Bialystok University of Technology, Faculty of Mechanical Engineering									
Field of study	*Mechatronics*							**Degree level and programme type**	*first-cycle (BSc, Eng) full-time studies*
Specialization/ diploma path	*Common course*							**Study profile**	*academic*
Course name	*Drive systems in mechatronics*							**Course code**	*IS-FME- 00249S*
								Course type	*compulsory*
Forms and number of hours of tuition	**L**	**C**	**LC**	**P**	**SW**	**FW**	**S**	**Semester**	*summer*
	30		*15*	*15*				**No. of ECTS credits**	*5*
Entry requirements	*Fundamentals of electrical engineering and electronics, Measuring and control signals*								
Course objectives	*Getting acquainted with the principle of operation, applications and directions of the development of fluid and electric drive systems. Acquiring basic practical skills of assembling pneumatic, hydraulic and electric drive and control systems.*								
Course content	*Lecture: Basic concepts of fluid (pneumatic and hydraulic) and electric drive systems. Classification of fluid and electric drives. Graphic symbols of hydraulic, pneumatic, electric and hybrid components. Principles of reading and developing diagrams of pneumatic, hydraulic and electric drive and control systems. Applications and properties of the transmission medium. Production, preparation and transmission of the transmission medium. Pneumatic components used in drive and control systems. Pneumatic linear drives – cylinders. Pneumatic rotary drives - actuators. Classification, properties and applications of electric drives. Feedback control, shaping the mechanical characteristics of electric motors. Start-up, control of angular speed and braking of DC motors, single-phase motors and three-phase AC motors. Inverter drives with DC motors (block diagrams, principle of operation, properties and applications). Frequency control of rotational speed of selected AC motors. Digital-analog control systems of angular speed and position. Position control systems with stepper motors and servo drives. Selection of electric motors for working machines. Electric equipment and protection systems for electric drive systems.* *Laboratory classes: Designing and testing electric drive and control systems. Testing of static and dynamic characteristics (properties) of selected drive systems. Testing of measurement systems of rotational speed and angular displacement.* *Project classes: Designing simple pneumatic and electric control systems, using the FluidSim computer software.*								
Teaching methods	*Information and problem lecture; Laboratory classes; Project classes*								
Assessment method	*Lecture: examination; Laboratory classes: evaluation of: self-preparation tests on specified issues before they are discussed during the course, students' reports, students' participation in discussions and their activity during classes; Project classes: evaluation of: students' projects, their ongoing work progress, participation in discussions and students' activity during classes*								

Symbol of learning outcome	**Learning outcomes Students who successfully complete the course:**	**Reference to the learning outcomes for the field of study**
LO1	*can correctly describe basic concepts related to electric and fluid drives.*	*MK1_W01, MK1_W03*
LO2	*can list and classify basic components of electric and fluid (pneumatic and hydraulic) drive and control systems.*	*MK1_W03*
LO3	*have the basic knowledge of the development trends of electric and fluid (pneumatic and hydraulic) drives.*	*MK1_W05*
LO4	*can correctly read and draw pneumatic, hydraulic and electric circuit diagrams of drive and control systems.*	*MK1_W07, MK1_U03*
LO5	*can assembly and test basic pneumatic, hydraulic and electric circuit diagrams of drive and control systems.*	*MK1_U03, MK1_U02, MK1_K03*
LO6	*can prepare correct schematic diagrams of the designed pneumatic, hydraulic and electric drive and control systems.*	*MK1_K03, MK1_U03*

Symbol of learning outcome	Methods of assessing the learning outcomes	Type of tuition during which the outcome is assessed
LO1	*Lecture: examination*	*L*
LO2	*Lecture: examination*	*L*
LO3	*Lecture: examination*	*L*
LO4	*Lecture: examination; Laboratory classes: evaluation of: self-preparation tests on specified issues before they are discussed during the course, students' reports, students' participation in discussions and their activity during classes; Project classes: evaluation of: students' projects, their ongoing work progress, participation in discussions and students' activity during classes*	*L, LC, P*
LO5	*Laboratory classes: evaluation of: self-preparation tests on specified issues before they are discussed during the course, students' reports, students' participation in discussions and their activity during classes; Project classes: evaluation of: students' projects, their ongoing work progress, participation in discussions and students' activity during classes*	*LC, P*
LO6	*Laboratory classes: evaluation of: self-preparation tests on specified issues before they are discussed during the course, students' reports, students' participation in discussions and their activity during classes; Project classes: evaluation of: students' projects, their ongoing work progress, participation in discussions and students' activity during classes*	*LC, P*

Student workload (in hours)		No. of hours
Calculation	*Participation in lectures*	*30*
	Participation in laboratory classes	*15*
	Participation in project classes	*15*
	Preparation for examination based on lecture content; participation in examination	*16*
	Preparation for laboratory classes	*12*
	Preparation for passing the laboratory classes	*3*
	Preparation for project assignments	*19*
	Completion of project assignments (including preparation of presentations)	*5*
	Preparation for passing project assignments	*6*
	Participation in consultations	*4*
	TOTAL:	*125*

Quantitative indicators	HOURS	No. of ECTS credits
Student workload – activities that require direct teacher participation	*66*	*2.6*
Student workload – practical activities	*77*	*3.1*

Basic references	*1. Szenajch W., Napęd i sterowanie pneumatyczne, WNT, Warszawa 2014.* *2. Huścio T., Kulesza Z., Kuźmierowski T.; pod red. Siemieniako F., Napędy i sterowanie pneumatyczne, Wydawnictwa Politechniki Białostockiej, Białystok 2013.* *3. Koczara W., Wprowadzenie do napędu elektrycznego, Oficyna Wydawnicza Politechniki Warszawskiej, Warszawa, 2012.* *4. Łastowiecki J., Napędy elektryczne w automatyce i robotyce, Wydaw. Politechniki Świętokrzyskiej, Kielce, 2011.* *5. Tarnowski W., Kiczkowiak T., Kęska W., Ociepa Z., Napędy w urządzeniach mechatronicznych, Wydawnictwo uczelniane Politechniki Koszalińskiej, 2015.*
Supplementary references	*1. Kosmol J., Napędy Mechatroniczne, Wydawnictwo Politechniki Śląskiej, Gliwice, 2013.* *2. PN-ISO 1219-1:1994 – „Napędy i sterowania hydrauliczne i pneumatyczne – Symbole graficzne i schematy układów – Arkusz 1: Symbole graficzne" zgodne z normą ISO 1219-1:1991.* *3. PN-ISO 1219-2:1998 – „Napędy i sterowania hydrauliczne i pneumatyczne – Symbole graficzne i schematy układów – Arkusz 2: Schematy układów" zgodne z normą ISO 1219-2:1995.* *4. Iserman R., Mechatronic systems: Fundamentals (in English), Springer, New York 2005.* *5. Sieklucki G., Automatyka napędu, Wydawnictwa AGH Kraków 2009.*

Organisational unit conducting the course	*Department of Robotics and Mechatronics*	**Date of issuing the programme**
Author of the programme	*Rafał Grądzki, PhD, Eng*	*17.12.2021*

L – lecture, C – classes, LC – laboratory classes, P – project, SW – specialization workshop, FW - field work, S – seminar	