.

PREREQUISITES: The main prerequisites for the present course are the following courses: Automation of Technological Processes, Computer Controlled Systems, System Design and other courses from the Bachelor of Science academic program.

TEACHING METHODS: Lectures. The laboratory work visualizes the lecture material, expands the knowledge and focuses on acquiring practical knowledge and skills.

METHOD OF ASSESSMENT: One two-hour examine

INSTRUCTION LANGUAGE: Bulgarian

BIBLIOGRAPHY:
1. Kamen Velev, Adaptive systems. Self tuning controllers. Sofia, 1998 (in Bulgarian). 2. Soeterboek, R. Predictive Control. A Unified Approach, Prentice Hall, New York (1992).3. Ray W.H. Advanced Process Control. McGraw Hill Book Company, 1981. 4. Camacho, E.F. and C. Bordons, Model Predictive Control, Springer, London (1999). 5. Bitmead, R.R., M. Gevers and V. Wertz, Adaptive Optimal Control - The Thinking Man's GPC, Prentice Hall, Englewood Cliffs (1990). 6. Morari M., L.Ricker. Model Predictive Control Toolbox. For use with MATLAB. User's Guide. Mathworks. 1997. 7. Hadjiski M., K.Velev, G. Sotirov, I. Kalajkov. Methods and Algorithms for control. Sofia, Tehnika, 1992.(in Bulgarian)

DESCRIPTION OF THE COURSE

Name of the course: **Automated Production Systems**	Code: **MpAICE07**	Semester: **2**
Type of teaching: Lectures, Laboratory work	Lessons: L – 30; LW – 30.	Number of credits: **4**

LECTURER: Assoc. Prof. Ph.D. Ivan Kostov (FEA) – tel.: +35932659526, e-mail: 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: Compulsory subject for full-time students in the major of Automation, Information and Control Equipment at the Faculty of Electronics and Automation in TU-Sofia, Plovdiv Branch, Master's degree.

AIMS AND OBJECTIVES OF THE COURSE: The purpose of the course is to demonstrate the technical, economic and social necessity of development and improvement of automated production systems and to prepare the engineers for their graduation thesis design and engineering practice.

DESCRIPTION OF THE COURSE: Automated Production Systems are analyzed on the grounds of basic technological production schemes by their formalization to functional schemes and organization-and-structure models. Large-scale and multiple-related systems, systems of interrupted and directly-uninterrupted nature, systems of changing nature are the subject of analysis. Attention is paid to optimal according to various criteria automated production systems. The problems of parametric optimization are covered as well as optimal static corrections in production systems of the uninterrupted-flow type. Special emphasis is placed on contemporary devices of identification in real time and for the realization of an adaptive strategy of control of production systems.

PREREQUISITES: The main prerequisites for the present course are the following courses: Automation of Technological Processes, Computer Control Systems, Automation of Production Mechanisms, Control Systems of Electrical Drives and other courses from the Bachelor of Science academic plan and courses from the Master of Science academic plan.

TEACHING METHODS: Lectures, laboratory work and self-preparation. The laboratory work visualizes the basic lecture material; the self-preparation assignments are used for the easier subject matter.

METHOD OF ASSESSMENT: Written examination at the end of the semester. Lectures (73%), laboratories (27%).

INSTRUCTION LANGUAGE: Bulgarian

BIBLIOGRAPHY:

1. **Bolton W.**, Mechatronics. Electronic Control Systems In Mechanical And Electrical Engineering, Sixth Edition, Pearson Education, 2015, p.663, ISBN 978-1-292-08159-5.
2. **Liuping Wang, Shan Chai, Dae Yoo, Lu Gan and Ki Ng**, PID and Predictive Control of Electrical Drives and Power Converters using MATLAB®/Simulink®, First Edition, 2015, John Wiley & Sons Singapore, ISBN: 9781118339442, Pages: 344.
3. **Chiasson J**, Modelling and High-Performance Control of Electric Machines, John Wiley & Sons Inc., 2005, ISBN 0-471-68449-X (cloth), p.709.
4. **John J. Craig**, Introduction to Robotics: Mechanics and Control, Pearson Education Limited, 2014, Third Edition, p.369.
5. **Steven A. Frank**, Control Theory Tutorial, Basic Concepts Illustrated by Software Examples, SpringerBriefs in Applied Sciences and Technology, 2018, ISBN 978-3-319-91706-1, ISBN 978-3-319-91707-8, https://doi.org/10.1007/978-3-319-91707-8, p.112.
6. **Rik De Doncker, Duco W.J. Pulle, André Veltman**, Advanced Electrical Drives, Analysis, Modeling, Control, Springer, 2011, e-ISBN 978-94-007-0181-6, DOI 10.1007/978-94-007-0181-6, p.475.
7. **Шрейнер Р. Т., Ю. А. Дмитренко,** Оптимальное частотное управление асинхронными электроприводами, Кишинев, Штиинца, 1982, с.223**.**

DESCRIPTION OF THE COURSE

Name of the course **Robotics**	Code: Mp**AICE08**	Semester: 2
Type of teaching: Lectures and laboratory work	Lessons: L–30 hours; LW– 30 hours	Number of credits: **4**

LECTURER: Assoc. Prof. Ph.D. Nikola. Shakev (FEA) – tel.: 659 528,
email: shakev@tu-plovdiv.bg Technical University of Sofia, Branch at Plovdiv

COURSE STATUS IN THE CURRICULUM: Compulsory for the students specialty "Automatics, Information and Control Engineering" MEng programme of the Faculty of Electronics and Automatics

AIMS AND OBJECTIVES OF THE COURSE: The aim of the course is to make students familiar with modelling the robot kinematics and dynamics, with classical and intelligent approaches for robot control, and with path planning methods.

DESCRIPTION OF THE COURSE: The main topics concern: Introduction in Robotics – definitions, history and applications; Kinematics and dynamics of manipulators and mobile robots; Sensor systems in autonomous robots; Control of a non-holonomic mobile robot by backstepping kinematics into dynamics; Trajectory tracking, path following and point stabilization control; Robot control architectures – deliberative, reactive, behaviour-based and hybrid ones; Path planning – roadmap, cell decomposition and potential field methods; Approaches for collective behaviour of robots.

PREREQUISITES: Control Theory, Artificial Intelligence and Robotics, Control of Industrial Manipulators, Intelligent Control Systems, Computer Vision and Image Recognition, Automation of Production Mechanisms, et al.

TEACHING METHODS: Lectures using slides; laboratory work using MATLAB/SIMULINK simulation environment, work in teams, protocols.

METHOD OF ASSESSMENT: Written examine

INSTRUCTION LANGUAGE: Bulgarian

BIBLIOGRAPHY:
1. Arkin, R.C., *Behavior-Based Robotics*, MIT Press, Cambridge, Massachusetts, USA, 1998; 2. Asada H., and J.-J. E. Slotine, *Robot Analysis and Control*. John Wiley and Sons, USA, 1986; 3. Canudas de Wit, C., B. Siciliano, and G. Bastin (Eds), *Theory of Robot Control*. Springer Verlag, London, 1997; 4. Dixon, W.E., D.M. Dawson, E. Zergeroglu, and A. Behal, *Nonlinear Control of Wheeled Mobile Robots*. Springer-Verlag, London, 2001; 5. Kanayama, Y., Y. Kimura, F. Miyazaki, and T. Noguchi, "A Stable Tracking Control Method for an Autonomous Mobile Robot", *Proc. IEEE Int. Conf. on Robotics and Automation*, Vol.1, pp.384-389, 1990; 6. Latombe, J.-C., *Robot Motion Planning*. Kluwer Academic Publishers, 1991; 7. Frank L.Lewis, Darren M.Dawson, and ChaoukiT.Abdallah Lewis, *Robot Manipulator Control: Theory and Practice,* Marcel Dekker, New York, 2004.

COURSE DESCRIPTION

Name of the course: **Fuzzy and Neural Network-based Control**	Code: **MpAICE09**	Semester: 2
Type of the education: Lectures, Laboratory exercises.	Hours during the semester: Lectures – 30 hours, Lab. exercises – 30 hours.	Credits: **4**

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

STATUTE OF THE COURSE IN THE CURRICULUM: This is a compulsory course for the students from the specialization "Automation, information and control engineering", qualification degree in education "master".

GOALS OF THE COURSE: Students are building skills allowing them to design and maintain intelligent control systems for complex nonlinear plants where there are difficulties to obtain by analytical means adequate description and modeling of plant dynamics by analytical means (existence of coupled dynamics, uncertainties, ambiguities, etc.) as well as plants with time-varying parameters.

COURSE DESCRIPTION: Problems related to the design of fuzzy, neural network–based or hybrid fuzzy-neural and neuro-fuzzy models, synthesis of membership functions and decision rules, choosing, investigation and implementation of control strategies, architectures and learning algorithms for neural networks are discussed. Attention is paid to the application of fuzzy systems and artificial neural networks for control of nonlinear plants and plants with time-varying parameters. Fuzzy expert systems and decision making systems and their application to fuzzy classification and optimization problems are also discussed.

While studying methodology for the synthesis of fuzzy control and neuro-control systems, students are also learning to work with contemporary programming systems for solving particular practical problems.

PREREQUISITES: „Artificial intelligence", „System identification", „Computer-based simulation", „Automation of technological processes", „System optimization", „Applied methods for process control".

TEACHNG METHOD: Lectures, laboratory exercises with written reports.

GRADING: Two hours written exam during the examinations (82%), laboratory exercises (18%).

LANGUAGE OF TEACHING: Bulgarian

REFERENCE TEXTS: 1. Burnev P., P. Stanchev, Fuzzy sets, Sofia, Narodna prosveta, 1987 (in Bulgarian). 2. Driankov D., H.Hellendorn, M.Reinfrank. An introduction to fuzzy control. Springer Verlag, 3. Liu G.P. Nonlinear identification and control: A neural network approach. Springer-Verlag London, 2001. 4. Spooner J. T., M. Maggiore, R. Ordonez and K. Passino. Stable adaptive control and estimation for nonlinear systems: Neural and fuzzy approximator techniques. John Wiley & Sons, Inc., 2002.

DESCRIPTION OF THE COURSE

Name of the course **System Analysis**	Code: **MpAICE10**	Semester: 2
Type of teaching: Lectures and laboratory work	Lessons per semester: L – 30 hours; LW – 30 hours	Number of credits: **4**

LECTURER: Prof. Ph.D. Michail Petrov, e-mail: mpetrov@tu-plovdiv.bg;

Assoc. Prof. Ph.D. Sevil Ahmed, e-mail: sevil.ahmed@tu-plovdiv.bg; Faculty of Electronics and Automation, Control Systems Department; tel.: +359 32 659 585, Technical University of Sofia, Branch in Plovdiv

COURSE STATUS IN THE CURRICULUM: Elective course for the students specialty "Automatics, Information and Control Engineering" 'master' degree of qualification of the Faculty of Electronics and Automatics.

AIMS AND OBJECTIVES OF THE COURSE: The purpose of the course is to introduce students to the basic information related to the complex control systems, the principles of their building and implementation. The students should acquire knowledge in the formatting of engineering system projects and so on.

DESCRIPTION OF THE COURSE: The course covers the basic information about system analysis. This is one of the modern trends in the complex control systems, integrating contemporary system technique with modern methods and approaches of control in hierarchical systems.

The subject is devoted to typical structures of complex systems. The various subsystems and components in the structural analysis of the systems are presented. Special attention is focused on the information assurance of the systems and their technical and algorithmic performance.

A significant part of the course is devoted to the theoretical grounds of a number of contemporary methods and approaches for solution of different system tasks: tasks of optimal control, control decision-taking tasks, tasks from the theory of mass servicing and so on.

PREREQUISITES: The main prerequisites for the present course are the following courses: Automation of Technological Processes, Computer Control Systems, Automation of Production Mechanisms, System Design and other course from the Bachelor of Science academic plan

TEACHING METHODS: Lectures. The laboratory work visualizes the lecture material, expands the knowledge and focuses on acquiring practical knowledge and skills.

METHOD OF ASSESSMENT: One two-hour examine

INSTRUCTION LANGUAGE: Bulgarian

BIBLIOGRAPHY:
1.Taha, H.A., Introduction to operational investigation. M., Mir, 1988.(in Russian) 2.Harsanyi L., Z. Kralova, M. Dubravska. Systemova analyza. TU Bratislava, 1988.(in Slovak). 3.Whitten J.L., Systems Analysis and design, McGraw Hill, 2000. 4.Hoffer J.A., Modern Systems Analysis and Design, Prentice Hall, 2001. 5.Langer A.M., The Art of Analysis, Springer, 1997. 7.Miser H.J. (editor), Handbook of System Analysis vol. 1-4, John Wiley & Sons, 1996. 8.de Neuville R., Applied System Analysis, McGraw Hill, 1996.17.Gore&Stube, Contemporary Systems Analysis, McGraw Hill,1995. 18.Gore&Stube, Elements of Systems Analysis, McGraw Hill, 1996.

DESCRIPTION OF THE COURSE

Name of the course: **Project Planning for Electrical Drives**	Code: **MpAICE11.1**	Semester: 2
Type of teaching: Lectures (L), Laboratory Works (LW), Course Project	Lessons: L - 30, LW - 15	Number of credits: **3**

LECTURER: 1. Assoc. Prof. PhD. Ivan Kostov (FEA) – tel.: +35932659531, email: ijk@tu-plovdiv.bg , Technical University - branch Plovdiv. 2. Chief Assist. Prof. Radoslav Hrischev, Ph.D., (FEA), Control Systems Department, Technical University - Sofia, Branch Plovdiv, Phone: +35932659525, e-mail: hrischev@tu-plovdiv.bg

COURSE STATUS IN THE CURRICULUM: Elective subject for full-time students of the Automation, Information and Control Systems specialty at FEA of TU-Sofia, Plovdiv Branch, Master's degree.

AIMS AND OBJECTIVES OF THE COURSE: Upon completion of the course, students must have the necessary skills to apply engineering knowledge in designing electric drive and automation systems - from the power supply network to the engine shaft.

DESCRIPTION OF THE COURSE: The course places key emphasis on: a) studying engineering methods for research of dynamic and static properties of engines and converters in eclectic drives for alternating and direct current, b) defining and computing indicators forming the selection criteria for the type and structure of the electric drive system: productivity, operational efficiency, power consumption etc.; c) illustrating the application of up-to-date engineering methods used in the process of electric drive systems design - by solving typical problems; d) acquiring the necessary knowledge on the selection of blocks and elements part of the eclectic drives systems' structure.

PREREQUISITES: The subject builds upon knowledge from courses in Electro-Mechanical Systems Blocks, Control Theory, Control of Electro-Mechanical Systems, Electrical Drives Theory, Control of Electrical Drives, and Automation of Production Mechanisms.

TEACHING METHODS: Classical lectures with visual aids and demos. Laboratory works with individual laboratory reports. Project with defense prepared in standard form – theoretical and experimental (solutions and results) part.

METHOD OF ASSESSMENT: Final assessment is formed by written final examination, laboratory reports defense and students' activity during laboratory work with equal weights. The project has separate assessment.

INSTRUCTION LANGUAGE: Bulgarian.

BIBLIOGRAPHY:

8. **Божинов Б.Г.**, *Електрозадвижване на подемно-транспортни машини*, АВС Техника, С., 1997г.
9. **Стоянов С., Ц. Цанев**, *Електрообзавеждане на производствени агрегати*, ДИ Техника, С., 1982г.
10. **Frank L. Lewis, Darren M. Dawson, Chaouki T. Abdallah**, Robot Manipulator Control: Theory and Practice (Automation and Control Engineering), Edition: 2nd, CRC Press, ISBN-13: 978-0824740726.
11. **SEW Eurodrive**, Efficient Plant Automation With Mechatronic Drive Solutions, Edition 03/2011, p.124.
12. **SEW Eurodrive**, Project Planning for Controlled and Non-Controlled Drives, Edition 06/2019, p.144.
13. **SEW Eurodrive**, Drive Engineering – Practical Implementation – Servo Technology, Edition 09/2006, p.144.
14. **SEW Eurodrive**, DOCU-ROM3, Edition 05/2005.
15. **SEW Eurodrive**, *Проектирование приводов*, 11/2001г.
1. http://dox.bg/files/dw?a=ee15eee88aa

DESCRIPTION OF THE COURSE

Name of the course: **Control Systems of Combustion Processes**	Code: **MpAICE11.2**	Semester: **2**
Type of teaching: Lectures, Laboratory Works, Course Project	Lessons: L – 30, LW – 15	Number of credits: **3**

LECTURER: Assoc. Prof. PhD. Ivan Kostov (FEA) – tel.: +35932659531, email: ijk@tu-plovdiv.bg , Technical University - branch Plovdiv.

COURSE STATUS IN THE CURRICULUM: Optional for students in the Automation Information and Control Engineering MEng programme of the Faculty of Electronics and Automation at Technical University of Sofia, Branch Plovdiv.

AIMES AND OBJECTIVES OF THE COURSE: This course introduces knowledge about combustion processes followed by design and control solutions. Developing skills for creating programs, logical and hybrid control algorithms for of different software and technical platforms.

DESCRIPTION OF THE COURSE: The course covers the basic information for analysis, modeling and synthesis of boiler combustion control systems. Standard schemes and solutions related to solving the basic functional tasks in multi-mode operations are analyzed. It is given a special attention to solving the additional requirements associated with both operation and equipment such as safety; performance and efficiency; minimizing emissions; tasks of higher hierarchical levels. Lectures include detailed review of the requirements for start-up and normal operation. This includes the associated safeguarding system and operational procedures to ensure safety of equipment and personal in accordance with current regulations. The course presents contemporary schematic and algorithmic solutions of information and control problems using specialized or universal programmable controllers, distributed control systems integrated into different structures.

PREREQUISITES: The main prerequisites for the present course are the following courses: Process Control, Control Instrumentations, Applied Process Control, and Computer Control Systems.

TEACHING METHODS: Classical lectures with visual aids and demos. Seminars during which the students solve and discuss problems in relation with the lectures. Laboratory works with individual laboratory reports. Project with defense prepared in standard form – theoretical and experimental (solutions and results) part.

METHODS OF ASSESSSMENTS: Final assessment is formed by written final examination, laboratory reports defense and students' activity during seminars with equal weights. The project has separate assessment.

INSTRUCTION LANGUAGE: Bulgarian

BIBLIOGRAPHY:

1. Мумджиян Г.С., Автоматично управление и регулиране на топлинни процеси, Т., 1988г.;
2. Плетнев Г.П., Автоматическое управление и защита теплоэнергетических установок электростанций, Энергоатомиздат., 1986, 344 с.;
3. Левин., Регулирование парокотельных установок пищевых предприятий, Агропромиздат., 1987, 224 с.;
4. Hjalti Kristinsson, Sofie Lang., Boiler control-improving efficiency of boiler systems, Lund University, Faculty of Engineering, Division of Industrial Electrical Engineering and Automation, 2010, p.90.;
5. Boiler Control Operation Manual, Cleaver-Brooks HAWK 4000, 2012, p.122;
6. Клюев А.С., Лебедев А.Т., Новиков С.И. Наладка автоматических систем регулирования барабанных парогенераторов. – М.: Энергоатомиздат, 1985.

COURSE DESCRIPTION

Name of the course: **Control of Industrial Manipulators**	Code: **MpAICE12.1**	Semester: **2**
Type of the education: Lectures, Laboratory exercises, Course project.	Hours during the semester: Lectures – 30 hours, Lab. exercises – 15 hours.	Credits: **3**

INSTRUCTOR:
Prof. PhD Andon V. Topalov (FEA), phone: 659 528, email: topalov@tu-plovdiv.bg
Technical University – Sofia, branch at Plovdiv
Assoc. Prof. PhD Nikola Shakev (FEA), phone: 659 528, e-mail: shakev@tu-plovdiv.bg
Technical University – Sofia, campus 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 "master".

GOALS OF THE COURSE: The course goal is to introduce students into the basics of mechanics and control of robot manipulators. The obtained knowledge will allow them to design simple manipulator mechanisms and control systems for manipulators as well as to solve problems requiring kinematics analysis of a manipulator structure. They will be able to read and understand constantly emerging technical literature about the subject.

COURSE DESCRIPTION: Problems related to the description and classification of robot manipulators, a general view of mechanics and kinematics for joints, links and gripper, inverse kinematics, determination of dynamical models, state-space representation and linearization of nonlinear models, control of robots, including independent joint control, computed-torque control, force control, trajectory planning and control.

PREREQUISITES: „Automatic control theory - part III", „System identification", „Computer-based simulation", „Automation of technological processes", „Analysis and recognition of patterns and scenes", „Artificial intelligence", „Technical mechanics", „Electromechanical devices".

TEACHNG METHOD: Lectures, laboratory exercises with written reports, project work.

GRADING: Two one hour written tests in the middle and at the end of the semester (62%), laboratory exercises (18%), course project (20%).

LANGUAGE OF TEACHING: Bulgarian

REFERENCE TEXTS: 1. John Craig, Introduction to Robotics: Mechanics and Control, 2nd ed., Addison Wesley, 1989. 2. F. L. Lewis, C. T. Abdallah, D. M. Dawson, Control of Robot Manipulators, Macmillan, 1993. 3. L. Sciavicco, B. Siciliano, Modelling and Control of Robot Manipulators, Springer, 2000.

DESCRIPTION OF THE COURSE

Name of the course **Automatic Tuning of Controllers**	Code: **MpAICE12.2**	Semester: **1**
Type of teaching: Lectures and laboratory work Course project	Lessons: L – 30; LW – 15.	Number of credits: **3**

LECTURER:

Assoc. Prof. Ivan Ganchev, Ph.D., (FEA), Control Systems Department e-mail: ganchev@tu-plovdiv.bg

Technical University - Sofia, Branch Plovdiv

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

AIMS AND OBJECTIVES OF THE COURSE: After studying this course the students should be able to apply methods and develop algorithms for automatic tuning of controllers in process control systems.

DESCRIPTION OF THE COURSE: The main topics concern: Adaptive control and Automatic tuning of controllers. Methods and approaches for automatic tuning. Automatic tuning of controllers using the time response of the plant. Direct automatic tuning using multiple integrations method. Relay feedback methods for automatic tuning. Automatic tuning of controllers in cascade systems. Automatic tuning of controllers in multiple-input multiple-output systems. Automatic tuning of controllers in time delay systems. Automatic tuning of controllers in systems with motor valve. Bumpless transfer to automatic mode. Automatic tuning and diagnostics. Automatic tuning of some industrial controllers.

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

TEACHING METHODS: Lectures, handouts, laboratory work using industrial controllers, modeling and simulations using MATLAB/Simulink, written reports on the laboratory work. Individual course project.

METHOD OF ASSESSMENT: Two assessments during the semester (100%). The course project has a separate assessment.

INSTRUCTION LANGUAGE: Bulgarian, English

BIBLIOGRAPHY: **1**. Dragotinov I., I.Ganchev, Process Control, University of Food Technologies, Plovdiv, 2003. **2**. Astrom K-J., T. Hagglund, PID Controllers: Theory, Design, and Tuning, Instrument Society of America, Research Triangle Park, 1995. **3**. Yu C.C., Autotuning of PID Controllers, Springer, 1999.

DESCRIPTION OF THE COURSE

Name of the course: **Electromagnetic compatibility in electrical drives**	Code: **MpAICE12.3**	Semester: **2**
Type of teaching: Lectures, Laboratory Work and Course Project	Lessons: L – 30; LW – 15.	Number of credits: **3**

LECTURER: Assoc. Prof. Ph.D. Ivan Kostov (FEA) – tel.: +35932659531, email: ijk@tu-plovdiv.bg , Technical University - branch Plovdiv.

COURSE STATUS IN THE CURRICULUM: Elective subject for full-time students in the major of Automation, Information and Control Equipment at the Faculty of Electronics and Automation in TU-Sofia, Plovdiv Branch, Master's degree.

AIMS AND OBJECTIVES OF THE COURSE: The aim of the course is to provide knowledge and develop practical skills and habits for the ability to control sevveral electrical and electronic components (converters, motors) and with one another within a particular environment without interference. This course is based on practical situations and experiences. Acquire skills and approaches for measuring, testing and implementation of electromagnetic compatibility (EMC) through laboratory conducted a physical and mathematical models.

DESCRIPTION OF THE COURSE: Electromagnetic compatibility (EMC) denotes the capability to operate several electrical and electronic components together and next to each other within a certain environment without any electromagnetic interference (EMI).

The main topics are: Causes and types of electromagnetic interactions (EMI) - galvanic, inductive, capacitive, radiation, high frequency wire, EMI frequency converters, filters, cables, screens, methods and tools for measuring and testing interference. Measurement uncertainty. Practice of EMC installation - cabling, installing filters bonding, shielding, design EMC-compatible systems.

PREREQUISITES: The course is conducted on the basis of knowledge from the course in Blocks for Electromechanical Systems, Measurement of Non-electrical Measurements, Control of Electromechanical Systems, Automation of Production Mechanisms, Power and Control Electronics in Electric Drives, and Control of Electrical Drives from the Bachelor of Science plan.

TEACHING METHODS: Classical lectures with visual aids and demos. Laboratory works during which the students solve and discuss problems with individual laboratory reports. Course project with defense prepared in standard form – theoretical and experimental (solutions and results) part.

METHOD OF ASSESSMENT: Written test during 15th academic week on the subject matter. Test duration – two hours. Lectures (73%), laboratories (27%). The project has separate assessment.

INSTRUCTION LANGUAGE: Bulgarian.

BIBLIOGRAPHY:
1.Drive Engineering - Practical Implementation, Volume 9, Electromagnetic Compatibility (EMC) in Drive Engineering, Edition 08/2002. 2. EMC in Drive Engineering – Theoretical Principles, EMC-Compliant Installation in Practice, Edition 04/2012. 3. Boldea I., Nasar S.A., Electric Drives, Chapter XIII, 1998. 4. IVAN KOSTOV, BOJIL MIHAYLOV, VASIL SPASOV, EXPERIMENTAL ANALYSIS OF THE SUPPLY VOLTAGE QUALITY OF INDUCTION MOTORS WITH PWM CONVERTERS, International Scientific Conference on Engineering, Technologies and Systems TECHSYS 2017, Technical University – Sofia, Plovdiv branch, 18 – 20 May 2017, Plovdiv, Bulgaria. 5. Шнайдер Електрик, Ръководство за решения по автоматизация. Практически въпроси на индустриалното управление, 2014, с.331.

DESCRIPTION OF THE COURSE

Name of the course: **Protections of Electrical Drives**	Code: **MAICE12.4**	Semester: **2**
Type of teaching: Lectures, Laboratory Work and Course Project	Lessons: L – 30; LW – 15.	Number of credits: **3**

LECTURER: Assoc. Prof. Ph.D. Ivan Kostov (FEA) – tel.: +35932659531, email: ijk@tu-plovdiv.bg , Technical University - branch Plovdiv.

COURSE STATUS IN THE CURRICULUM: Elective subject for full-time students in the major of Automation, Information and Control Equipment at the Faculty of Electronics and Automation in TU-Sofia, Plovdiv Branch, Master's degree.

AIMS AND OBJECTIVES OF THE COURSE: The purpose of the course is to demonstrate the technical, economic and social necessity of use, improvement and expansion of the functional capacity of protections in electrical drive systems. The purpose of the acquired knowledge is to prepare engineers for the graduation thesis design and for the engineering practice.

DESCRIPTION OF THE COURSE: The course Protections of Electrical Drives provides knowledge in the following fields: the technical, economic and social necessity of use, improvement and expansion of the functional capacity of protections from dangerous phenomena and situations related to the operation of drive systems; basic requirements to protection devices, principles of their development and compatibility with the drive systems; contemporary trends in compatibility of the protection functions with preventive action, as well as automated statistical assessment of quantities, modes and processes for specification of algorithms of control and of measurement and adjustment parameters. Examples of widely used and typical protections, as well as examples of protections that have not yet been satisfactorily solved;

Laboratory works are conducted on physical and mathematical models. They provide for acquiring practical skills and abilities for adjustment of some of the most common protections in addition to better learning of the lecture material.

PREREQUISITES: The course is conducted on the basis of knowledge from the course in Blocks for Electromechanical Systems, Measurement of Non-electrical Measurements, Control of Electromechanical Systems, Automation of Production Mechanisms, Power and Control Electronics in Electric Drives, and Control of Electrical Drives from the Bachelor of Science plan.

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 emergency modes of operation, protocols and course project description preparation and defence.

METHOD OF ASSESSMENT: Written test during 15th academic week on the subject matter. Test duration – two hours. Lectures (73%), laboratories (27%). The project has separate assessment.

INSTRUCTION LANGUAGE: Bulgarian.

BIBLIOGRAPHY:
1. Йорданов С., И. Костов, Защити в електрозадвижванията, София, Печатна база на ТУ, 1997. 2. Мошеков К. М. , Защита на асинхронни електродвигатели, С., ДИ “Техника”, 1985. 3. Drive Engineering – Practical Implementation, Volume 9, Electromagnetic Compatibility (EMC) in Drive Engineering, Edition 08/2002. 4. Шнайдер Електрик, Ръководство за решения по автоматизация. Практически въпроси на индустриалното управление, 2014, с.331.

DESCRIPTION OF THE COURSE

Name of the course **Modeling and Optimization**	Code: **MpAICE 12.5**	Semester: 2
Type of teaching: Lectures, Laboratory work, Course project	Lessons per week: L – 30 hours; LW – 15 hours	Number of credits: **3**

LECTURER: Assoc. Prof. Ph.D. Albena Taneva (FEA) – tel.: +359 32 659 585, email: altaneva@tu-plovdiv.bg Technical University of Sofia, Branch in Plovdiv;

Assoc. Prof. Ph.D. Nikola Shakev (FEA) – tel.: +359 32 659 528, email: shakev@tu-plovdiv.bg Technical University of Sofia, Branch in Plovdiv

COURSE STATUS IN THE CURRICULUM: Elective course for the students specialty "Automatics, Information and Control Engineering" at the Faculty of Electronics and Automation in TU-Sofia, Plovdiv Branch, Master's degree.

AIMS AND OBJECTIVES OF THE COURSE: The purpose of the course is to introduce students to the basic information related to modeling and optimization of production processes, that are applicable to various field of studies - Systems Optimization, Practical methods for process control, Adaptive control, Systems design etc.

DESCRIPTION OF THE COURSE: The course covers the basic information about methods for modelling and optimization of production processes. The basic principles for development of static and dynamical mathematical models of production processes are discussed. Some approaches based on mathematical statistics and statistical analyses of experimental data are introduced. The considered analytical models and approaches are applied to basic industrial processes in metallurgy, chemical industry, textile industry etc. A special emphasis upon application for design and analysis of control systems is placed. The course finished with methods for dynamic and multi criteria optimization. There are Individual Course Project assignments.

PREREQUISITES: The main prerequisites for the present course are the following courses: Automation of Technological Processes, Mathematics, System Design and other course from the Bachelor of Science academic plan.

TEACHING METHODS: Lectures. The laboratory work visualizes the lecture material, expands the knowledge and focuses on acquiring practical knowledge and skills. The course work includes a case analysis.

METHOD OF ASSESSMENT: Outgoing exams at the end of semester (80%), and Laboratory work (20%).

INSTRUCTION LANGUAGE: Bulgarian

BIBLIOGRAPHY:
1.ВУЧКОВ, И., С. СТОЯНОВ. Математическо моделиране и оптимизация на технологични обекти. Техника, София, 1980, 1986

2. САПУНДЖИЕВ Г., М. ГЕОРГИЕВ, Оптимизация на системи, ТУ София, 2008

3.СТОЯНОВ, С. Оптимизация на технологични процеси. Техника, София, 1993.

4.ЦОЧЕВ, В., Д. ДАМГАЛИЕВ, Н. КОЗАРЕВ, Н. МАНОЛОВ. Ръководство по методи за експериментални изследвания и оптимизация. МАРТИЛЕН, София, 1994.

5.ВУЧКОВ, И., С. СТОЯНОВ, Н.КОЗАРЕВ, В.ЦОЧЕВ. Ръководство за лабораторни упражнения по статистически методи.Издателство "Нови знания", София, 2002

6.ЙОРДАНОВ Й., MATLAB® 7, Част III Преобразуване, Изчисления, Визуализация Издателство „Техника", София 2009.

COURSE DESCRIPTION

Name of the course: Robust control	Code: **MpAICE12.6**	Semester: **2**
Type of teaching: Lectures (L), Laboratory (Lab.) Project work (P)	Lessons per semester: L – 30 hours, Lab. – 15 hours	Credits: **3**

LECTURER: Assoc. Prof. PhD S. Ahmed (FEA) - tel. +359 32 659 585, e-mail: sevil.ahmed@tu-plovdiv.bg; Technical University of Sofia, branch Plovdiv

COURSE STATUS IN THE CURRICULUM: Elective course for the students from specialty "Automation, Information and Control Engineering", Master Degree, Faculty of Electronics and Automation.

AIMS AND OBJECTIVES OF THE COURSE: To give knowledge on the modern methods for analysis and design of robust control systems. To develop skils for description of uncertain systems, robust stability and robust performance analysis, to perform H_∞ design and μ-synthesis of multivariable control systems. To develop practical skills for using MATLAB in the robust analysis and design of control systems.

DESCRIPTION OF THE COURSE: The main topics concern: Properties of multivariable feedback systems, application of the singular values in the analysis of multivariable systems, H_2 and H_∞ norms of transfer matrices, uncertainty description, application of the linear fractional transformations, obtaining of unstructured and structured uncertainty models, properties of the structured singular value, robust stability and robust performance, mixed sensitivity H_∞ design, H_∞ loop shaping, μ synthesis and D-K iterations.

Program language – MATLAB.

PREREQUISITES:

Mechanics, Theoretical Electrotechnics I, II, Control Theory I, II.

TEACHING METHODS:

Lectures, laboratory work from laboratory manual, work in teams, protocols preparation and defense.

METHOD OF ASSESSMENT:

Written final examination (80 %); laboratory work (20 %).

INSTRUCTION LANGUAGE: Bulgarian.

BIBLIOGRAPHY:

1. П. Петков, М. Константинов (2002), Робастни системи за управление. Анализ и синтез с MATLAB. АВС Техника, София.

2. D.-W. Gu, P.Hr. Petkov, M.M. Konstantinov (2012), Robust Control Design with MATLAB®. Springer London.

3. K. Zhou, J. C. Doyle (1999), Essentials of Robust Control. Prentice Hall.

4. K. Zhou, J. C. Doyle and K. Glover (1996), Robust and Optimal Control. Prentice Hall, Englewood Clifs, New Jersey

DESCRIPTION OF THE COURSE

Name of the course **Time series forecasting**	Code: **FaMpAICE01**	Semester: 1
Type of teaching: Lectures, Laboratory work	Lessons: L– 20 hours; LW– 20 hours	Number of credits: **3**

LECTURERS: Assoc. prof. PhD Georgi Ganev, tel. 659680, e-mail: gganev@tu-plovdiv.bg;
Technical University – Sofia, branch Plovdiv

COURSE STATUS IN THE CURRICULUM: Facultative course for the students specialty "Electrical Engineering", "Automatics, Information and Control Engineering" and "Computer systems and technologies" at the Faculty of Electronics and Automation in TU-Sofia, Plovdiv Branch, Master's degree.

AIMS AND OBJECTIVES OF THE COURSE: After the successful completion of the course students must know the basic methods for forecasting time series and be able to apply them in data analysis.

DESCRIPTION OF THE COURSE: In the learning process, students are introduced to different methods for predicting time series - conventional (regression and autocorrelation methods, smoothing methods, etc.) and modern, based on artificial intelligence (neural networks, etc.). Algorithms for analysis of the initial data, selection of a suitable mathematical model and methods for determining the parameters of the model are considered. The course deals with applied examples and tasks, focused mainly on engineering applications for modelling and making forecasts based on the compiled models. Algorithms for quantitative assessment of the accuracy of the applied models are studied.

PREREQUISITES: Knowledge of the basics of mathematics is required.

TEACHING METHODS: Multimedia presentations are used in the lectures. Students have pre-accessed the presentations and can supplement them with explanations from the teacher. Laboratory exercises include specific tasks using computers and data processing software..

METHOD OF ASSESSMENT: Two examines during the semester (80%), Laboratory work (20%).

INSTRUCTION LANGUAGE: Bulgarian

BIBLIOGRAPHY:
1.Вучков, И., С. Стоянов. Математическо моделиране и оптимизация на технологични обекти. Техника, София, 1980, 1986

2. Цочев, В., Д. Дамгалиев, Н. Козарев, Н. Манолов. Ръководство по методи за експериментални изследвания и оптимизация. МАРТИЛЕН, София, 1994.

3. Вучков, И., С. Стоянов, Н.Козарев, В.Цочев. Ръководство за лабораторни упражнения по статистически методи.Издателство "Нови знания", София, 2002

4. R.H. Shumway, D. S. Stoffer. Time Series Analysis and Its Applications, Springer Texts in Statistics, 3rd ed. 2011.

DESCRIPTION OF THE COURSE

Name of the course **Mathematical methods for digital signal processing**	Code:**FaMpAICE02**	Semester: **II**
Type of teaching: Lectures and Laboratoty work	Semester hours: L – 20 hours, LW – 20 hour	Number of credits: **3**

LECTURER:

Assoc. Prof. PhD B. K. Pachedjieva (FEA) – tel.: 659 708; e-mail: pachedjieva@tu-plovdiv.bg

Technical University of Sofia, branch Plovdiv

COURSE STATUS IN THE CURRICULUM: Optional course for the students in Master's programs in "Electrical Engineering", "Computer Systems and Technologies" and "Automatics, Information and Control Engineering"

AIMS AND OBJECTIVES OF THE COURSE: The aim of the course is to provide theoretical knowledge and practical skills using mathematical methods for digital processing and in particular Probabilistic and statistic methods at solving most important theoretical and practical problems in electronics – in particular statistical treatment of experimental data.

DESCRIPTION OF THE COURSE: The main topics concern: Probabilities; Random variables; System from random variables; Deterministic connections between Random variables; Statistical treatment experimental date; Random Processes; Stationary Random Processes; Markov Random Processes; Elements of the theory telegraphic systems; Transforming random processes in electronics units.

PREREQUISITES:. Good fundamental knowledge in the courses: Higher mathematics, Theoretical electrical engineering, Signals and systems.

TEACHING METHODS: Lectures, and laboratory work.

METHOD OF ASSESSMENT: Two two-hour assessments at mid and end of semester.

INSTRUCTION LANGUAGE: Bulgarian

BIBLIOGRAPHY:
1. Vencel E. S., L. A. Ovcharov. The theory of probability and its engineering applications. Moscow, Science press, 1988. 2. Gmurman V. E. The theory of probabilities and mathematical statistics. Moscow, Higher school press, 2002.
3. Gmurman V. E. Manual to the decision of tasks on the theory of probabilities and mathematical statistics Moscow, Higher school press, 2003. 4. Srinath M. D. Introduction to statistical signal processing with applications. Prentice-Hall, New Jersey, 1996. 5. Alberto Leon-Garcia. Probability and Random Processing for Electrical Engineering, Addison–Wesley, 1994. 6. Ferdinandov E. S., B. K. Pachedjieva. Probabilistic and statistic methods in communications. Sofia, Siela, 2005.