STUDIJŲ KOKYBĖS VERTINIMO CENTRAS

KAUNO TECHNOLOGIJOS UNIVERSITETO STUDIJŲ PROGRAMOS *MECHANIKOS INŽINERIJA (valstybinis kodas – 612H30001)* VERTINIMO IŠVADOS

EVALUATION REPORT OF *MECHANICAL ENGINEERING* (*state code – 612H30001*) STUDY PROGRAMME at KAUNAS UNIVERSITY OF TECHNOLOGY

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Išvados parengtos anglų kalba
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2015

DUOMENYS APIE ĮVERTINTĄ PROGRAMĄ

Studijų programos pavadinimas	***Mechanikos inžinerija***
Valstybinis kodas	612H30001
Studijų sritis	Technologijos mokslai
Studijų kryptis	Mechanikos inžinerija
Studijų programos rūšis	Universitetinės studijos
Studijų pakopa	pirmoji
Studijų forma (trukmė metais)	nuolatinė (4), ištęstinė (6)
Studijų programos apimtis kreditais	240
Suteikiamas laipsnis ir (ar) profesinė kvalifikacija	Mechanikos inžinerijos bakalauro laipsnis
Studijų programos įregistravimo data	2007-02-19

INFORMATION ON EVALUATED STUDY PROGRAMME

Title of the study programme	***Mechanical Engineering***
State code	612H30001
Study area	Technology Sciences
Study field	Mechanical Engineering
Type of the study programme	University studies
Study cycle	First
Study mode (length in years)	Full-time (4), part-time (6)
Volume of the study programme in credits	240
Degree and (or) professional qualifications awarded	Bachelor in Mechanics Engineering
Date of registration of the study programme	19-02-2007

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I. INTRODUCTION

1.1. Background of the evaluation process

The evaluation of on-going study programmes is based on the **Methodology for evaluation of Higher Education study programmes,** approved by Order No 1-01-162 of 20 December 2010 of the Director of the Centre for Quality Assessment in Higher Education (hereafter – SKVC).

The evaluation is intended to help higher education institutions to constantly improve their study programmes and to inform the public about the quality of studies.

The evaluation process consists of the main following stages: *1) self-evaluation and self-evaluation report prepared by Higher Education Institution (hereafter – HEI); 2) visit of the review team at the higher education institution; 3) production of the evaluation report by the review team and its publication; 4) follow-up activities.*

On the basis of external evaluation report of the study programme SKVC takes a decision to accredit study programme either for 6 years or for 3 years. If the programme evaluation is negative such a programme is not accredited.

The programme is **accredited for 6 years** if all evaluation areas are evaluated as "very good" (4 points) or "good" (3 points).

The programme is **accredited for 3 years** if none of the areas was evaluated as "unsatisfactory" (1 point) and at least one evaluation area was evaluated as "satisfactory" (2 points).

The programme **is not accredited** if at least one of evaluation areas was evaluated as "unsatisfactory" (1 point).

1.2. General

The Application documentation submitted by the HEI follows the outline recommended by the SKVC.

1.3. Background of the HEI/Faculty/Study field/ Additional information

Kaunas University of Technology (KTU) was established in 1920 and is one of the largest technical universities in the Baltic countries. It consists of 9 faculties, 10 research institutes, a library and departments of administration and support. The university is offering 156 study programmes covering all three levels for more than 10 000 students and has about 1000 academic staff members. The vision of the university is "To be a leading European university with knowledge and technology development and transfer-based activities". The university is

integrated into the world's academic and research communities and is a member of the major European higher education organizations such as European University Association (EUA) and European Society for Engineering Education (SEFI).

The first cycle programme (BA) in Mechanical Engineering was created in 1992 and is carried out at the Faculty of Mechanical Engineering and Design at KTU where Department of Mechanical Engineering is responsible for the programme. The study programme and the study environment are updated continuously accordingly to a continuous development philosophy. The curriculum was last updated in 2014.

The present evaluation is the second one for the programme. The first evaluation was carried out in 2007-2008 with a Lithuanian evaluation team. Although, the programme was then accredited for the maximum period of six years the evaluation team made several recommendations. These recommendations have been taken into account, but the programme would benefit from continuing to work along the same lines.

The self-evaluation report (SER) for the present evaluation was carried out by a self-evaluation team appointed by the order of the Rector. The self-evaluation group consisted of the five professors, one student and one social partner and was headed by the programme manager.

1.4. The Review Team

The review team was completed according *Description of experts' recruitment*, approved by order No. 1-01-151 of Acting Director of the Centre for Quality Assessment in Higher Education. The Review Visit to HEI was conducted by the team on *24th February 2015.*

1. **Prof. dr. Olav Aarna (team leader),** *Adviser to the Management Board of the Estonian Qualifications Authority, Vice-Rector for Research at Estonian Business School, Estonia.*
2. **Prof. dr. Hartmut Ulrich,** *Professor for Mechatronics and Fluid Power Technology, Institute for Mechanical Engineering, University of Applied Sciences Ruhrwest, Germany.*
3. **Prof. dr. Jolanta Janutėnienė,** *Head of the Department. of Mechanical Engineering, Faculty of Sea Mechanics, Klaipėda University, Lithuania.*
4. **Prof. dr. Mikael Enelund,** *Professor at the Department of Applied Mechanics, Chalmers University of Technology, Sweden.*
5. **Dr. Vaidas Liesionis,** *Marketing Director at Machinery plant "Astra" AB, Lithuania.*
6. **Mr. Eduardas Gvozdas,** *student of Vilnius University study programmes Laser Physics and Optical Technologies, International Business Economics and Management*.

Evaluation coordinator Ms. Natalja Bogdanova

II. PROGRAMME ANALYSIS

2.1. Programme aims and learning outcomes

The Bachelor's programme in Mechanical Engineering (ME) has strong links to the needs of the regional industry with activities in engineering design, manufacturing and production. The employability of the graduates is evidenced to be very high. The employers are very satisfied with the graduates and unanimously stated that the graduates from KTU are better prepared for engineering work in industry compared to the graduates from other first cycle ME programmes in Lithuania. The employers also expressed the need of substantially more graduates from the KTU ME programme.

The main aim of the programme is "to provide fundamental knowledge in mechanical engineering, develop abilities, skills and competencies necessary to function effectively in developing products, components and technologies of mechanical nature, carry out research and management tasks, perform control, exploitation of mechanical systems and develop abilities to communicate and cooperate with professionals and non-professionals" (SER p.7, item 23). This is consistent with the name as well as with the vision to be a modern mechanical engineering programme. The aim might be considered to be on a rather high level for a first cycle programme in that it states that the graduates shall be able to carry out research. The aim is consistent with the more detailed aims and the inherent meaning of the learning outcomes (LOs).

The detailed aims of the programme and the inherent purpose of the LOs are in lines with national standards and the EUR-ACE requirements for the first cycle engineering degrees and thus established to the international standards. The LOs have been contextualized, decomposed and specialized to the selected branch of ME namely the design of mechanical products and processes by applying computer aided means (SER p.6).

However, the programme LOs (SER, p.8-9) are not sufficiently well formulated. They are too complicated, not specific enough and difficult to assess. LOs F1 and F2 combine several different objectives that by their nature are developed in different ways/courses. For example, the LO F2 "is able to work independently and in mixed groups (teams)", combines two abilities, whereas the ability to work independently is best trained and assessed differently from the ability to work in mixed groups. In the LO F1 it is stated that the student should be able to communicate in both Lithuanian and at least one foreign language. Those abilities are better to separate in two different LOs for the same reasons above. Moreover, the LOs should be further decomposed to give a clearer description of what the student is expected to know, understand and be able to do upon graduation. The LO A2 "Has fundamental knowledge of nature and phenomena of nature

which are basic for mechanical engineering, understanding of quantitative expressions of those phenomena" is too vague and gives no explanation on what specific knowledge, skills and competence the student has.

Active verbs are not used in the formulations of several LOs that make it very difficult during the assessment process to determine whether the student has achieved the LOs or not. In order to be able to clearly assess whether a student has achieved the LO, formulations like: has awareness, has knowledge, has approach and has skills should be avoided. For example, the LO A3 "Has knowledge of the properties of engineering materials, understanding of their selection principles" may be written as "Is able to explain the basic properties of engineering material" and "Is able to select materials with respect to how such choices will affect the manufacturing process, product behaviour and environmental impact during the life of the product".

Although the courses where the programme LOs are supposed to be achieved and assessed are marked in the curriculum, the connections between the programme LOs and the individual courses LOs are inconsistent and weak. For example, the final thesis project is expected to cover all programme LOs. This is most likely not the case, e.g. the ability to work in mixed groups cannot be learnt and assessed in the final thesis. Two other examples are: "the ability to communicate in grammatically correct Lithuanian and at least one foreign language" that is marked to be enhanced in the Philosophy course is out the course scope, and "has holistic approach towards the impact of engineering solutions on society and environment, awareness of the importance to conduct in compliance the norms of ethics and take responsibility for engineering solutions made" that is expected to be learnt in the course of Measurements and Control is definitely unrealistic. Moreover, the LOs should refer to the entire student body and not to an individual learner that means that all of the programme LOs must be achievable in the mandatory courses of the programme. Thus, an elective course in foreign language is not enough to guarantee the fulfilment of the programme LO about the ability to communicate in a grammatically correct foreign language.

During the visit, it was made clear the teachers were not familiar with the LOs based approach, especially understanding the link between assessment and LOs was generally weak. Moreover, it was also evident that the students were not aware of or paid any attention to the LOs although the LOs are publicly available on the KTU website. The website itself is somewhat incomplete as far as the aim and detailed aims as well as the updated curriculum for the academic year 2014-15 are missing.

The programme aims and LOs are reviewed and updated annually by the Study Programme Committee with input from stakeholders, students and faculty members. There is

only one Study Programme Committee for all engineering programmes in mechanical engineering and design responsible for more than 30 study programmes. It is highly questionable if the committee is able to handle all these programmes. The curriculum development, incl. reviewing and updating the LOs is somewhat limited by the lack of appropriate national standards. During the visit the evaluation team learned that new LOs based national requirements are under preparation.

2.2. Curriculum design

The Mechanical Engineering programme is, in full-time mode, a four years programme of 240 credits (ECTS) (8 semesters of 30 credits each). The 240 credits duration is by international standards rather long for a bachelor's programme, well exceeding the 180 ECTS which is the requirement in many countries and which is the baseline for the EUR-ACE standards for the first cycle engineering programme. The duration allows the programme to provide a large number of elective general courses covering economics, sustainable development, personal development and entrepreneurship. The programme offers also a possibility for the students to specialize in engineering design with focus on applying computer aided means.

Each semester consists of 16 weeks of teaching plus four weeks for examinations. The planned student workload for a semester is 800 hours. The number of subjects does not exceed 7 courses per semester. The main subjects of mechanical engineering make a total of 165 credits, 15 credits are allocated for practical work and the final degree project allocated 12 credits in the study plan of the period 2009-2014. From the academic year 2014/2015 the study plan is revised and the final degree project is upgraded to 18 credits, this together with the 15 credits of practice and a semester project of 9 credits will strengthen the abilities and practical skills and thus better prepare the students for the upcoming career as a professional engineer. To conclude, the programme meets the general requirements for the first cycle study (Bachelor's) programmes in the Republic of Lithuania.

The contents and methods of teaching the courses are appropriate for the achievement of most of the intended programme LOs. Nevertheless, the students need to choose their elective courses with care to reach the LOs regarding sustainable development, communication in foreign language, management etc. The training in teamwork is limited to lab assignments and the programme cannot guarantee that the students obtain skills in working in mixed teams. The introduction of a semester project from the academic year 2014/15 is positive, but it could be used more for learning general engineering competences and transferable skills needed for the

students to work efficiently in teams with complex problems. The semester project is an individual project with individual assessment but in order to address the assigned programme LO regarding team work it would rather be a team project.

The content of the courses is consistent with a first cycle programme in Mechanical Engineering. However, the volume of mathematics courses in terms of credits seems to be somewhat low: 12 credits of analysis and algebra, 6 credits of probability and 6 credits of numerical methods. In particular, the content regarding calculus in several variables is rather limited. Further, the students asked for more mechanical engineering related courses in the initial phase of the curriculum. In particular, they mentioned the finite element method that is first taught in semester 7 in the elective course in Computer-aided Analysis of Structures. They assumed that this method could already have been introduced in the math/numerical methods courses and later utilized in courses such as Mechanics of Materials and Machine Elements as a development tool and/or a pedagogical tool to illustrate theory and phenomena. The evaluation team found that an introduction to the Finite Element Method is given in the course Strength of Structural Elements that is taught in semester 4. However, this does not seem to have had any major impact on student learning and the programme would benefit from more focused introduction and use of the method. Moreover, the courses in information technology do not include a specific programming language and substantial training in programming is missing apart from a short introduction to Matlab in the Information Technologies 2 course. It is notable that Matlab programming is not included in the learning outcomes, which reinforces the impression that it is only a very brief introduction of Matlab. Although, the programme would benefit from a more up-to-date approach with applications from ME in the initial phase, the scope of the programme is sufficient to ensure the core of the programme LOs.

The content of the programme reflects the latest achievements in science and technology satisfactorily. Nevertheless, the programme would benefit from updating the curriculum to reflect best practise. The mathematics courses can be modernized to integrate symbolic and numerical calculations and elements of programming and the finite element method. Programming is a key skill for a modern engineer and programming needs to be taught, integrated and utilized throughout the programme. Moreover, there is a potential for strengthening the ability to handle complex problems by introducing more projects, e.g., one major project each study year. The project tasks should then have increasing degree of uncertainty and difficulty. The projects are also very suitable for integrated learning of general skills such as team work, communication, project management, development methodology, intellectual properties etc. This is found to be more efficient than having separate and often

isolated courses in the end of the programme aiming at developing personal and general engineering skills.

2.3. Teaching staff

The staff members who teach in the programme meet the legal requirements and have the appropriate qualifications. Approximately 90% of the teaching staff has scientific degrees. There is a sufficient number of staff (81 of which 15 are full professors, 46 associate professors and 20 lectures). The age and gender mix of teachers is balanced. The programme has an open policy for teaching by visiting professors and each year about 5-10 visiting professors are involved in teaching. The number of the teaching staff is adequate to ensure the programme LOs. Eight teachers in programme leaved the university during the last five years, mostly due to retirement and the positions have been replaced. Five associate professors are in the process of being promoted to full professors. Moreover, the Department of Mechanical Engineering has five doctoral students and four new young teachers have started working at the department since 2009. The average age of the teaching staff in the programme is approx. 43 years. To conclude, teaching staff turnover is able to ensure an adequate provision of the programme.

The teaching staff members are generally very experienced and active in both teaching and research. The research profiles of the teachers support well the subjects in the curriculum. The teaching staff members have good contacts with Lithuanian industrial companies and some also with universities abroad. Most teachers have written class texts, lecture notes and/or textbooks and performed research in their fields of teaching. Moreover, lecturers are appointed to their positions by means of public competition. Teaching staff members have to pass periodical attestation procedure in five years periods. Pedagogical, scientific and public activities of teachers are evaluated in accordance with qualification requirements at the university and faculty level.

KTU provides relevant conditions for the competence development of the teaching staff in their research fields. Teachers are active in international activities and exchanges. Professional development in teaching, research and practical activities is regulated by the Rules of Qualification Development. Teaching staff members must go through some kind of in-service training at least once in five years. For the period under evaluation all full time teaching staff members of the programme were successfully attested.

Most of the teaching staff participates in the courses of foreign languages, information technologies and engineering software. Regarding professional development in teaching methods and pedagogics the situation is not as favourable. The university has no system to acknowledge

excellence in teaching and the faculty management made it very clear that research merits are much higher valued than teaching merits in the periodic evaluations (attestation) and in promotions. The management claimed that teaching merits are taken into account in discussions on labour agreement. In interviews with teaching staff members the evaluation team found no evidence that this has come through. KTU has no unit which could support teaching staff and provide courses in pedagogics or didactics, and also in fundamentals of LOs based approach. Currently the programme manager has this responsibility and encourages teaching staff members to develop LOs and contents of their courses.

From the teaching staff's CVs and academic activities it is obvious that the qualification of the teaching staff is adequate to ensure the programme LOs. However, they need to be trained in the implementation of LOs based approach usually referred to as the constructive alignment, i.e. aligning teaching, LOs and assessment.

The interview with students confirmed the picture on highly qualified and dedicated teaching staff. The students found them very supportive. It was evident that there is a very strong element of personal contact between teachers and students.

2.4. Facilities and learning resources

The premises for studies are adequate both in their size and quality. The programme has access to good auditoriums, labs and to a well-equipped library. The teaching and learning equipment (laboratory and computer equipment, consumables) are up-to date as well as adequate both in size and quality. The maximum number of students in classrooms and labs is regulated by occupancy norms that ensure safe learning environment suitable for efficient teaching and learning. The students have access to a sufficient number of computers equipped with an impressive modern suite of mathematics, design, analysis and manufacturing software as Matlab, CAD, FEM and CAM. The physical laboratory facilities and equipment are very good, incl. laboratories for physics, strength of materials, manufacturing, CNC, mechatronics, biomechanics and new equipment for rapid prototyping, tooling, material and machine element testing.

The workshop is spacious and very well-equipped with lathes, milling machines, drills, CNC and hand tools. The site visit confirmed that the order of the workshop was excellent with technicians to support the students in their practical training. It is evident that the department provides adequate arrangements for the students' practical training.

The teaching materials are adequate and available in the library (textbooks, books, electronic papers, journals, electronic databases) and the access is very good. The electronic library resources are available for students.

2.5. Study process and students' performance assessment

The admission requirements are well-founded. Admission to the programme is realised according to the Rules of Admission to the First Cycle and Integrated Studies at Lithuanian Higher Education. The programme admits students with at least 12 years secondary or equivalent education on a competition bases. In the last years the recruitment of students has improved significantly and the programme admits around 50 students to state financed study places and about 20-25 students to self-financed study places.

Despite the favourable conditions regarding teaching staff and facilities the numbers of drop-outs is high. It seems that there is a culture among teachers and students that accepts this as being the norm. The most common explanation was low motivation and complexity of engineering studies. The management has taken measures and students results and drop-outs are discussed and analysed at meetings of dean's office. The strategy is to increase student motivation, support and offer a mentorship programme together with the second and third year students. Results seem to be promising but more needs to be done.

The SER states that students are encouraged to do independent research and present their results in conferences for young scientists. The number of students that present their results is low but the report appoints five students that have contributed to applied research at the department. Involving first cycle students in research is admirable and demonstrates that the students have developed deep and active technical knowledge as well as their ability to actively contribute to research.

The organization of the study process is adequate. A variety of teaching methods are used, incl. interactive and virtual training, theoretical and practical lectures, sessions and exercises, seminars and projects. Elements of problems based learning are reported to be included into 14 courses where students solve complex and incompletely defined problems. However, except for the Semester Project no examples are provided of such projects, nor in which courses they are included. Elements of team work seem to be very limited in the lab work. This picture is confirmed by the students interviewed.

Faculty of Mechanical Engineering and Design has 23 ERASMUS agreements and the students can go for studies into any country participating in the programme for the duration of 3-12 months. Despite the seemingly good conditions the number of students going abroad is low. 35 students from the programme have taken this possibility during the last five years. Further, in recent years the number of students going abroad for studies is substantially lower than the KTU's strategic aim of 5% mobility per year (SER, p 29) which is a rather modest goal compared to reputable university in Europe. The common explanation for the low number is that

Lithuanian students are employed in companies to work in parallel with their studies and unwilling to leave for a longer period. During the visit the evaluation team also found that there might be some administrative obstacles as well. One student who was planning to go abroad could not do that due to a mismatch in courses offered. This seems a bit strange since mechanical engineering is offered at almost every university. Obviously, in some occasions credit transfer is not based on course LOs, but other criteria. A favourable condition is that the number of incoming students since 2013 is high and about 45 Erasmus students have been joining the programme annually. The major reason for this is the strategic decision to offer the study programme entirely in English from 2013. Although the evaluation team learnt that not all courses are yet taught in English, it is very admirable to offer a first cycle programme in English. The most common practice at other universities in Europe is to offer the first cycle programmes in the national language and offer a smaller range of courses taught in English.

The university ensures an adequate level of academic and social support. There is a good support for students from teachers, Student Information Centre, Student Welfare Group, Career Centre, and Students Association. The mentor programme launched in 2014 is working fine and is very much appreciated by the students.

The assessment structure is well presented, clear and publicly available. However, it is unclear to what extent it is constructively aligned to the LOs, to the teaching activities and assessment. A ten grades scale is used and the final grade is built-up from several components (lab, projects and individual work) and the final exam. Clear relationships between the grade levels and the LOs seem to be missing. Further, it is unclear whether the LOs are regarded as describing the threshold level that every student should has to reach or aspirational level that defines excellent achievements.

The titles of the final degree projects confirm their relevance for the programme and the programme aim. However, as all the reports presented were written in Lithuanian and the English summaries generally were very weak it is very difficult to judge their level and quality. The evaluation team also found that the concluding remarks/conclusions sections are insufficient. Instructions, objectives and assessment criteria for the final degree projects are available but it is questionable if they are sufficient or used by students, supervisors and examiners.

Professional performance of the majority of graduates meets the programme providers' expectations. All graduates have relevant jobs before or within two months after graduation. About 50% of the graduates continue on master’s level studies, most of them in the second cycle Mechanical engineering programme at KTU. Currently, data for graduates are collected and

analysed by the programme management. A system for monitoring the graduates is under development.

2.6. Programme management

General management and quality assurance of study programmes are the responsibility of the vice-rector for studies with support from of Department of Academics Affairs. The programme manager is responsible for the content and quality of the study programme, incl. descriptions of the programme, the programme aim and LOs. The programme manager also prepares proposals for changes in the programme or course content. The Study Programme Committee with 11 members (among them 4 professors, 3 representatives from employers and 3 students) advises the programme manager. The Study Programme Committee is the major body for the programme and quality development. Changes in a programme are approved by the Faculty Council with 15 members among them 3 students appointed by the Student Union, one representative from the employers and the dean of the faculty. The programme manager is responsible for the implementation and follow-up of changes.

Responsibilities for decisions and monitoring of the implementation of the programme are formally clearly allocated. The role of the programme manager is clear and it is certainly favourable to have one person leading the curriculum development. However, the evaluation team learnt that one Study Programme Committee is responsible for more than 30 programmes. In practice, such committee cannot have detailed knowledge of the needs of all programmes and the influence of stakeholders, students and teachers on the programme will be weak as they do not cover all programmes.

Information and data on the implementation of the programme are regularly collected and analysed. The university has a common electronic course evaluation system. All courses are evaluated by students and the results are analysed. However, from interviews with the students the evaluation team found that rather many students do not care to fill in the questionnaire and that the feedback to the students concerning the review of the questionnaires was non-existing. Moreover, international students informed the evaluation team that the questionnaires are available only in Lithuanian.

The SER presents changes of the programme due to results of internal and external evaluations. Remarks of previous evaluation were taken into account. The evaluation team found that the programme has followed the recommendations regarding the development and use of laboratories, reduced the number of specializations and to made amendments to the programme to meet national requirements. Measures have been taken to strengthen the role of final degree

project and to improve students' entrepreneurial skills. Nevertheless, this seems to be insufficient. Introducing an economical part in the final projects as stated in the SER (Table 2.10 on p.34) is natural but insufficient. The elective courses in entrepreneurship provide a more comprehensive picture and elements of the courses can be integrated into the final degree project and the semester project. During the visit the evaluation team found that the students were not fully aware of the methodology and the assessment criteria for the final degree project and structure of the thesis was not appropriate, although they were awarded high grades (seven to nine).

2.7. Examples of excellence

The student learning oriented laboratories and workshop are excellent facilities with up-to-date adequate equipment. The facilities are used in very conscious manner with focus on the students' opportunity to test, implement and evaluate.

Close and mutually beneficial relations with the Lithuanian industry are admirable. As a result, the knowledge, skills and attitudes of the graduates perfectly match the needs of the industry and the graduates quickly find relevant job position.

III. RECOMMENDATIONS

1. Consider having a dedicated Study Programme Committee for each programme. For the committee to be an efficient body for programme development and quality assurance it is recommended that the committee is chaired by the programme manager and consists of at least one student and one professor from the programme and at least one representative of the employers and a representative of alumni.

2. Formulate programme learning outcomes focussing on the students' expected knowledge, skills, and attitudes upon graduation. The programme learning outcomes should be externally verifiable and formulated in such a way that during an assessment process it can be determined whether the student has achieved the learning outcomes. The learning outcomes should be defined on the threshold level that every student has to achieve. Make sure that the learning outcomes are covered, taught, trained and assessed in the mandatory courses and projects. Teach and train the teachers in the learning outcomes based approach.

3. Teach, train and assess general engineering competences such as team work, communication and project management on a demanding and more structured manner. For example, consider running the semester project as a team project and integrate teaching and learning of general competences into the project course. The project task may be taken from industry to integrate real world engineering experience into the curriculum.

4. Introduce methods and applications from mechanical engineering early in the curriculum. For example, the finite element method can be taught and utilized already in the mathematics and strength of materials courses in the year one and two. Programming is a key skill for a modern engineer and programming needs to be taught, integrated and utilized to a wider extent. Consider introducing a programming language, e.g., Python or Matlab, in the very beginning of the programme. The mathematics courses can be modernized to integrate symbolic and numerical calculations and elements of programming to enable students handle more applied problems.

5. Launch a study methodology centre with specialists to teach and train for in-service training of teaching staff in pedagogics, methodology and educational developments. Encourage teachers to create pedagogical portfolios and acknowledge excellence in teaching, e.g. in

promotion applications and career planning. Consider introducing career paths for excellent teachers and educational developers.

6. Continue to develop and extend the international learning environment. Consider teaching some courses only in English to promote Lithuanian students to cooperate with international students. Encourage and support Lithuanian student to go abroad for studies and internships.

IV. SUMMARY

The first cycle programme in Mechanical Engineering at Kaunas University of Technology (KTU) offers a traditional mechanical engineering programme with very strong links to the needs of the Lithuanian industry oriented towards engineering design, manufacturing and production. The employability of the graduates is very high. Alumni as well as the employers are very satisfied with the programme as a whole and are in particular happy with the match of the programme aims and the needs of the industry.

The programme aims and programme learning outcomes are derived from the first cycle EUR-ACE specifications ensuring the programme's compliance to international standards. However, the learning outcomes are not sufficiently well defined. They are too complicated, too vague, active verbs are not used and they are difficult to assess. Each learning outcome should be observable and externally verifiable, which is not the case right now. This is extremely important for stakeholders to know what the students are capable to do upon graduation. This also enables to compare the programme at KTU with other first cycle ME programmes in Europe to facilitate the exchange of students, teachers and graduates as well as quality assurance. Further, the assignment of learning outcomes to the courses is obsolete and needs to be clarified.

For the programme to become a European top class ME programme as stated in the KTU's vision, the curriculum needs to be reformed. Teaching, training and assessment of general engineering competences need to be taught and integrated in a more structured manner. This may be done by introducing a sequence of team-based projects in traditional courses and in specific project courses. The training in mathematics, programming and numerical analysis need to be reformed to prepare the students to handle more complex problems of mechanical engineering applications.

The teaching staff are very dedicated and supportive. All teachers are active in research and have expert knowledge in their fields of teaching. However, teaching merits are not appreciated as highly as expected from a reputable university with a long tradition of teaching with visible evidence of excellence in teaching. Moreover, a unit for pedagogical support and in-service training is missing.

The programme has adequate library, auditoria and the laboratory facilities are excellent with up-to-date equipment suitable for students to test, implement and evaluate. The number of computers is adequate and the computers are equipped with a suitable modern suite of mathematics, design, analysis and manufacturing software.

The students are dedicated and hardworking. It is evident that the collegial relations between teachers and students are successful. However, the influence of the students on the

programme development and quality assurance of the programme needs to be strengthened. The management needs to create incentives for the students to fill in course questionnaires and provide feedback to the students on the results of the course evaluations. The management is dedicated and educational developments are clearly on the agenda but having a single Study Programme Committee handling over 30 programmes is far from optimal for programme development with tangible influence from students, teachers and employers.

V. GENERAL ASSESSMENT

The study programme *Mechanical engineering* (state code – 612H30001) at Kaunas University of Technology is given **positive** evaluation.

Study programme assessment in points by evaluation areas.

No.	Evaluation Area	Evaluation of an area in points*
1.	Programme aims and learning outcomes	2
2.	Curriculum design	3
3.	Teaching staff	3
4.	Facilities and learning resources	4
5.	Study process and students' performance assessment	3
6.	Programme management	3
	Total:	**18**

*1 (unsatisfactory) - there are essential shortcomings that must be eliminated;
2 (satisfactory) - meets the established minimum requirements, needs improvement;
3 (good) - the field develops systematically, has distinctive features;
4 (very good) - the field is exceptionally good.

Grupės vadovas:
Team leader: Prof. dr. Olav Aarna

Grupės nariai:
Team members: Prof. dr. Hartmut Ulrich

Prof. dr. Jolanta Janutėnienė

Prof. dr. Mikael Enelund

Dr. Vaidas Liesionis

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KAUNO TECHNOLOGIJOS UNIVERSITETO PIRMOSIOS PAKOPOS STUDIJŲ PROGRAMOS *MECHANIKOS INŽINERIJA* (VALSTYBINIS KODAS – 612H30001) 2015-06-15 EKSPERTINIO VERTINIMO IŠVADŲ NR. SV4-142 IŠRAŠAS

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V. APIBENDRINAMASIS ĮVERTINIMAS

Kauno technologijos universiteto studijų programa *Mechanikos inžinerija* (valstybinis kodas – 612H30001) vertinama **teigiamai**.

Eil. Nr.	Vertinimo sritis	Srities įvertinimas, balais*
1.	Programos tikslai ir numatomi studijų rezultatai	2
2.	Programos sandara	3
3.	Personalas	3
4.	Materialieji ištekliai	4
5.	Studijų eiga ir jos vertinimas	3
6.	Programos vadyba	3
	Iš viso:	**18**

* 1 - Nepatenkinamai (yra esminių trūkumų, kuriuos būtina pašalinti)

2 - Patenkinamai (tenkina minimalius reikalavimus, reikia tobulinti)

3 - Gerai (sistemiškai plėtojama sritis, turi savitų bruožų)

4 - Labai gerai (sritis yra išskirtinė)

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IV. SANTRAUKA

Kauno technologijos universitete (KTU) dėstoma pirmosios pakopos Mechanikos inžinerijos studijų programa – tai tradicinė mechanikos inžinerijos programa, kuri atitinka

Lietuvos pramonės inžinerinio projektavimo, konstravimo ir gamybos poreikius. Baigusieji šią studijų programą turi geras įsidarbinimo galimybes. Absolventai ir darbdaviai labai patenkinti studijų programa, visų pirma, dėl to, kad jos tikslai atitinka pramonės poreikius.

Studijų programos tikslai ir rezultatai atitinka EUR-ACE pirmosios pakopos inžinerijos studijų akreditavimo standartų reikalavimus, todėl studijų programa atitinka tarptautinius standartus. Tačiau studijų rezultatai nėra apibrėžti aiškiai. Jie pernelyg painūs, nekonkretūs, jų apibrėžimuose nevartojami aktyvieji veiksmažodžiai, todėl rezultatus sunku įvertinti. Reikia kiekvieną rezultatą aiškiai apibrėžti ir užtikrinti, kad rezultatus būtų galima išoriškai patikrinti. Šiuo metu taip nėra. Socialiniams dalininkams labai svarbu žinoti, ką studentai galės daryti pabaigę studijų programą. Įvykdžius šią rekomendaciją bus galima palyginti KTU pirmosios pakopos Mechanikos inžinerijos studijų programą su kitų Europos šalių pirmosios pakopos mechanikos inžinerijos studijų programomis, supaprastės studentų, dėstytojų ir absolventų mainai, bus užtikrinta studijų programos kokybė. Modelis, pagal kurį bendri studijų rezultatai pasiskirstomi tarp atskirų studijų dalykų, yra pasenęs ir turi būti patikslintas.

Kad Mechanikos inžinerijos studijų programa taptų aukšto lygio europine mechanikos inžinerijos studijų programa, kaip numatyta KTU vizijoje, programos sandarą reikia pertvarkyti. Skirti dėmesį bendrųjų inžinieriaus kompetencijų mokymui, įgijimui ir vertinimui – šie procesai turėtų būti integruoti struktūriškiau. Šiam tikslui pasiekti į studijų dalykus galima įtraukti grupinius darbus ir projektus. Matematikos, programavimo ir skaičiavimo metodų dėstymas turi būti pertvarkytas, kad studentai gebėtų spręsti sudėtingesnes mechanikos inžinerijos taikomąsias užduotis.

Dėstytojai labai atsidavę darbui ir padeda studentams. Visi dėstytojai dalyvauja moksliniuose tyrimuose ir turi savo srities profesinių žinių. Tačiau dėstytojų nuopelnai nepakankamai įvertinami, kaip paprastai tikimasi iš pripažinto universiteto, turinčio senas aukšto lygio mokymo tradicijas. Nėra pedagoginės pagalbos dėstytojams ir kvalifikacijos kėlimo centro.

Biblioteka, auditorijos ir laboratorijos yra gerai įrengtos ir aprūpintos šiuolaikine įranga, kad studentai galėtų testuoti, tirti ir vertinti. Kompiuterių yra pakankamai, juose įdiegta tinkama šiuolaikiška matematikos, projektavimo, analizės ir konstravimo programinė įranga.

Studentai motyvuoti ir darbštūs. Dėstytojai ir studentai sėkmingai bendradarbiauja tarpusavyje. Tačiau studentams turėtų būti suteikta galimybė aktyviau dalyvauti studijų programos plėtros ir kokybės užtikrinimo procese. Vadovybė turėtų skatinti studentus pildyti dalykų vertinimo anketas ir aptarti su studentais dalykų vertinimo rezultatus. Programos vadyba gera, programa plėtojama, tačiau vienas studijų programos komitetas, prižiūrintis 30 studijų programų vykdymą,

negali užtikrinti veiksmingos programos plėtros, o studentai, dėstytojai ir darbdaviai negali atlikti svarbaus vaidmens plėtojant programą.

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III. REKOMENDACIJOS

7. Apsvarstyti galimybę kiekvienai studijų programai įsteigti atskirą studijų programos komitetą. Kad studijų programos komitetas veiksmingai plėtotų programą ir užtikrintų jos kokybę, komitetui turėtų vadovauti programos vadovas ir komitetą turėtų sudaryti mažiausiai vienas programos studentas, vienas programos profesorius, vienas darbdavių atstovas ir vienas absolventų atstovas.

8. Studijų programos rezultatus suformuluoti atsižvelgiant į žinias ir gebėjimus, kuriuos studentai turėtų įgyti ir jų lūkesčius baigus studijų programą. Užtikrinti, kad programos studijų rezultatus būtų galima patikrinti išoriškai; suformuluoti juos taip, kad vertinant būtų galima nustatyti, ar studentui pavyko juos pasiekti. Numatomi studijų rezultatai turi būti suformuluoti atsižvelgiant į jų minimalų pasiekimo lygį, kurį turi pasiekti kiekvienas studentas. Studijų rezultatai turi būti įtraukti į privalomuosius dalykus ir projektus; studijų rezultatų reikia siekti ir vertinti jų pasiekimą. Mokyti dėstytojus į studijų rezultatus orientuoto modelio.

9. Ugdyti ir vertinti bendrąsias inžinieriaus kompetencijas, pavyzdžiui, gebėjimą dirbti komandoje, bendravimą ir projekto valdymą, ir taikyti griežtus ir labiau struktūruotus šių kompetencijų vertinimo kriterijus. Pavyzdžiui, semestro projektą pavesti atlikti komandai ir vykdant projektą ugdyti bendrąsias kompetencijas. Projekto užduotys gali būti imamos iš pramonės sektoriaus, kad studijų turinys nebūtų atitrūkęs nuo tikrovės.

10. Su mechanikos inžinerijos metodais ir taikymo sritimis studentus supažindinti pradiniame studijų etape. Pavyzdžiui, baigtinių elementų metodas gali būti dėstomas ir naudojamas matematikos ir medžiagų atsparumo dalykuose pirmame ar antrame kurse. Šiuolaikinis inžinierius turi mokėti programuoti, todėl programavimo dalykas turėtų būti integruotas ir išsamesnis. Ankstyvajame studijų etape reikėtų dėstyti programavimo kalbas, pavyzdžiui, *Python* ar *Matlab*. Matematikos dalykas turėtų būti šiuolaikiškesnis, jis turi apimti skaitinius ir simbolinius skaičiavimus, programavimo elementus, kad studentai išmoktų spręsti taikomąsias užduotis.

11. Įkurti studijų metodologijos centrą, kurio specialistai padėtų dėstytojams kelti kvalifikaciją pedagogikos, metodologijos ir švietimo plėtojimo srityje. Skatinti dėstytojus sudaryti profesinės kompetencijos portfelius, įvertinti dėstymo kompetencijas, pavyzdžiui, priimti sprendimus dėl paaukštinimo ir karjeros planavimo. Aukštos kvalifikacijos dėstytojams ir švietimo programų kūrėjams suteikti galimybę daryti karjerą.

12. Toliau kurti ir plėsti tarptautinio mokymosi aplinką. Kai kuriuos dalykus dėstyti tik anglų kalba, kad lietuviai studentai bendradarbiautų su kitų šalių studentais. Skatinti lietuvius studentus vykti studijuoti ir stažuotis į užsienį ir suteikti jiems paramą

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Paslaugos teikėjas patvirtina, jog yra susipažinęs su Lietuvos Respublikos baudžiamojo kodekso 235 straipsnio, numatančio atsakomybę už melagingą ar žinomai neteisingai atliktą vertimą, reikalavimais.

Vertėjos rekvizitai (vardas, pavardė, parašas)