Projekt "Perspektywy Współpraca Synergia Zarządzanie w Tarnowie" współfinansowany jest przez Unię Europejską ze środków Europejskiego Funduszu Społecznego w ramach Programu Operacyjnego Wiedza Edukacja Rozwój. Projekt realizowany w ramach konkursu Narodowego Centrum Badań i Rozwoju z III Osi priorytetowej: Szkolnictwo wyższe dla gospodarki i rozwoju; Działanie 3.5 Kompleksowe programy szkół wyższych. Nr umowy o dofinansowanie projektu: POWR.03.05.00-00-Z087/17-00.

Module SYLLABUS

Organizational unit name	The Polytechnic Institute – Department of Electronics and Telecommunications		
Field of study	Electronics and Telecommunications		
Module name	Electronics in home appliances		
Module code	POWER.IP.10	**Erasmus code**	06.5
ECTS	3	**Module type**	Optional
Year of study	3	**Semester**	6

Form of classes	**Hours total**	**Form of assessment**
Project classes	30	Graded credit

Coordinator teacher	PhD Grzegorz Szerszeń		
Academic teacher	PhD Grzegorz Szerszeń		
Language of instruction	English		
Basic courses	No	**Open course / course at he another field of study**	No
Profile of education	Practical profile	**Study level**	First-cycle level

Prerequisites and additional requirements

- Basic knowledge about the design and properties of electronic circuits
- Basic knowledge of microprocessor systems
- Basic knowledge of electrical and electronic metrology
- Knowledge of operating systems and basics of using computers and CAD software.
- Basic knowledge of signal processing
- Very good knowledge of digital technology
- Knowledge of English to a degree that allows you to study professional literature.
- Knowledge of semiconductor devices, applications of analog electronic circuits.
- Basic knowledge of general mechanics

Learning outcomes for module

No.	**Student after module completion has the knowledge/knows how to/is able to Learning outcome code**	**Learning outcome type**	**Method of learning outcomes verification**	**Form of classes**
				Project

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1.	He knows the construction, properties, principles of operation and operation of electronic equipment for general use	Skills	Project documentation	Y
2.	Is able to obtain information from literature, databases, catalog sheets of producers and other properly selected sources also in English, can integrate the obtained information, make their interpretation, as well as draw conclusions and formulate and justify opinions	Knowledge Skills	Project implementation, making measurements in the laboratory	Y
3.	Is able to perform the requirements analysis, develop a project implementation schedule and prepare a complete technical documentation of the designed device.	Skills	Project, technical documentation	Y
4.	Can use mathematical models to design and analyze simple analog electronic circuits	Skills, project implementa-tion	Project	Y
5.	Is able to design, perform and test a simple electronic circuit, make its appropriate modifications and prepare a report on project work.	Skills	Project, making measurements in the laboratory	Y
6.	Is aware of the role and importance of knowledge in society, economy, companies and organizations.	Social competence	Project	Y

Didactic methods

Forms of classes:
Classes have a design form, within which individual projects of selected functional blocks used in general-purpose equipment are implemented. The element of the project is the stage of modeling the system and simulating its operation using selected computer tools (Multisim, Tina Ti, eDesign Suite ST). The final implementation is subject to simple electronic circuits that can be made in laboratory conditions using available measuring equipment. The completion of the project requires a public presentation of the results in English. Individual consultations and final project presentation.

Teaching methods:
Motivating to learn about the construction of selected electronic devices, and then systematically carrying out the subsequent stages of the project, brainstorming, the method of the project.

Rules of assessment

Passing the project. The grades are issued in accordance with the current regulations of studies at the State Higher Vocational School in Tarnow.

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Module content (brief)

I. Choice of topic and project assumptions
II. Requirements analysis, conceptual design
III. Completion of calculations and selection of elements
IV. Simulation and optimization
V. Execution of the electronic system
VI. Testing and modification
VII. Preparation of complete technical documentation

Module content (comprehensive)

I. Choice of topic and project assumptions

Selection of one of the prepared topics, taking into account the participant's possibilities and interests. Discussing the characteristics and parameters of a given electronic device for general use with which the project topic is related. Formulating basic assumptions about system parameters. Suggested topics for projects:

1. Class D audio power amplifier built in integrated and discrete technology.
2. Measuring pre-amplifier with galvanic isolation designed for cooperation with Pt100 temperature sensor in bridge system.
3. Low EMI / EMC Emission Switching Converter EASES ADAS Designs.
4. DC / DC converter with TPS40200.
5. Microprocessor battery charger Li-Pol, Li- Ion, NiCd and NiMH.

Additional topics:

6. Automatic humidity and temperature measurement system in the laundry drier.
7. Automatic Gain Control (AGC) and Automatic Voltage Control (AVC) in a modern radio receiver.
8. Digitaly Controlled Gain Stage Amplifier.
9. The controller of household appliances with FPGA.
10. LED driver with floating buck-boost converter (LED6001).
11. FM receiver with microprocessor-controlled frequency synthesis.
12. BLDC motor control in an example applications.
13. Microprocessor battery charger Li-Ion.
14. Remote Keyless Entry.
15. Internet of Things in application.

It is possible to implement the topics proposed by the participants of the classes or to modify the topics already existing. Fields of technology that can be taken into account are:

- Major appliances: Cooker hood, Cooking top, Dish washer, Oven, Refrigerator and freezer, Residential water heater and heating system, Washer and dryer.
- Small home appliances : Air purifier and humidifier, Coffee machine, Cordless vacuum cleaner, Mixer, blender and food processor, Residential and living fan
- Residential air conditioners
- Service robots: Vacuum robot, Robotic lawn mower
- Garden and power tools: Cordless handheld garden tool, Cordless power tool, Lawn mower, Mains powered tools
- Appliances system components: Appliances battery charger, Appliances pumps and fans, Appliances user interface and connectivity modules, Smart home remote control
- Building automation
- Automotive
- LED lamp and luminaires
- Lighting control

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II. Requirements analysis, conceptual design

Analysis of service documentation of selected home appliances, analysis of datasheets of integrated circuits, searching for alternative solutions, checking the availability of elements, determining the costs of performance and technological possibilities. Checking contemporary solutions of a given problem and literature reports. Developing a schedule of activities and project implementation concepts. The choice of programming environment and hardware platform and type of power supply. Elaboration of block and ide block diagrams of the electronic system together with the operation algorithm (if present).

III. Completion of calculations and selection of elements

Calculation of the value of elements and electrical parameters of the system based on documentation of integrated circuits and the literature of the subject. Performing the analysis of the system's impact on the environment (disturbances). Selection of electronic components, housing, cooling system, power supply and protection circuits against damage (ESD). Use powerful WEBENCH design tools (Texas Instruments) to create custom circuits. These easy-to-use tools deliver customized power, lighting, filtering, clocking and sensing designs in seconds.

IV. Simulation and optimization

Simulation of the system operation using the selected software (ex. Multisim, SPICE, TinaTI, Design suite ST, Analog Design). If necessary, development of own libraries and element models. Performing basic tests and analyzes. Comparison of the results obtained with the design assumptions. Introduction of necessary system modifications and searching for optimal solutions. Use of ready-made test systems (development boards) if present (ex. ELVIS, ASLAb Kit Pro, Arduino, Raspberry Pi, Spartan FPGA).

V. Execution of the electronic system

Design and manufacture of printed circuit boards (PCBs) taking into account the IC manufacturer's suggestions, proper mass distribution for digital and analog circuits, assembly of electronic components with safety conditions (ESD), housing design if possible, planning and execution of shielding, cable routing. In systems that require heat dissipation or the design of a cooling system. Checking the correctness of assembly and conducting a trial run. If the design of the system uses a ready test platform, then the PCB design stage should be omitted and the remaining issues should be focused on.

VI. Testing and modification

Specify the conditions under which the system will be tested and which parameters will be checked. Due to the variety of projects carried out individually, the measuring system should be planned (load, control signals, supply voltage, temperature, measuring equipment, etc.). Take into account the resistance of the system to changes in environmental parameters (temperature, humidity, vibrations, etc.). In the case of power systems, it is necessary to develop characteristics of voltage changes as a function of load.

VII. Preparation of complete technical documentation

Preparation of a complete technical documentation of the project using the adopted conventions, including standards applicable when preparing reports on laboratory exercises. Each stage of the project implementation should be documented (description, diagrams, photos, code fragments). Preparation of the presentation in English and a public performance.

Recommended literature and teaching resources

- Leśniewicz M.: Domowe systemy audio. Wydawnictwo BTC, Warszawa, 2014.
- Gołaszewski J.: Wzmacniacze audio. Poradnik konstruktora. Wydawnictwo BTC, Warszawa, 2008.
- Hadam P.: Projektowanie systemów mikroprocesorowych, Wydawnictwo BTC, Warszawa, 2004.
- Butrym W.: Dźwięk cyfrowy. Systemy wielokanałowe. Wiedzieć więcej, WKiŁ, Warszawa, 2004.
- Nawrocki Z.: Wzmacniacze operacyjne i przetworniki pomiarowe, Oficyna Wydawnicza Politechniki Wrocławskiej, Wrocław 2008.
- Fryśkowski B., Grzejszczyk E.: Systemy transmisji danych. WKŁ Warszawa 2010.
- Boxall J.: Arduino. 65 praktycznych projektow. Helion, Gliwice, 2013

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- Bogusz J.: Lokalne interfejsy szeregowe w systemach cyfrowych. Wydawnictwo BTC, Warszawa, 2004.
- Kałużny P.: Telewizyjne systemy dozorowe. Wydawnictwo Komunikacji i Łączności, Warszawa 2008.
- Frei M.: Samochodowe magistrale danych w praktyce warsztatowej, WKŁ, Warszawa 2016.
- Klugmann-Radziemska E.: Fotowoltaika w teorii i praktyce, Wydawnictwo BTC, Warszawa 2010
- Norris D.: Raspberry Pi Projects for the Evil Genius, Helion, Warszawa 2014
- Nawrocki W.: Rozproszone systemy pomiarowe, WKŁ, Warszawa 2006
- Kitchin C, Counts L., A designer's guide to instrumentation amplifiers 3RD Edition, Analog Devices , 2006.
- Producers' websites
- http://www.ti.com/applications/industrial/appliances/overview.html

Connection with area of study	engineering sciences
Student workload (ECTS credits balance)	
Student workload form	Student workload[hours]
Participation in Project classes	30
Completion of a project	35
Individual consultations and final project presentation	10
Summary student workload	75
Module ECTS credits	
Workload of the direct assistance of the academic teacher	**1.6**
Workload of the practical classes	**3**

Annotation:
1 hour = 45 minutes