

PROBLEM OF PREPARING STUDENTS TO STUDY IN THE FIELD OF "MANAGEMENT AND PRODUCTION ENGINEERING" IN THE FIELD OF BASIC TECHNICAL KNOWLEDGE - CASE STUDY

12.1 INTRODUCTION

In contemporary world, the meanings and significance of technologies is growing up very quickly. Of course, a varying in time intensity of the development of technical environment of human society was observed through all the history of presence of our species on the Earth. The specialists have noted a number of technical revolutions: now we are in the fourth approach to the phenomenon of these type (named "Industry 4.0").

This is the evident demand addressed to the society of a time of "technical revolution": to be well prepared to absorb fully and effectively the results of developing technologies: products, services, processes. But – apart of such a general demand – the society needs also specialists, responsible for recognizing needs, designing and manufacturing technical units/systems, and also for being able to supervise the using of the technical means in every-day practice.

The education of such specialists is an obvious role of dedicated institutions: universities of technologies. However, both from the experience of the authors of this article and from the knowledge and experience described in many available resources, it is evident that the responsibility of a technical university for the proper development of the knowledge and competencies of a future engineer should be linked to the assessment of the preparation for the technical studies of these young people who apply for admission to such studies. It was an intention of authors of this paper to present – in the above presented context – their experience in raising awareness of a young person who has received general education in general (which does not cover the problems of modern technology and technology), and will be contacted in the course of engineering studies.

This is – in the assumption of creators of the program of studies in the Faculty of Organization and Management, Silesian University of Technology - a role to be played by the subject of studies "Introduction to technology". Next parts of this paper show a general review of this subject, particular assumptions of carrying on lectures and laboratory and some experiences connected with both problems of recognizing the "initial" preparation

of young students to understand and study technical subjects and, last but not least, problems of evaluating the progress of students according to adopted rules.

12.2 GENERAL ASSUMPTIONS TO THE „INTRODUCTION TO TECHNOLOGY” AS THE MATTER OF TEACHING

The contents of this paper are based on the document “Course description” which has been developed by authors of the paper for the subject "Introduction to technology" and is now an element of program of teaching in the field of “Management and Production Engineering”, offered by the Faculty of Organization and Management, Silesian University of Technology for English-speaking students [1, 7]. The general information about the scope of teaching in this subject is presented in Tab. 12.1.

Tab. 12.1 General information about the subject “Introduction to technology”

4. Level of studies: First-cycle studies				
9. Semester: 1				
12. Course classification: Common/ Specialization courses				
13. Course status: Compulsory /Elective				
15. Pre-requisite qualifications: Physics, mathematics, technical subjects taught in high school				
16. Course objectives: Delivering structured knowledge of human creative activity in the area of technical means. Understand the construction and operation of simple machine systems and general issues related to construction materials, manufacturing techniques and operation of machines and equipment. Get acquainted with the core issues of product and technology innovation. Understanding the basic issues related to the environmental, economic and social effects of using technical means. Acquiring skills to acquire information from various sources, integrating and interpreting the information obtained, and concluding on topics related to human technical activities.				
18. Teaching modes and hours				
Lecture	Classes	Laboratory	Project	Seminar
30		15		
20. Examination: no				
23. Total workload required to achieve learning outcomes				
Lp.	Teaching mode:	Contact hours / Student workload hours		
1	Lecture	30/60		
2	Classes			
3	Laboratory	15/75		
4	Project			
5	BA/ MA Seminar			
6	Other			
	Total number of hours	45/135		
24. Total hours:				180
25. Number of ECTS:				6
26. Number of ECTS credits allocated for contact hours:				1,5
27. Number of ECTS credits allocated for in-practice hours (laboratory classes, projects):				3

Source: own elaboration

12.3 THE THEMATIC SCOPE AND THE WAY OF DELIVERING THE LECTURE ON THE SUBJECT "INTRODUCTION TO TECHNOLOGY"

The general scope of the lectures given in the framework of subject "Introduction to technology" is presented in the part of the syllabus description dedicated for Lecture. The detailed description introduces the following categories of problems as the contents of successive lectures:

1. Introduction. Basic concepts and terms. Selected issues in the philosophy of technique and the history of technical/technological development. Definition of creativity. Process of meeting needs. Technical accuracy and ability to meet needs.
2. Construction and operation of technical equipment. Complexity of technical equipment. Hierarchical structure of technical means - assembly, subassembly, element. Relationship man - machine. Properties and properties of technical means. Structural design features.
3. Geometric design feature. Rules of projection. Basic problems of construction documentation, structure of construction documentation. Support systems for the construction of machinery and equipment. Investigations in processes of designing.
4. Material design feature. Types of construction materials. Properties of materials and their application. Basic principles of selection of construction materials.
5. Techniques of manufacturing. Basic manufacturing technologies. Features of basic manufacturing techniques - significant differences between them. Production systems. Fundamentals of organization and production management.
6. Exploitation of machinery and technical equipment. Basic concepts and terms of exploitation and maintenance of machinery. Use, maintenance and repair of technical equipment. Monitoring and condition diagnosing of machines. Supporting systems for maintenance management.
7. Fundamentals of Production Engineering. Basic tasks of production engineering. Means and methods used in production engineering. Innovation and management of product and process innovations.
8. Non-technical aspects of the use of technical systems and technologies. Selected issues of environmental protection. Philosophy of "sustainable development". Issues related to the assessment of the social and technological impact of products and technologies ("Technology Assessment").

The presented above contents of the lecture – on the one hand – are dedicated to give the students of first semester a general review of the problems which form the general framework of engineering. On the other hand, it is often stated by the lecturer that student who begins the education in the university of technology doesn't understand the fundamental terms (like for instance the term "Engineering"). In really frequent cases the student is not able to answer the questions like:

- "Why do you decide to study just in the Engineering?" or
- "What are your expectations concerning being the engineer after your studies?"

So that, it has been assumed by authors of presented in this paper curricula of the subject "Introduction to technology" to focus rather on showing students some manner of thinking about contemporary sense of the term "technology" than to give them practical and detailed knowledge in "classic" subjects which are included in programs of studied in further semesters.

The target formulated as above has been tried to obtain in two variants of performing the discussed subject of studies. Firstly, it should be mentioned here the variant concerning the subject "Introduction to technology" in the direction of studies named "Management and Production Engineering". The curricula in this case cover the lecture together with a laboratory, which offer relatively comfortable situation due to forming personal competencies of every individual student. The concept of laboratory classes is presented in the next part of this paper.

Secondly, the presented subject is present in the direction of studies named "Logistics" as the monographic lecture. In this case, the lecturer tries to obtain an individualization of treating individual students by giving them a possibility to express their "technical" interests and thinking about contemporary engineering in the form of a final work. The structure of this work is common for all the students. They are obliged:

- to present a chosen by them case of existing in contemporary (or being developed) product or technology,
- to show a historical view on technological development which has carried to actual state of the product/technology,
- to present (very briefly) how the product is manufactured or what are the key elements of the technology,
- to introduce present and future impact of the chosen product/technology on society.

Some more details concerning the manner of evaluating such final works are presented in the subchapter 12.5.1.

12.4 THE CONCEPT OF LABORATORY CLASSES

The general scope of the laboratories given in the framework of subject "Introduction to technology" is presented in the part of the syllabus description dedicated for Laboratory. The detailed description introduces the following rules for carrying on successive lessons (meetings with the teacher):

1. Student prepares an essay about a chosen technical mean. The essay should consist of the following elements:
 - a description of the technical mean,
 - a beginning and a history of the technical mean,
 - a description of how the technical mean works,
 - an assessment of the technical mean (advantages and disadvantages of the technical mean),
 - a perspective of a development/a future of the technical mean (students' creativity and own work).

2. Student prepares an oral presentation about a chosen technical mean which was a subject of the essay. He or she makes the presentation in front of the group.
3. Students, working in groups, prepare presentations on the subjects developed by the academic. The topics referred to elements of a process of meeting needs, technical system, design, constructing, exploitation, utilization and other issues linked with the basis of a technology.

Laboratory classes provide a good chance for students to present their activities. While students gain knowledge and broaden horizons in the range of technology at lectures, laboratory classes have a different form. Students show their own work, engagement and creativity. "Introduction to technology" laboratory helps them to perceive technology from different perspectives. Students could approach some technology issues in individual ways based on their own ideas. At the same time, they cooperate with other students in groups and learn how to work with each other. Laboratory classes teach students to think like engineers and see technological problems from different points of view. These classes foster an ability to integrate fragments of knowledge into one coherent whole. They combine knowledge, practice, skills, experience and motivation. Students learn how to work in teams, organize work and time, share ideas and solve some technological problems. Moreover, laboratory classes teach patience, accuracy, involvement, responsibility and communication.

Laboratory classes consist of three elements that influence technological thinking and help to develop knowledge, creativity, imagination and different kinds of competence. Firstly, student prepares an essay about a chosen technical mean. This task demands individual work. Students develop their essays on their own. Naturally, students can, and even should, consult the work with the teacher. The first thing, which is done by students, is to choose a topic. The topic refers to the technical mean that will be the subject of the work. Students report their topics to the teacher and after acceptance write according to the drafts made by the teacher. The essay should consist of five main elements. First thing is a description of the technical mean. This point includes an overall characteristic of the chosen technical mean, its properties, features, use, types and other important issues. The second element describes a beginning and a history. It should present by whom, when, why and how the particular technical mean was invented, as well as the circumstances and causes. Then students describe the history of the technical mean which describes changes during the time and the steps of development. It relates to the different kinds of changes in size, use, production way, application, utilization, technology, costs, destination, function and so on. The third point of the essay emphasizes the technology. It is a description of how the technical mean works. Students get to know and write the technological side of the chosen mean. In this part, figures, schemes and sections are welcome. The next element refers to a technology assessment. This point includes evaluation of the technical mean. Students should consider advantages, positive issues, good impact as well as disadvantages, negative effects, actual and potential problems and dangers that the mean can cause. This part demands not only an overall point of view but also very detailed analysis of different sides of the technical mean. It stimulates imagination, rational thinking

and awareness regarding engineering. It helps students to become aware of the responsibility for inventing and producing the technical means. It also teaches that an engineer should be good at predicting, noticing and observing. Students could present their thoughts, considerations, ideas, remarks, comments and observations about the technical mean and technology in general. The goal of this assessment is to understand the impact of production engineering on different spheres of human life. The environmental issue is very important in this point of the essay. Thanks to considering the negative influence, students also build an attitude of social responsibility. Students notice that every invention not only eases human life but also always has a negative impact on, for instance, health or environment. Finally, the last element includes a perspective on the technical mean's development. It provokes students' creativity and own work. They must think over and describe the future of the mean, so they should use their imagination and knowledge. Based on the previous point of the essay, they should be able to predict, make up or create the coming changes. The essay should have a short summary. The essay is a major work so students have some time for preparation. Naturally, students should inform the teacher about ideas and progress while working on the essay. Therefore, consultation with the tutor plays a significant role in this process.

The second element of the laboratory classes is an oral presentation on the chosen technical mean which was also the subject of the previously discussed essay. This presentation is made in front of the class so each student becomes the teacher of the other students. Their task is to make students interested in the subject of the essay and learn about the very technical mean. The presentation does not have to include all the elements which were in the written essay. The most important is to make the presentation interesting, scientific and engrossing. It is worth emphasizing that while teaching other students, each student learns as well. It could also be said that students become experts of the chosen technical means. To make a good and clear presentation, firstly, students must be knowledgeable on their subject. It is a very good way of gaining and transferring knowledge. Due to the fact that the "Introduction to technology" laboratory classes originally took place at the Faculty of Organization and Management of the Silesian University of Technology in Poland, the basic language was Polish. However, to internationalize the process and develop students linguistically it was made so the previously mentioned oral presentations could be done in English. Naturally, it was not required but optional for those who would like to try their hand at overcoming the language barrier. Because of the fact that English becomes more and more commonly used worldwide, creating the opportunity to make the first scientific presentation in English during the first year of studies seems to be a good solution.

The last but not least element is related to working in groups. Students divided into pairs or bigger groups prepare presentations on subjects developed by the academic. The topics include base problems and terms connected with technology. They referred to elements of a process of meeting needs, technical systems, designs, construction, exploitation, utilization and other issues linked with the basis of a technology. The presentation

should be multimedia and should consist of definitions, background, descriptions, divisions and examples referring to actual issues. Discussion questions are required at the end of the presentation. This point of presentation is particularly interesting because it encourages and engages students to make their points. It makes them active and provokes them to think. Students not only show their thoughts and ideas about some technological problem but also shape their opinions based on the other students' and the academic's points of view. What is more, discussions integrate, enrich, teach and help students to get to know each other.

To sum up, "Introduction to technology" laboratory classes include writing the essay, and making the oral and multimedia presentations. These three elements approach the technology in three different ways. It combines individual work and cooperation with others. It is worth emphasizing that it is crucial to teach both, individual and group work. These abilities will help students not only during the studies but also in their future work.

12.5 EVALUATION OF THE LEARNING RESULTS

In the Tab. 12.2 a part of the "Course description" for the subject "Introduction to technology" is presented which specifies expected learning outcomes in this subject, considering the outcomes for the lecture and for the laboratory.

It is worth in this point to make some comments about a practical experience in getting and evaluating these outcomes.

12.5.1 Discussion of learning results in lectures

As mentioned above, the subject "Introduction to technology" is currently being implemented in a slightly different way on two directions of study. For the course "Management and Production Engineering" the basis for obtaining a semester's credit is to pass laboratory classes and to be active during lectures.

The evaluation of learning results for the course "Logistics" bases on the mentioned above, individualized final works. After two years of experiences it can be stated, that such a solution is quite effective.

Of course, some students are approaching this task according to the "minimum effort, maximum effect" rule. However, in the vast majority of cases, the formulation of individual final work allows - above all - students to have a proper view of contemporary meaning of technology and engineering. In addition, many of the competences included in the "Learning outcomes" are clearly shown in the final work. Many students present products and technologies related to their individual hobbies in this work, which also corresponds to the subject matter of the "Introduction to technology".

12.5.2 Discussion of learning results in laboratory

All the described elements including an essay, a multimedia and an oral presentation have a great impact on students' development. Thanks to working on the essay, students became experts on their topics. It means that students gained knowledge about particular technical means. Then, they taught the other students about the technical means by making presentations. Therefore, students exchanged their knowledge and opinions.

Tab. 12.2 Learning outcomes for the subject "Introduction to technology"

17. Description of learning outcomes:				
No	Learning outcomes description	Method of assessment	Teaching methods	Learning outcomes reference code
1	Knows the basic principles of construction and operation of simple technical systems	Written final work	Lecture (discussion)	ROZ_ZIP1A_W10
2	Has organized knowledge of the construction and operation of machinery and technological equipment. Has organized technical knowledge in the design of technical systems	Written final work	Lecture (discussion, examples)	ROZ_ZIP1A_W11 ROZ_ZIP1A_W12
3	Has a structured and theoretical knowledge of manufacturing techniques and production systems. Has basic knowledge of the life cycle of equipment, facilities and technical systems	Written final work	Lecture (discussion, examples)	ROZ_ZIP1A_W15 ROZ_ZIP1A_W18
4	Can acquire information from literature, databases and other properly selected sources, in English as well as in another foreign language recognized as the international communication language in the field of management and production engineering; can integrate the information obtained, interpret it, draw conclusions, formulate and justify opinions. Is able to communicate using a variety of techniques in a professional environment and in other environments	Written final work, test (written)	Lecture (discussion, examples), lab	ROZ_ZIP1A_U08 ROZ_ZIP1A_U09
5.	Can prepare technical documentation and oral presentations in the English and foreign languages on management and production engineering issues. Has the ability to self-education	Test (written)	Lab	ROZ_ZIP1A_U10 ROZ_ZIP1A_U11
6	Can analyze the life cycle of an object and use tools to support the processes of operating machinery and equipment in an enterprise. Is capable of critically analyzing and evaluating technical and production systems based on technical solutions, in particular devices, facilities, systems, production processes and services, taking into account economic aspects	Test (written)	Lab	ROZ_ZIP1A_U16 ROZ_ZIP1A_U19
7	Is able to identify and formulate a specification of simple engineering tasks of a practical nature in the field of production engineering	Test (written)	Lab	ROZ_ZIP1A_U20
8	Understand the need for lifelong learning, primarily to improve your professional and personal skills. Is aware of the role of social technical college graduate, and especially understands the need to formulate and communicate to the public - among others. Through the mass media - information and opinions on the achievements of the technique and other aspects of the engineer's activity; endeavors to convey such information and opinions in a generally understandable manner.	Participation in classes	Lecture (discussion, examples), lab	ROZ_ZIP1A_K01 ROZ_ZIP1A_K06
9	Is aware of the importance and understanding of the non-technical aspects and effects of the engineering activity, including its environmental impact, and the resulting responsibility for the decisions	Written final work,	Lecture (discussion, examples), lab	ROZ_ZIP1A_K02

Source: own elaboration

Thanks to the multimedia presentations students learned a lot about the basic terms and issues of technology. At the end of every presentation, there were discussion questions. In fact, most of the time, the discussions seemed to last longer than the main parts

of presentations. It was the discussions that aroused the greatest emotions. Students were very active, open and willing to present their points of view. They presented their opinions and even concerns about some technological matters. On the one hand, the presenters prepared very clever and significant questions for future engineers. On the other hand, the students reacted very well, answered the questions very actively and also asked new questions. They pointed out many important problems with technology, especially influence of the technology on human social life. For example, automatization, social media, technological barriers, utilization, environmental protection, mechanization and other issues were discussed. They were all highly thought-provoking. It appears that young people are aware of potentially negative influence of technology, especially the innovative ones. They use modern technology but at the same time they realize, observe and see the dangers linked with it. This is optimistic news, considering that they are going to be future engineers who will create our world.

The form of the laboratory is linked with expected learning outcomes. Thanks to the essays, presentations, discussions and conversations, students are expected to gain knowledge and new skills which are discussed below. Firstly, students are able to obtain information from different kinds of sources, like literature, databases, programs, interviews and other kinds in the field of management and production engineering. It refers to information given in Polish, English as well as in another foreign language recognized as the international communication language. Moreover, students can integrate and interpret information, draw conclusions, formulate and justify opinions. They use a variety of techniques in a professional environment and in other environments while communicating. Another ability is to prepare technical documentation. Students also are capable of making oral presentations in English, or other foreign languages, on management and production engineering issues and self-educating. What is more, they know how to analyze the life cycle of an object and use tools to support the machinery operation in an enterprise. Additionally, to analyze and evaluate technological and production systems based on devices, systems, production processes and services. Students also learn how to formulate a specification of simple engineering tasks on production engineering. Another very important issue is to understand that lifelong learning process is crucial to improve students' professional and personal skills. Students are taught to be aware of the role of social technical college graduation and communication to the public. They learn how to cooperate, work in a team and communicate inside and outside the group. Thanks to presentations, they are able to convey information and opinions on the technology achievements and other aspects of the engineer's activity in an understandable way. What is more, students become more aware of the importance and understanding of the non-technical issues of the engineering activities and responsibility for the decisions. The activities include, for example, the environment, health and social sphere. All the expected learning outcomes are evaluated by the teacher during the semester, and they affect the final grade.

The concept of laboratory "Introduction to technology" appears to be favorable. All elements – made up of an essay, an oral presentation and a multimedia presentation – contributed to development and learning of students. The form of the classes allowed for

seeing technology from different perspectives and gaining knowledge and abilities. It developed creativity, engineering thinking, as well as the ability to assess technology. Students learned not only the basis of technology but, they also become familiar with positive and negative consequences of inventing.

CONCLUSIONS

In the opinion of authors of this paper, the problem of teaching students in XXI century is much wider than the aspects show here in the context of students of first semester of engineering studies as presented above. The role of technology in contemporary world, especially in the aspect of “explosive growth” in last decades (it is often said that we are now in the fourth “technical revolution”) implies also a necessity of a new look at not only “purely technical” context of the above statement. It is also well-seen in the contemporary science: we can observe a quickly development of new areas of research, like a general problem of technical innovations [4], the research on an impact of new/innovative products and/or technologies on society (named “Technology Assessment”: [5, 6] or the new meaning of the term “needs”, not only in engineering activities [2, 3].

It seems that the problem of educating students of engineering studies in the manner referring to current challenges is wider. It is evidently necessary to include the new ideas and results of new (interdisciplinary) research to curricula on faculties of engineering. But, taking into consideration the appearing social contexts of the “New Engineering”, it would be also worth to be consider the creation/enlargement the technological component in educating students of non-technical faculties, too. Perhaps it is a time to start with a debate concerning such a need (necessity?).

ACKNOWLEDGEMENTS

This article was created as part of statutory work 13/030/BK_17/0027 conducted at the Institute of Production Engineering at the Faculty of Organisation and Management of the Silesian University of Technology.

REFERENCES

1. *Apply.PolSl*. Pobrano z: <https://apply.polsl.pl/> [Dostęp: 14.04.2017].
2. J. Kaźmierczak. „Engineering of Needs (EoN): The Role of Identifying and Analyzing Needs in Engineering and Engineering Management.” *2016 3rd International Conference on Social Sciences (ICSS)*, 2016, p. 905 – 914.
3. J. Kaźmierczak. „Inżynier XXI wieku w wymiarze nie tylko technicznym.” *Organizacja i Zarządzanie: kwartalnik naukowy*, 2016, p. 181 – 194.
4. J. Kaźmierczak. „Technology Assessment: Educational Challenge,” *Innowacje w Zarządzaniu i Inżynierii Produkcji*, R. Knosala (red.). tom II, Opole: Oficyna Wydawnicza Polskiego Towarzystwa Zarządzania Produkcją, 2014, p. 949 – 955, ISBN 978-83-930399-6-8.

5. J. Kaźmierczak. „Technology Assessment” jako przykład nowego wyzwania w kształceniu inżynierów: analiza potrzeb i propozycje rozwiązań.” *General and Professional Education Journal*, 2/2015, p. 18 – 27.
6. J. Kaźmierczak. „Zagadnienia interdyscyplinarne w programie studiów na kierunku „Zarządzanie i Inżynieria Produkcji”, R. Knosala (red.). *Innowacje w Zarządzaniu i Inżynierii Produkcji*, tom II, Opole: Oficyna Wydawnicza Polskiego Towarzystwa Zarządzania Produkcją, 2015, s. 877.
7. *Outgoing.PolSl*. Pobrano z: <https://outgoing.polsl.pl/institutions/departments/id/-3#pages> [Dostęp: 01.06.2017].

PROBLEM OF PREPARING STUDENTS TO STUDY IN THE FIELD OF "MANAGEMENT AND PRODUCTION ENGINEERING" IN THE FIELD OF BASIC TECHNICAL KNOWLEDGE: A CASE STUDY

Abstract: *The subject of this article is to indicate the problems of preparing the first year of the first-degree students for studying in "Management and Production Engineering", especially in the field of basic technical knowledge and "technical" thinking. The experiences and thoughts of authors, referred to the mentioned problem, as well as proposed teaching methods and evaluation measures are presented in the article on the example of a particular subject of studies, implemented at the Faculty of Organization and Management of the Silesian University of Technology, which is named as "Introduction to technology". The introductory part of the article shows the conditions and premises that were the starting point for the development of the above-mentioned program. Next, the second chapter, presents the content of the course and the rules of the student's credit for the subject matter covered by the lectures. Chapter 3 discusses the concept and manner of implementing in the design classes provided for in the program of the subject. Chapter 4 is a collection of practical observations and conclusions, related to conducting both lectures and laboratory classes and student credit. The proposals formulated in the summaries concern, in particular, the preparation of didactic materials for the area of education discussed in the article, but also the needs and possibilities of using the experiences presented in the article, also in the education of non-technical students.*

Key words: *preparation of students, technical studies, modern engineering education*

PROBLEM PRZYGOTOWANIA STUDENTÓW DO STUDIÓW NA KIERUNKU „ZARZĄDZANIE I INŻYNIERIA PRODUKCJI” W ZAKRESIE PODSTAWOWEJ WIEDZY TECHNICZNEJ: STUDIUM PRZYPADKU

Streszczenie: *Przedmiotem niniejszego artykułu jest wskazanie problematyki przygotowania studentów pierwszego roku pierwszego stopnia studiów na kierunku „Zarządzanie i Inżynieria Produkcji”, zwłaszcza w zakresie podstawowej wiedzy technicznej oraz myślenia „technicznego”. Problem oraz proponowane środki i sposoby jego rozwiązania przedstawiono w artykule na przykładzie szczególnego przedmiotu, realizowanego na Wydziale Organizacji i Zarządzania Politechniki Śląskiej, którym jest „Wprowadzenie do techniki”. W części wprowadzającej artykułu pokazano uwarunkowania i przesłanki, które były punktem wyjścia dla opracowania programu ww. przedmiotu. W kolejnym, drugim rozdziale przedstawiono treści kształcenia oraz zasady zaliczania przez studentów przedmiotu w zakresie objętych wykładami. W rozdziale 3 omówiono koncepcję oraz sposób jej realizacji w zajęciach projektowych, przewidzianych w programie omawianego przedmiotu. Roz-*

dział 4 to zbiór obserwacji, związany z prowadzeniem zarówno wykładów jak i zajęć laboratoryjnych oraz zaliczaniem przez studentów tych zajęć. Sformułowane w podsumowaniu propozycje dotyczą zwłaszcza przygotowania materiałów dydaktycznych do omawianego w artykule obszaru kształcenia, ale także – potrzeb i możliwości wykorzystania doświadczeń przedstawionych w artykule w kształceniu studentów na kierunkach nietechnicznych.

Słowa kluczowe: *przygotowanie studentów, studia techniczne, nowoczesne kształcenie inżynierskie*

Prof. dr hab. Inż. Jan KAŻMIERCZAK
Politechnika Śląska
Wydział Organizacji i Zarządzania
Instytut Inżynierii Produkcji
ul. Roosevelta 26-28, 41-800 Zabrze
e-mail: Jan.Kazmierczak@polsl.pl

Mgr Kinga STECUŁA
Politechnika Śląska
Wydział Organizacji i Zarządzania
Instytut Inżynierii Produkcji
ul. Roosevelta 26-28, 41-800 Zabrze
e-mail: Kinga.Stecula@polsl.pl

Data przesłania artykułu do Redakcji: 24.06.2017
Data akceptacji artykułu przez Redakcję: 31.07.2017