Project: Digital transformation of HEIs education process in Ukraine and Moldova for sustainable engagement with enterprises, DIGITRANS
101127683 — DIGITRANS — ERASMUS-EDU-2023-CBHE
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Learning and Teaching Materials Report

Developing four text e-books for students' education

Deliverable D2.2

Version 1.2

06.10.2025

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Record of changes

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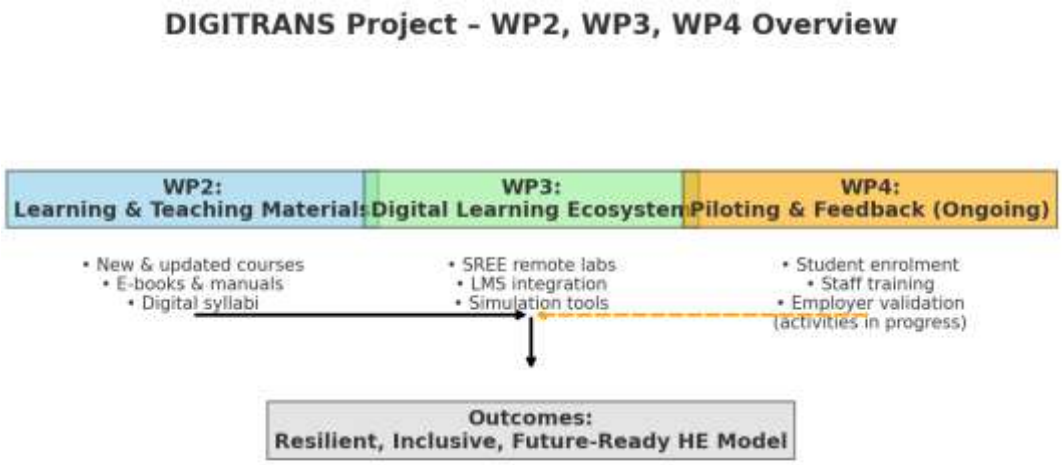
Contents

Abstract

This consolidated report presents the integrated achievements of Work Packages 2 and 3, together with the ongoing progress of Work Package 4 within the DIGITRANS project. WP2 delivered modernized and newly developed courses, enhancing curricula with a strong emphasis on electromobility, automation, renewable energy, and digital engineering. WP3 provided the digital infrastructure, including the Sharing Remote Experiment Environment (SREE) and Digital Learning Ecosystem (DLE), enabling remote and blended learning. WP4, launched midway through WP2 currently ongoing, pilots these outputs in practice, engaging students, staff, and employers to ensure relevance, inclusivity, and sustainability. Together, the three work packages form a coherent system linking content, infrastructure, and validation, creating a resilient, future-ready higher education model aligned with European digital and green transition priorities.



Extended Summary

This consolidated report presents the outcomes of Work Package 2 (WP2) on Learning and Teaching Materials, closely linked with the parallel achievements of Work Package 3 (WP3) of the DIGITRANS project. While WP2 focused on the modernization of curricula, the creation of updated syllabi, and the development of innovative digital learning materials across Ukrainian and Moldovan partner universities, WP3 concentrated on the development of the Sharing Remote Experiment Environment (SREE) and the broader Digital Learning Ecosystem (DLE). The parallel progress of these two work packages ensures a comprehensive modernization process, coupling the renewal of educational content with the technological infrastructure that supports digital, remote, and blended learning. Together, WP2 and WP3 address urgent regional needs—responding to disrupted educational systems due to conflict—while aligning higher education with EU priorities on sustainability, digital transition, and employability.

WP4, launched midway through WP2 and currently ongoing, pilots and validates these outputs in real teaching environments. Activities include student enrolment into new and updated courses, training teaching staff in the use of SREE and digital pedagogies, and engagement with employers to ensure alignment with labor market needs. While initial feedback has confirmed the value of interactive, accessible, and practice-oriented materials, further results will be consolidated as WP4 progresses.

WP2 outcomes include the introduction of new courses in electromobility, automation, computer engineering, and renewable energy, complemented by updated laboratory manuals, e-books, bilingual synopses, and interactive course platforms. WP3 outcomes focus on piloting virtual and remote laboratories through SREE, integrating open-source simulation tools (SMSE), and embedding them into a distributed digital environment interconnected with Moodle. This synergy provides a powerful educational ecosystem where students not only access high-quality teaching materials but also gain hands-on experience in simulated and remote laboratory settings.

Together, WP2 and WP3 have laid a solid foundation, and WP4 ensures that the outputs are tested, refined, and aligned with stakeholder expectations, contributing to a resilient and future-ready higher education model.

The DIGITRANS project created and published online four digital textbooks, produced through collaboration between partner universities in Ukraine, Moldova, Latvia, Romania, and beyond. This milestone is central to the project's goal of strengthening digital education infrastructure and aligning higher education with modern industry needs. All e-books are available in English, with translations into Ukrainian and Moldavian planned, and have been uploaded to the DIGITRANS e-Library, the Google Drive of DIGITRANS, for open access: https://drive.google.com/drive/folders/1FJsxIUorm2BohPZuqm1n0wKbwvZm319C?usp=drive_link

Electric Drive, Automotive Electronics and Energy-Saving Technologies for Modern Transport, (137 pages, ISBN 978-9934-37-194-3)

This textbook provides a clear introduction to electric drives, vehicle electronics, and sustainable energy-saving technologies. It serves as a foundation for understanding electric and hybrid vehicles, charging infrastructure, and power electronics, preparing students for the rapidly expanding e-mobility sector.

Integrated Course "Automotive Transport", (556 pages)

A comprehensive resource integrating technical, organizational, economic, and environmental perspectives of the automotive transport system. Intended for engineering and transport students, it supports coursework, diploma projects, and professional practice by offering a holistic understanding of road transport as a national infrastructure component.

Digital Control Systems: Modern Aspects in Modelling and Implementation, (178 pages)

This e-book focuses on modern digital control systems within the context of Industry 5.0. It covers microcontroller- and FPGA-based systems, UAV swarm intelligence, and the use of neural networks and fuzzy logic. It combines theory and applied methods, equipping graduate and postgraduate students with the skills to design and implement advanced cyber-physical systems.

Sustainable Digital Transformation in the Automotive Industry, (163 pages)

Addressing the broader industry context, this textbook explores sustainability, digitalization, automation, and cybersecurity in the automotive sector. It highlights ecological challenges, workforce transformation, and the role of ERP systems and online marketplaces, providing students and professionals with insights into innovation and adaptation in a digitally-driven industry.

Introduction

The DIGITRANS project was conceived to support systemic modernization of higher education in Moldova and Ukraine by addressing three interconnected dimensions: curriculum content (WP2), enabling digital infrastructure (WP3), and piloting with validation (WP4).

WP2 and WP3 evolved in parallel to ensure that course content renewal was matched by the creation of a digital infrastructure to deliver and apply it. WP2 concentrated on modernizing academic programs and developing accessible, digitally enabled teaching resources, while WP3 focused on building the Sharing Remote Experiment Environment (SREE) to enable practical, remote experimentation and collaborative learning environments. This dual approach strengthens educational resilience, inclusivity, and innovation, offering students both theoretical knowledge and digital tools for real-world applications.

WP4, which began midway through WP2 and is ongoing, operationalizes these outputs by piloting them in classrooms and digital environments. Students are currently enrolled in new and updated courses, staff are receiving training on SREE-based tools, and structured feedback is being collected from employers and other stakeholders. While WP2 and WP3 provide the foundation, WP4 is the mechanism that ensures practical validation and continuous improvement.

WP2 achievements include the introduction of entirely new courses in emerging fields such as electromobility, automation, and renewable energy, and the modernization of established curricula to incorporate digital resources, sustainability, and contemporary engineering practices. WP3 has complemented this by developing the SREE platform and integrating it with institutional LMS systems, enabling remote laboratories and simulation-based teaching.

Partner Contributions: New and Updated Courses

This section provides an overview of the updated or newly developed courses by partner universities under WP2, which form the pedagogical foundation of the DIGITRANS Digital Learning Ecosystem.

The following table distinguishes between newly introduced courses, which reflect innovation and adaptation to emerging fields such as electromobility and renewable energy, and updated courses, which represent the modernization of existing curricula through digital integration, sustainability, and alignment with labour market needs.

Partner University	New Courses	Updated Courses	Total Number of courses
CPNU	Microcontroller Systems Programming; Systems on Chip; Design of Digital Devices	Electrical Circuit Design; Digital Systems of Telecommunications; Digital Electronics Devices	6
KhNAHU	Electric Vehicle Infrastructure; Energy Supply and Energy Saving Systems	Electric Drive Theory (Part 1 & 2); Electric Machines and Devices; Electronics and Microcircuit Engineering (Part 1 & 2)	7
LNTU	–	Management of Transport Processes; Road Transport Enterprises (Part 1–3); Technical Operation of Cars; Theory of Operational Properties of the Car	6
UTM	Electric Vehicle Powertrain	Digital Control Systems; Electrical and Electronic Equipment; Static Power Converters	4
USARB	Autonomous Vehicles; Hybrid vehicles; Engineering Bionics;	Electromobiles; Automatic Control Engineering; Automation in Production; Automotive Electrical and Electronic Equipment	7
USC		Tools of Ecological Production; Production Management; Computer-Aided Design of Products in Machine Building Industry; Computer-Aided Design of Technological Processes and CALS Technologies; Design of Electric Machines; Human Resources Management	6

In parallel, WP3 focused on the development of the SREE and its integration with the Digital Learning Ecosystem. This included the creation of virtual labs in every Moldovan and Ukrainian partner university, interconnection with the SMSE developed in the Erasmus+ CybPhys project, integration with LMS Moodle, and the introduction of Jupyter-based semi-natural laboratory experiments. Such progress ensures that WP2-developed teaching resources are supported by advanced tools for experimentation, fostering a holistic and modern educational environment.

Structure of the report

The consolidated Learning and Teaching Materials Report follows a unified structure based on a template that was applied by all partner universities. The template was designed to standardize the presentation of results, ensuring that contributions from

diverse institutions could be easily compared and integrated. Each partner's section begins with an abstract, followed by a systematic description of new or revised courses, syllabi, and related accreditation information. Subsequent parts outline the teaching and learning resources developed—such as lecture notes, laboratory manuals, digital platforms, and e-books—and describe how these materials are embedded in existing study programs. This structured approach not only guarantees clarity and coherence across the report but also highlights the common direction of the consortium in modernizing education, while allowing space for each university to reflect its specific disciplinary strengths.

A. Kharkiv National Automobile and Highway University

1. Executive Summary

The primary aim of the developed materials is to support the digital transformation of the educational process at Kharkiv National Automobile and Highway University (KhNAHU) by:Enhancing students' digital competencies and employability; Aligning learning outcomes with EU strategies such as the Green Deal and Fit for 55; Providing high-quality, accessible, and inclusive educational content; Supporting remote and flexible learning modalities, especially in the context of war-affected Ukraine.

Target Audience: Undergraduate and Master's level students, particularly those in electrical engineering, information and computer systems, automotive transport, and sustainable mobility; Academic staff, including lecturers and laboratory instructors; Industry stakeholders, who are involved in co-developing content or providing feedback; Internally displaced students and staff, who need access to learning from remote locations.

Structure and Content. Each course includes:

- Lecture notes;
- Methodical instructions for laboratory and practical work;
- Syllabus and work plan;
- Weekly modules with clearly defined learning materials and self-study questions;
- Formative assessments (weekly tests) and summative evaluation (final test).

Materials are built in Moodle and hosted on KhNAHU's learning platform, allowing consistent delivery and flexible access.

Main Findings.

High consistency and structure across all developed courses, ensuring a coherent student experience. Well-defined learning outcomes matched to course content and assessments. Significant use of digital tools, including simulations and modeling environments. Positive user feedback from students and staff regarding clarity, structure, and accessibility. Adaptation to wartime conditions successfully ensured continuity of learning.

2. Introduction

The DIGITRANS project responds to the urgent need to modernize and digitalize the educational systems of Ukraine and Moldova, particularly in the context of ongoing geopolitical and economic challenges. Given the increasing role of digital technologies and green innovations in the global job market, higher education institutions (HEIs) must prepare graduates with skills that are both technically relevant and adaptable to evolving societal needs.

Developing high-quality learning materials is essential to:

- Ensure alignment with EU strategic goals, including the Green Deal and Fit for 55;

- Support international mobility and recognition through double diplomas and collaborative programs;
- Equip students with practical, job-market-oriented skills, especially in areas like renewable energy, smart transport, and digital diagnostics;
- Create resilient digital infrastructure that can sustain education during disruptions (e.g., war, displacement).

Developing Sharing Remote Experiment Environment, as a digitally distributed educational infrastructure, will support the implementation of the Digital Learning Ecosystem (DLE), which enables the application of learning and teaching methodologies and pedagogical approaches, the implementation of a variety of digital practices. DLE will support a joint web-based e-Library with synopses and teaching materials, a virtual environment for distance learning, and virtual mobility, the development of learning and teaching approaches, focused on the use of digital tools, which support students' engagement, assisting self-learning, development of blended courses and other innovative tools.

Kharkiv National Automobile and Highway University, (KhNAHU)

Study program "**Electric vehicles and Automotive electronics**": 7 courses (bachelor's level).

For each course, a Synopsis of lectures and methodological materials for conducting laboratory and practical sessions are developed (if such types of sessions are included in the curriculum)

- **Intended Users:** Identify target audiences such as students, teachers, and other stakeholders.

1. Students (Bachelor and Master's level):
- Gain access to modern, cross-border programs, including double degree programs;
- Participate in remote laboratories, simulations, and real-world internships;
- Acquire transversal skills in electrical engineering, sustainability, and digital innovation.
2. Academic Staff:
- Engage in joint research and curriculum development;
- Receive training in digital teaching methods and remote experimentation tools;
- Participate in teaching across institutions through shared virtual platforms.
3. University Administrators and Policy Makers:
- Use the DIGITRANS ecosystem to inform decisions about educational standards and internationalization strategies;
- Promote recognition of competencies and credits between partner countries and EU institutions;
- Harmonization of Study programs between partner universities.
4. Industrial Partners and Enterprises:

- Cooperate with universities on curriculum design and enterprise-based training;
- Offer internships and professional courses aligned with modern technological needs;
- Benefit from a pool of better-trained, job-ready graduates.

5. Refugees and Internally Displaced Persons:
- Access continuity of education via digital platforms, regardless of physical location;
- Reintegrate into the academic system through flexible online learning environments.

3. Learning and Teaching Materials Overview

- **Types of Materials:** List and describe various resources (e.g., textbooks, workbooks, presentations, guides).

For each course, a Synopsis of lectures and methodological materials for conducting laboratory and practical sessions is developed (if such types of sessions are included in the curriculum).

Link to developed Synopsis of lectures KhNAHU *(See Developed Synopsis of lectures in* ***Chapter 8. Annexes****):*
https://drive.google.com/drive/u/0/folders/1gcOwxhGVRZIAJD1Y5tXU9Mric9ykrOr-

Link to developed learning/teaching materials KhNAHU *(See Methodological materials for conducting laboratory and practical sessions in* ***Chapter 8. Annexes****):*
https://drive.google.com/drive/u/0/folders/1ttx8U-9QCTwlSFRg7ns60S2Z5NVtXEYz

- **Digital Tools and Methods:** Outline digital resources, platforms, and methodologies used.

Courses and their digital learning /teaching materials are developed based on the Moodle system, which is posted on the KhNAHU educational website.

Courses on Moodle KhNAHU:

1. Інфраструктура електромобілів / Electric vehicle infrastructure, https://dl2022.khadi-kh.com/course/view.php?id=2827
2. Системи енергопостачання та енергозбереження /Energy supply and energy saving systems, https://dl2022.khadi-kh.com/course/view.php?id=4849
3. Теорія електроприводу. Частина 1 / Electric Drive Theory. Part 1, https://dl2022.khadi-kh.com/course/view.php?id=6405
4. Теорія електроприводу. Частина 2 / Electric Drive Theory. Part 2, https://dl2022.khadi-kh.com/course/view.php?id=5927
5. Електричні машини та апарати / Electric machines and devices, https://dl2022.khadi-kh.com/enrol/index.php?id=5924

6. Електроніка та мікросхемотехніка Частина 1 /Electronics and microcircuit engineering (Part 1),
https://dl2022.khadi-kh.com/enrol/index.php?id=3541
7. Електроніка та мікросхемотехніка Частина 2 / Electronics and microcircuit engineering (Part 2).
https://dl2022.khadi-kh.com/course/view.php?id=5350

- **E-books for Teachers and Students:** Describe the available e-books, their content, and accessibility.

KhNAHU is responsible for the development of the e-book "**Electric drive, automotive electronics and Energy-saving technologies for Modern transport**". The development of the textbook has been completed. The e-book is available to all participants of the DIGITRANS project consortium.

The e-book is devised for students studying in the fields of electrical engineering, computer engineering, and automotive transport. The book comprehensively overviews key concepts, technologies, and applications related to modern electric drive systems, automotive electronics, and energy-efficient transportation solutions. It covers theoretical foundations, practical implementation, and recent advances in these fields, offering valuable information for students, researchers, and professionals in the automotive and electrical sectors.

- **Multimedia Resources:** Highlight interactive tools, videos, and simulations used in teaching.

During training on the developed electronic courses, the following are used:
- during lectures - Video presentations;
- during laboratory and practical classes - simulations in Mathcad, Electronic Workbench, Proteus and other programs and electronic applications, videos of real equipment;
- during current and final control - interactive test tasks.

4. Pedagogical Approach

- **Instructional Design:** Explain the methodology behind content organization and structure.

The electronic courses are developed in the Moodle system on the Educational Website of KhNAHU.
The learning and teaching materials developed by KhNAHU within the framework of the DIGITRANS project are integrated into these courses (links to the courses are provided in Section 3: Learning and Teaching Materials Overview).

The main part of each course contains general course information, the syllabus, a detailed teaching plan, the lecture compendium, and methodological guidelines for laboratory and practical sessions.
Below this section, the course is structured week by week, with each week featuring:

- work plan for the week;
- dedicated lecture materials;
- separate methodological instructions for other types of activities;
- supplementary resources;
- and self-study questions.

Additionally, formative assessment is provided through weekly quizzes. At the end of the course, there are test assignments for summative assessment.

- **Teaching Strategies:** Describe approaches such as flipped classrooms, blended learning, or problem-based learning.

Due to Russia's military aggression against Ukraine, distance learning is being conducted in all higher education institutions in Kharkiv. All classes and communication between teachers and students will take place (in KhNAHU) via webinar. A separate webinar is provided for each type of class. All webinars are recorded and students can review the educational content at any time. There is also the opportunity to communicate via forums and chats that are built into the developed e-courses (links to the courses are provided in Section 3: Learning and Teaching Materials Overview). Each week has its own list of tasks that students must complete and upload/submit to the e-course in the appropriate directory. Also, each week a list of questions for self-control and tests for ongoing control are offered. Completing all assigned tasks and passing the tests successfully allows the student to receive a positive grade for this course.

- **Assessment and Evaluation:** Provide details on tools used for measuring student learning outcomes.

At KhNAHU, a comprehensive approach is taken to assess and evaluate student learning outcomes. The evaluation system combines traditional academic assessment methods with modern digital tools to ensure fairness, transparency, and alignment with intended learning outcomes.
1. Traditional Assessment Methods
KhNAHU continues to apply established forms of academic assessment:

- Written exams (mid-term and final);
- Oral examinations for theoretical knowledge;
- Lab and practical work reports evaluated by instructors;
- Course projects and research presentations, especially in engineering and technical disciplines;
- Defense of term papers or coursework in selected programs.

These are aligned with each course's learning objectives and are graded using the national and ECTS grading scales.

2. Digital Assessment Tools via LMS (Moodle)

The university's primary LMS, Moodle, offers a range of digital tools for formative and summative assessment:

- Quizzes and tests with automatic grading (multiple-choice, true/false, matching, numerical, etc.);
- Open-ended assignments for essays, design tasks, and lab reports with instructor feedback;
- Timed online exams with randomization and plagiarism-check integration;
- Interactive forums and peer review for formative feedback and active learning;
- Weekly knowledge checks to reinforce learning in asynchronous courses.

These tools are used extensively in both on-campus and distance learning formats, including within international projects such as DIGITRANS.

3. Competency-Based Evaluation

In line with modern curriculum design, some programs use rubrics and competency matrices to evaluate:

- Professional competencies (technical knowledge, application skills);
- Transversal skills (communication, teamwork, problem-solving);
- Digital and entrepreneurial competences (especially in programs developed under EU projects).

These are embedded in course syllabi and transparent to students from the beginning.

4. Final Attestation and Qualification Exams

At the end of each study cycle (bachelor/master), students undergo Final State Attestation, which includes:

- Defense of a qualification thesis or final project;
- Oral examination by a board of faculty members and external stakeholders;
- Evaluation based on pre-defined rubrics and learning outcomes.

KhNAHU’s assessment strategy ensures that student learning outcomes are measured fairly, objectively, and comprehensively, combining traditional academic rigor with digital tools and competency-based approaches. The use of Moodle and other tools enables consistent tracking and supports students' academic success in both national and international contexts.

5. Digital Platforms and Tools

- **E-learning Platforms:** List and describe LMS systems (e.g., Moodle, Blackboard, Google Classroom).

E-learning Platforms Used at KhNAHU.

To support digital and blended learning, KhNAHU actively integrates several Learning Management Systems (LMS) and e-learning tools. Below is an overview of the main platforms used:

1. Moodle (Modular Object-Oriented Dynamic Learning Environment)

Status at KhNAHU: Primary LMS platform.

Moodle is the main platform used for delivering digital courses at KhNAHU. It is hosted on the university's official «Educational Website» and serves as the core of the university's digital learning ecosystem.

Key Features:

- Course pages with syllabi, lecture notes, lab guides, and practical work;
- Weekly structure with assignments and self-assessment quizzes;
- Integration with video, text, and interactive resources;
- Accessibility for students with low bandwidth (downloadable materials);
- Used extensively in EU-funded projects like DIGITRANS for hosting; bilingual (Ukrainian-English) modules.

2. Google Classroom

Status at KhNAHU: Supplementary LMS for specific faculties and teachers.

Some instructors at KhNAHU use Google Classroom, particularly during emergency remote teaching periods.

3. Microsoft Teams / OneNote Class Notebook

Status at KhNAHU: Occasional use for collaborative and remote classes.

Microsoft Teams, part of the Office 365 suite, has been used for online seminars, group collaboration, and file sharing, particularly for research and cross-institutional projects.

KhNAHU's digital learning strategy is based on the effective use of «Moodle» as the central LMS, complemented by tools like «Google Classroom» and «Microsoft Teams» where appropriate. These platforms ensure flexibility, accessibility, and compliance with modern pedagogical approaches-including asynchronous learning, student-centered course design, and integration of industry-aligned content.

- **Collaboration Tools:** Mention digital collaboration tools (e.g., MS Teams, Zoom, Slack, Padlet).

Also, to expand learning opportunities, MS Teams, Zoom, Google Classroom tools can be used.

- **Accessibility and Inclusivity:** Explain measures taken to ensure digital tools are inclusive and accessible to all users.

Measures to Ensure Inclusivity and Accessibility of Digital Tools within the DIGITRANS Project at KhNAHU

1. Moodle-Based Digital Ecosystem

As part of the DIGITRANS project, KhNAHU developed and implemented digital learning tools based on the Moodle platform. This platform complies with international accessibility standards (e.g., WCAG 2.1) and is part of a broader

Digital Learning Ecosystem. It ensures access via various devices and supports features like screen readers, keyboard navigation, and mobile learning.

2. Multilingual Content to Broaden Participation

All DIGITRANS courses are available in both Ukrainian and English to ensure inclusiveness for both local and international participants, internally displaced students, and staff who may have been affected by the war in Ukraine. This dual-language format ensures equitable access to knowledge and teaching materials.

3. Modular and Flexible Course Structure

Each DIGITRANS course is structured into weekly modules that include lecture notes, lab and practical guides (when applicable), self-study resources, and weekly assignments. This modular design allows learners to follow the content asynchronously and at their own pace-critical for students in regions with unstable connectivity.

4. Accessibility-Oriented Instructional Design

Course materials follow Universal Design for Learning (UDL) principles:

- Clear course navigation
- Alternative formats (e.g., text summaries, downloadable PDFs, subtitled video lectures)
- Use of visual aids, infographics, and simplified charts to assist comprehension

5. Dedicated Resources for Students with Special Needs

DIGITRANS courses include flexible assessment options and personalized support for students with specific accessibility needs. Staff members are trained to adapt coursework and provide alternative formats when necessary.

6. Offline Access and Device Compatibility

All core teaching materials-syllabi, lecture notes, lab manuals, etc.-can be downloaded from the KhNAHU Moodle site for offline use. This is essential in war-affected zones or rural areas with limited internet coverage.

7. Integration with National Digital Infrastructure

The DIGITRANS Digital Learning Ecosystem is designed to connect with Ukraine’s forthcoming national Open University Platform. It includes an open interface to enable interoperability with other e-learning environments and ensure scalability and long-term sustainability.

8. Feedback-Driven Improvements and Monitoring

Students and faculty participating in DIGITRANS courses are invited to provide feedback regarding accessibility and usability. Based on this feedback, continuous updates are made to enhance the learning experience and remove barriers.

6. Quality Assurance and Feedback

- **Review Process:** Describe how materials were validated and tested.

The learning materials developed at KhNAHU under the DIGITRANS project underwent a structured review process to ensure their academic quality, relevance to the labour market, and compliance with modern pedagogical standards. Each course was developed by a subject-matter expert, then reviewed by internal university committees and external academic partners.

The review process included:

- Alignment with national and EU education standards, including ECTS and Bologna principles;
- Technical verification of all lecture notes, lab guides, and practical instructions;
- Pilot testing with student groups enrolled in the updated curricula to check usability and clarity;
- Expert evaluation by academic reviewers and representatives from industrial partners involved in DIGITRANS.

- **User Feedback:** Summarize feedback from teachers, students, and experts.

Feedback was collected from multiple stakeholder groups throughout the implementation of the DIGITRANS courses:

- Teachers appreciated the structured templates, bilingual resources, and Moodle-based learning format. They reported improved clarity in delivering course content and enhanced engagement during lab sessions;
- Students responded positively to the modular structure, interactive elements in the Moodle platform, and practical relevance of topics like electromobility, diagnostics tools, and digital systems;
- Industry experts noted that the courses align well with evolving market demands in transport, electrical engineering, and ICT, particularly in relation to sustainability and digital transformation.

Feedback was gathered via surveys, informal interviews, and reports from course instructors after each semester.

- **Continuous Improvement:** Outline plans for updates and enhancements.

KhNAHU is committed to continuously improving the DIGITRANS-developed courses. Key actions planned include:

- Annual updates of course content to reflect advances in green technologies, transport electrification, and digital tools;
- Integration of emerging software tools and simulation environments into lab assignments (e.g., for diagnostics, modelling, or remote lab access);
- Expansion of bilingual content (Ukrainian-English) to support double-degree delivery and cross-border mobility;
- Feedback loops: Future cohorts of students will regularly evaluate courses using structured questionnaires and participate in focus groups;

- Enhancement of accessibility by adapting materials for students with diverse needs and ensuring mobile-friendly access through Moodle.

These improvements will be coordinated within the framework of the DIGITRANS sustainability and quality assurance plan, and in collaboration with partner universities and enterprises.

The developed courses for the bachelor's level educational program "Electric Vehicles and Automotive Electronics" have successfully received accreditation, dated 16.05.2024 ***(See Certificate of Accreditation in Chapter 8. Annexes)***.

7. Conclusions and Recommendations

Summarize key findings and provide recommendations for future development and improvement of learning materials.

Key Findings

1. Integration of Digital Tools and Platforms.

All developed courses are hosted on the KhNAHU Moodle-based Learning Management System (LMS), providing structured access to syllabi, lecture notes, lab manuals, assignments, and assessments.

The courses are designed following a modular format, enabling weekly delivery of content, interactive learning, and continuous assessment.

2. Content Quality and Structure.

Each course includes a complete lecture outline, lab/practical manuals, and supporting materials such as self-preparation questions and auxiliary resources.

Clear alignment with DIGITRANS goals: materials support digital skills, entrepreneurship, and Green Deal-aligned knowledge in automotive, IT, and electrical engineering domains.

3. Inclusivity and Accessibility.

The materials are designed for remote and hybrid learning, catering to internally displaced students and those affected by war in Ukraine.

The content accommodates different levels of student preparedness and supports asynchronous learning.

4. Validation and Feedback.

Courses were reviewed internally and externally by subject matter experts and piloted with students.

Feedback highlighted clarity, practical relevance, and the usefulness of weekly modularization, though some suggestions were made to improve interactivity and multimedia content.

5. Assessment Tools.

The LMS incorporates automated quizzes, self-assessment modules, and final control tests, which allow effective tracking of learning outcomes.

Recommendations for Future Development and Improvement

1. Enhance Interactivity and Engagement.

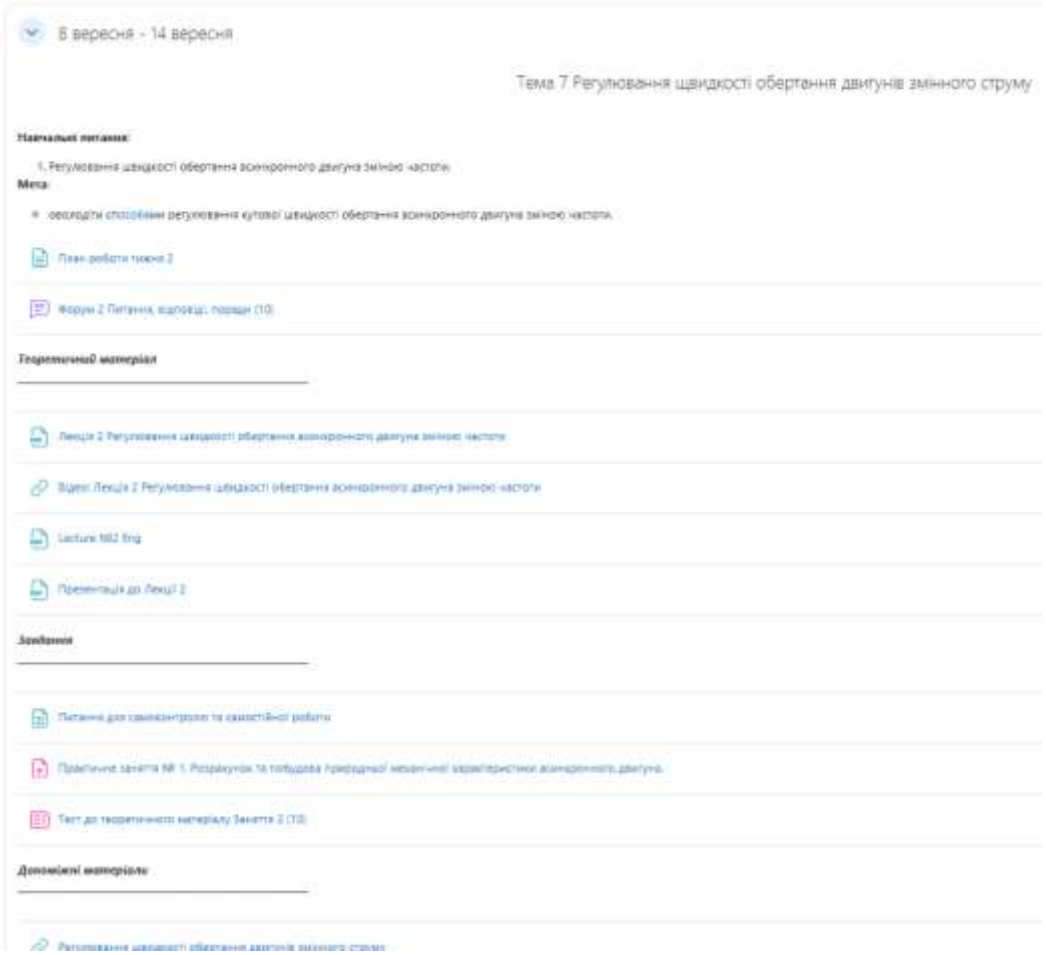
Incorporate more multimedia content (e.g., videos, simulations, animations) to cater to diverse learning styles.
Develop interactive exercises, such as drag-and-drop, simulations, or live coding labs for IT-related modules.
2. Expand Remote Practice Opportunities.
Extend the use of virtual labs and remote experiments, particularly in engineering and diagnostic courses.
Integrate tools for real-time collaboration, such as forums, peer review assignments, or group projects via integrated plugins.
3. Improve Feedback Mechanisms.
Implement systematic student satisfaction surveys at the end of each module to gather structured feedback on the clarity, difficulty, and engagement of the content.
Create a feedback loop for teachers to share best practices and challenges in course delivery.
4. Strengthen Accessibility.
Ensure all materials meet accessibility standards, including the use of alternative text, transcripts for videos, and high-contrast visual design.
Provide translated versions or bilingual interfaces where possible for Ukrainian/Moldovan and English audiences.
5. Continuous Updating and Sustainability
Establish a course improvement calendar for regular updates in response to new technological trends and student feedback.
Encourage involvement of industry partners to co-develop updated case studies and real-world projects.
6. Certification and Microcredentials.
Integrate digital badges or certificates aligned with specific competencies to motivate learners and enhance employability.
Explore linking course achievements with EUROPASS or other recognized frameworks.

8. Annexes

Include additional supporting materials such as:

- Sample lesson plans

Sample lesson plan "Electric Drive Theory. Part 2":



- User guides for digital tools

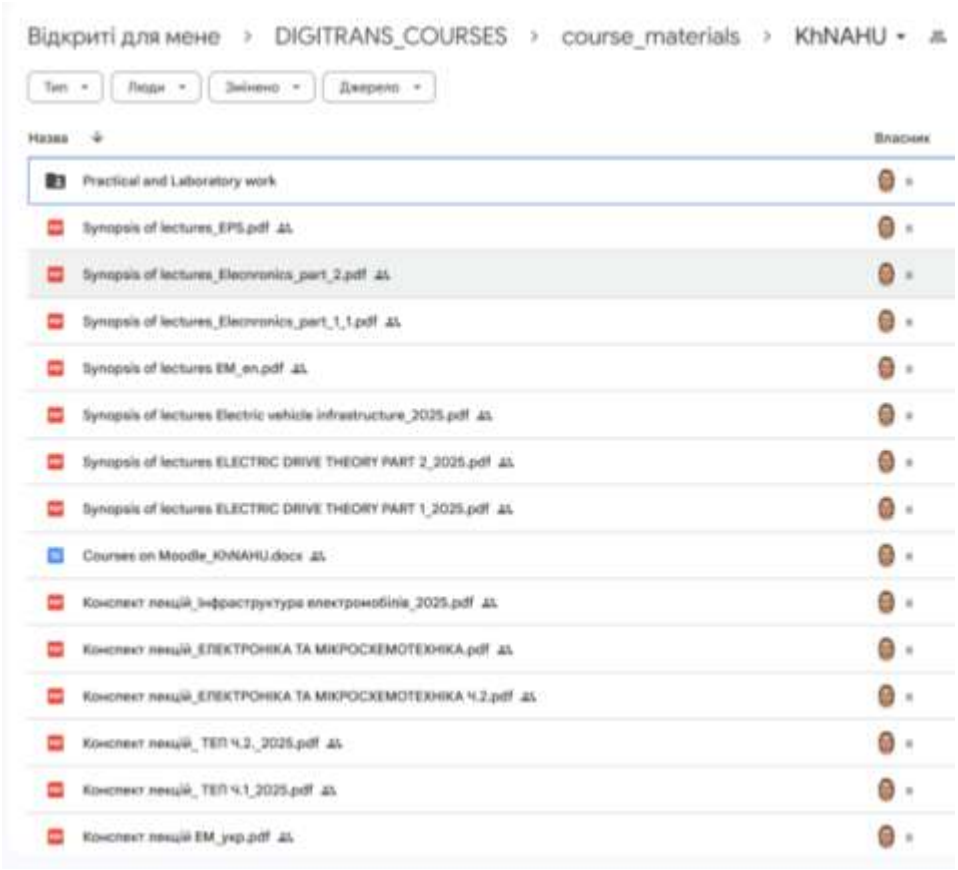
Structure and Accessibility of the Guides in KhNAHU

Each course contains a dedicated "Start Here" or "User Guide" section, typically located at the top of the course page in Moodle. These guides are:

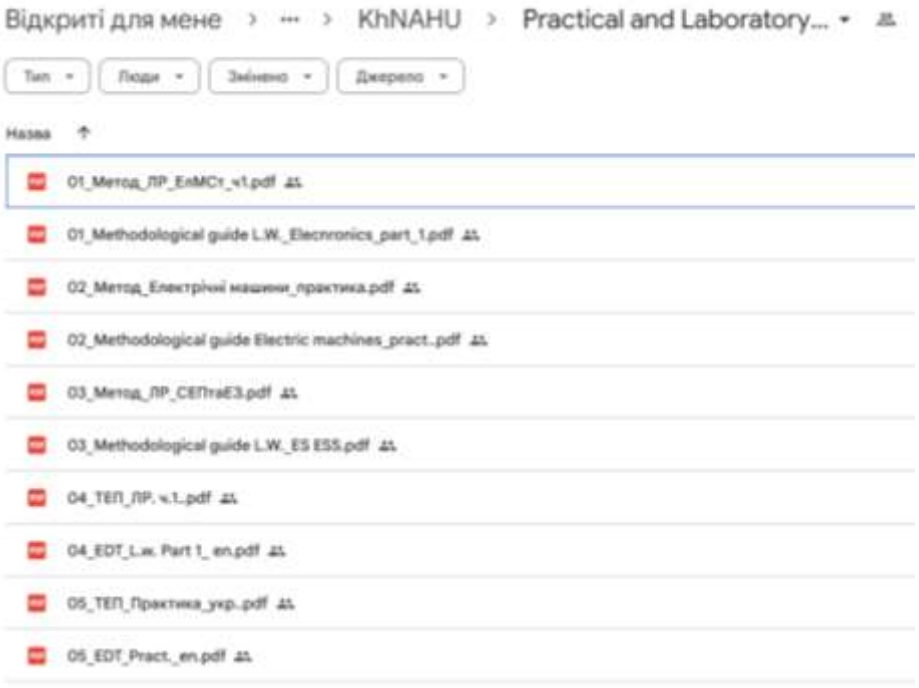
- Written in Ukrainian and English to support bilingual learners and potential international double-degree participants;
- Presented in PDF format and embedded as web-readable pages within the Moodle course interface.
- Designed for mobile-friendly access, allowing users to refer to instructions via smartphones and tablets.

- Screenshots and links to digital resources

KhNAHU: Developed Synopsis of lectures.



KhNAHU: Methodological materials for conducting laboratory and practical sessions.



KhNAHU: Certificate of accreditation of the «Electric Vehicles and Automotive Electronics» educational program dated 16.05.2024

НАЦІОНАЛЬНЕ
АГЕНТСТВО
ІЗ ЗАБЕЗПЕЧЕННЯ
ЯКОСТІ ВИЩОЇ ОСВІТИ

СЕРТИФІКАТ
ПРО АКРЕДИТАЦІЮ ОСВІТНЬОЇ ПРОГРАМИ

Освітньо-професійна програма

Електромобілі та автомобільна електроніка

141 Електроенергетика, електротехніка та електромеханіка

перший (бакалаврський) рівень

Харківський національний автомобільно-дорожній університет

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Дата видачі 16.05.2024 Строк дії 01.07.2029

№ 8175

B. Cahul State University

1. Executive Summary

Provide a concise overview of the learning and teaching materials developed, including key objectives, target audience, and main findings.

This report provides a comprehensive overview of the learning and teaching materials developed for six courses at Cahul State University "B.P. Hasdeu".
The courses were enhanced with modern pedagogical approaches and digital tools:

- Production Management - https://e-learning.usch.md/course/view.php?id=624
- Tools of Ecological Production – https://e-learning.usch.md/enrol/index.php?id=634
- Computer-Aided Design of Products in Machine Building Industry – https://e-learning.usch.md/enrol/index.php?id=646
- Computer-Aided Design of Technological Processes and CALS Technologies https://e-learning.usch.md/enrol/index.php?id=647
- Design of Electric Machines – https://e-learning.usch.md/enrol/index.php?id=645
- Human Resources Management – https://e-learning.usch.md/enrol/index.php?id=635

Key objectives were to improve teaching quality through high-quality materials, integrate digital platforms (notably the e-learning.usch.md) and industry-grade software, and foster practical, interdisciplinary skills in students. The target audience includes undergraduate students (primarily in engineering, management, and applied sciences) as well as faculty who implement these materials; indirect beneficiaries are industry partners through better prepared graduates. Overall, the materials encompass a mix of traditional textbooks, e-books, presentations, and interactive resources, combined with methodologies like problem-based learning (PBL), collaborative projects, and case studies. The main findings indicate that using a central e-learning platform alongside tools such as Miro, Mentimeter, and SOLIDWORKS® Education Edition has enriched student engagement and learning outcomes. Each course's content and assessments were aligned with real-world applications – including interdisciplinary group projects, simulations, and even f ield visits – which collectively contribute to more effective and sustainable teaching and learning practices.

2. Introduction

- **Background and Context:** Explain the importance of developing high-quality learning materials.

In the context of rapid digital transformation and the need for closer university-enterprise collaboration, developing high-quality learning materials has become critically important. The DIGITRANS project facilitated a revamp of course syllabi and content to embrace modern educational practices and technology. Traditional teaching methods in engineering and management disciplines often struggled to keep pace with industry advancements; hence this initiative aimed to modernize curricula, making them more interactive, practical, and aligned with current digital tools. High-quality learning materials – including up-to-date content and accessible digital resources – form the foundation for improving student competencies and engagement. By leveraging digital platforms and integrating industry-relevant software, the project addressed the

need for educational resources that prepare students for contemporary workplace demands while also supporting sustainable regional development through education.

- **Objectives:** Define the purpose and scope of the materials.

The primary objective of the developed materials was to enhance the teaching and learning experience by incorporating digital technologies and innovative pedagogy. This involved creating comprehensive course content that not only covers theoretical knowledge but also emphasizes practical application through simulations, case studies, and project-based learning. Each course material was designed with 1 clear learning outcomes aligned to industry needs, such as mastering CAD software or understanding sustainable production tools. A further objective was to enable flexibility in delivery – allowing for blended learning (combining face-to-face lectures with online components) – thereby increasing resilience of the education process (for example, during times when remote learning is necessary). Moreover, the project sought to standardize quality across courses, ensuring that all materials meet academic standards and are consistently structured for ease of use. An implicit goal was also to encourage interdisciplinary learning by linking concepts from engineering, environmental science, and management within and across the courses, reflecting real-world complexities.

- **Intended Users:** Identify target audiences such as students, teachers, and other stakeholders.

The intended primary users of these materials are undergraduate students enrolled in the respective courses, who benefit from the enriched content and interactive learning methods. The materials are tailored to students of Engineering and Management in Machine Construction (Automotive) study program. University teachers are another key user group; the syllabi, lesson plans, and digital tools serve as practical guides for faculty to deliver modernized instruction. The resources are designed to be teacher-friendly, providing clear outlines and ready-to-use digital platforms (like the LMS and interactive tools) to facilitate teaching. Finally, enterprise partners and industry stakeholders are indirect beneficiaries: by participating through guest lectures, providing case study data, or hosting field visits, they engage with the materials, and in turn they stand to gain from graduates who have hands-on experience and digital skills. The interdisciplinary and practical focus of the materials means that students are better prepared to enter the workforce, thus enterprises benefit from a talent pool trained with these up-to-date resources

3. Learning and Teaching Materials Overview

- **Types of Materials:** List and describe various resources (e.g., textbooks, workbooks, presentations, guides).

Across the six courses, a diverse set of learning materials was developed and compiled, blending traditional and digital formats. Textbooks and reference books remain a cornerstone: each syllabus lists required and recommended textbooks that cover the foundational theory and domain knowledge. Alongside textbooks, lecture presentations and notes were produced in digital format (e.g., PowerPoint slides and PDF handouts) to organize content by topic and provide visual illustrations. These presentations distill key concepts and often incorporate diagrams, charts, or workflow schematics pertinent to the subject. Furthermore, workbooks and problem sets were prepared for the hands-

on components of each course. For example, the laboratory portion of Production Management includes a series of case study tasks and calculations for each major topic, essentially acting as a workbook guiding students through practical problem-solving exercises. Similar lab or seminar worksheets were created for other courses – in Computer-Aided Design courses, step-by-step design project briefs and exercises were provided, and in Human Resources Management, students received case scenarios and role-play prompts to apply HR concepts. Each course also had a detailed syllabus document (the basis of this analysis) outlining objectives, contents, and evaluation methods, which itself serves as a guide for both students and teachers. Additionally, guides and manuals for specific tools or methods were included as supporting materials; for instance, the Design of Electric Machines course provided a user guide for the Simulink simulation platform as part of the required reading, aiding students in mastering the software used in the course. Overall, the types of materials ranged from printed texts to digital documents and interactive content, structured to complement each other – theoretical readings paired with practical exercise sheets, and lecture slides paired with discussion guides – thereby catering to various learning activities within the courses.

- **Digital Tools and Methods:** Outline digital resources, platforms, and methodologies used.

A hallmark of the DIGITRANS initiative is the integration of digital resources and methodologies into course delivery. All six courses employed a blend of face-to-face instruction and online/digital elements, effectively creating a blended learning environment. A central element was the university's e-learning platform (Moodle-based), which served as a repository for course materials and an interaction space for students. The platform also enabled the use of question banks and automated grading for tests, which the teachers leveraged for periodic assessments and exam preparation. In terms of methodologies, interactive digital methods were introduced to make learning more engaging. Several courses adopted problem-based learning (PBL) facilitated by online collaboration: students worked in teams to solve complex problems or case studies and often used collaborative software to coordinate. Tools like Miro, an online collaborative whiteboard, were used to enable students to jointly brainstorm and design in real time – for instance, creating mind maps of an ecological product lifecycle or sketching a production flow process remotely. Mentimeter, a live polling and quiz tool, was employed during class sessions (both in-person and virtual) to gather student feedback, test understanding with instant quizzes, or prompt discussions via word clouds. For the engineering design-oriented courses, specialized software tools were central to the teaching method: notably, CATIA and SOLIDWORKS® (Education Edition) for 3D modeling and simulation. Within the CAD of Technological Processes course, a Product Data Management tool (PDMWorks, part of the SolidWorks suite) was used to teach how design data is stored and managed collaboratively. The lab exercises in that course walk students through setting up a PDM database, managing revisions, and running simulations with SolidWorks' module, illustrating how digital tools and methods are inseparable from the content. By using these industry-standard digital tools, the courses not only conveyed theoretical knowledge but also allowed students to learn-by-doing in virtual environments that mimic real-world engineering and decision-making scenarios. This digital infusion across all courses represents a significant shift from traditional methods toward a more interactive, tech-enabled pedagogy.

- **E-books for Teachers and Students:** Describe the available e-books, their content, and accessibility.

To ensure both teachers and students have access to up-to-date knowledge, the courses incorporated e-books and digital publications as part of their learning materials. Several syllabi updated their reference lists with recent electronic resources that could be accessed online or through the university library's digital subscriptions.
The courses include publications in its bibliography, complete with DOI links for easy access. These are Springer e-books on sustainability and circular economy topics, which students and faculty can read in electronic format. By providing DOIs and online sources, the syllabus encourages students to utilize these digital books without the barrier of locating physical copies. The inclusion of such resources reflects a deliberate move towards more accessible and up-to date content, ensuring that students are learning the latest developments in the field (e.g., modern approaches to sustainability or the newest design methodologies).
Teachers, on their side, benefited from e-books such as teaching guides and manuals. One example is the inclusion of a Simulink® User's Guide as part of the required reading for the Electric Machines course – this guide is an electronic manual that teachers could use to design simulation labs and that students could follow for self-study. Moreover, some course authors have their own works available digitally.
By leveraging e-books for both students and staff, the courses promote a more flexible learning experience – students can study anytime on their devices, and teachers can easily pull excerpts or figures for inclusion in their slides. The use of e-books also has the advantage of enabling remote learning or hybrid classes, since all needed texts can be reached through the internet, aligning well with the project's digital transformation goals

- **Multimedia Resources:** Highlight interactive tools, videos, and simulations used in teaching.

The redesigned courses made substantial use of multimedia resources to complement text-based learning.
A key category of multimedia employed was interactive simulations and software-based exercises. In the technical courses students engaged with simulation tools as part of their learning: MATLAB, Simulink, CATIA or SolidWorks.
Another form of multimedia resource used was video and animation content. Teachers curated short videos to illustrate certain topics Additionally, some courses included multimedia presentations where slides were enriched with images, charts, and even short embedded media, which contained infographics on material flows and lifecycle stages, charts of organizational structures and video snippets illustrating leadership styles.
Interactive in-class tools like Mentimeter: using live polls or quizzes projected on screen allowed for an immediate visual representation of the class's responses (graphs, word clouds), turning student feedback into a collective image that could be analyzed on the spot.
Similarly, the use of Miro boards in class effectively created a multimedia collage of student contributions – sticky notes, sketches, and diagrams co-created by the group – which can be saved and reviewed later as learning artifacts. These boards often served as a visual summary of a lesson. Finally, the e-learning platform itself provided

multimedia elements: many courses' online modules included short tutorial videos (created by the teachers or sourced from platforms like YouTube, demonstrating how to solve a sample problem or use a software feature. By combining text, audio, video, and interactive software, the learning experience became more immersive and varied, catering to different learning preferences and keeping students engaged through multiple modalities.
Also, on the e-learning platform, teachers included links with direct access to the official websites of the EU and the Republic of Moldova to access laws and normative acts, national and international regulations.

4. Pedagogical Approach

- **Instructional Design:** Explain the methodology behind content organization and structure.

The instructional design of these courses was carefully planned to ensure a logical flow of content and a strong alignment between objectives, activities, and outcomes. In each syllabus, the course content is structured into modules or thematic units, following a progression from fundamental concepts to more complex applications.
This modular design helps students build upon their knowledge step by step, with each module containing a coherent set of topics. By breaking the curriculum into clear units, the teachers ensured that students could concentrate on one aspect at a time while seeing how each part integrates into the bigger picture by the end.
Another key aspect of the instructional design is the integration of theory and practice. Each theoretical topic delivered in lectures is closely paired with a practical or applied component in seminars or laboratories.
This one-to-one mapping (lecture topic → corresponding lab exercise) is by design, reinforcing learning by application. The syllabi explicitly list Laboratory Contents or Seminar Contents that mirror or extend the lecture topics, indicating careful planning to ensure that practical sessions are not an afterthought but an integral part of learning design.
To support diverse learners, the instructional design also incorporated differentiated instruction and scaffolding. As stated in some syllabi, teachers planned varied forms of work (individual, pair, group) and problem complexity to cater to different skill levels. For example, easier introductory problems build confidence, and later more complex tasks challenge advanced students while encouraging peer learning. The materials often start with illustrative examples (exemplification) to introduce a concept, then move to guided practice (perhaps through a structured case study), and finally to independent or group projects that require synthesis of multiple concepts. This scaffolding ensures that by the time students attempt the capstone project or final assessment, they have incrementally developed the necessary knowledge and skills. Moreover, because these courses often draw students from interdisciplinary backgrounds (engineering and management), the design intentionally revisits prerequisite knowledge and then extends it. The inclusion of review sections or prerequisite refreshers (noted in syllabi prerequisites and initial lectures) is another design choice to ensure all students share a baseline understanding before tackling advanced topics. In summary, the instructional design across these courses is characterized by a clear modular structure, a tight coupling of theory with practice, and a scaffolded progression tailored to meet the courses' learning objectives and accommodate the student cohort's needs.

- **Teaching Strategies:** Describe approaches such as flipped classrooms, blended learning, or problem-based learning.

The teaching strategies employed in the six courses emphasize active learning, collaboration, and real world problem solving, moving away from pure lecture-based delivery:
- Problem-Based Learning (PBL) - a prominent strategy common to all courses
- Case-based learning, used in seminars.
- Collaborative learning strategies
- Critical thinking and discussion techniques
- Flipped classroom
- Experiential learning.

Such an approach grounded abstract concepts in tangible experience. In summary, the teaching strategies were diverse and student-centered: by using PBL projects, case studies, group collaboration, interactive polling, and field experiences, the courses moved toward a pedagogy that engages students actively, develops their critical thinking, and simulates real-life problem solving. The result is a more dynamic classroom where students are co-creators of knowledge, guided by teachers who facilitate and provide expert insight as needed.

- **Assessment and Evaluation:** Provide details on tools used for measuring student learning outcomes.

The assessment methods across the six courses were designed to be continuous, formative, and comprehensive, reflecting the multifaceted learning outcomes expected from each course. A common assessment structure included: ongoing assessments (continuous evaluation) of weekly tasks or lab work, a mid-semester evaluation, a significant group project, and a final exam. This ensures that students are evaluated on a variety of skills and knowledge over time

5. Digital Platforms and Tools

- **E-learning Platforms:** List and describe LMS systems (e.g., Moodle, Blackboard, Google Classroom).

The backbone of the courses' digital infrastructure was the university's e-learning platform, e-learning.usch.md, which is a Moodle-based Learning Management System (LMS). This platform was the central hub for course delivery and coordination. All course materials – syllabi, lecture notes, assignments, reading resources – were uploaded to the LMS, allowing students convenient access from on-campus or remotely. Each course had its dedicated online space where teachers could post announcements, schedule, and supplementary links. The LMS supported bilingual interfaces (Romanian and English) , which was advantageous for accessibility (for instance, if any English speaking collaborators or materials were involved, the interface could be switched).

Through e-learning.usch.md, a variety of teaching and assessment functionalities were utilized. Discussion forums were available and some courses encouraged students to pose questions or continue class discussions online, which is particularly useful for complex design problems or case studies that may need more time to hash out. Assignment drop boxes were used for students to submit their reports, design project files, or essays electronically; this not only streamlined collection but also enabled instructors to use plagiarism checking tools and to keep a clear record of submissions.

One of the most significant uses of the LMS was for online quizzes and tests. Using Moodle's quiz engine, teachers created practice quizzes for self-assessment and formal quizzes for grading.
The e-learning platform also facilitated the blending of asynchronous and synchronous learning. In essence, e-learning.usch.md served as the digital classroom extension, ensuring continuity of learning beyond the physical classroom. Its use was crucial during any travel or mobility of students/faculty (given the project's international scope, having materials online meant that partner institutions or visiting lecturers could also view and contribute). Moreover, the platform's analytics allowed instructors to monitor student engagement (e.g., who has downloaded materials or attempted quizzes), which can inform interventions for students who may be falling behind.

- **Collaboration Tools:** Mention digital collaboration tools (e.g., MS Teams, Zoom, Slack, Padlet).

To complement the LMS and enhance interactivity, a suite of digital collaboration tools was employed throughout the courses>
- Google Meets
- Google Classroom
- Zoom
- Miro
- Google Docs/Sheets
- specialized software tools: SOLIDWORKS® Education Edition (Network), Matlab, CATIA.

- **Accessibility and Inclusivity:** Explain measures taken to ensure digital tools are inclusive and accessible to all users.

Ensuring that digital learning tools and materials are accessible and inclusive was an important consideration in the design and delivery of these courses. On the technical side, the chosen platforms are broadly accessible with any standard computer or mobile device and an internet connection. Content-wise, most materials were provided in Romanian (since that is the language of instruction), but whenever English-language resources were used (like certain textbooks or articles), teachers often provided summaries or discussed them in Romanian to ensure understanding. This bilingual approach in materials caters to inclusivity for students who may have varying levels of proficiency in English (common in technical fields).
Accessibility in the sense of disability support was considered by using accessible document formats and clear design. PDF and PowerPoint materials were formatted for readability, with appropriate fonts and contrast. When videos were used, the instructors endeavored to find versions with subtitles (especially if the video was in a language not spoken by all students, e.g., an English documentary for a Romanian class would ideally have Romanian subtitles or the instructor would pause and translate key points). The Moodle platform is screen-reader friendly and allows adding alternative text for images; whenever course materials had important images (diagrams, charts), the instructors provided descriptions or captions.
Another aspect of inclusivity is ensuring that students with different learning paces and styles can succeed. The combination of synchronous and asynchronous tools addressed this: those who needed more time or a different modality to learn could review content

on the LMS (e.g., re-reading lecture notes or trying a practice quiz again) at their own pace.

Internet connectivity and device availability can be an inclusivity issue in digital education. To mitigate this, the university provided on-campus computer labs with all needed software (like SolidWorks, MATLAB) installed, so that students who did not have powerful computers at home could complete their assignments on campus. For online resources, materials were made as bandwidth-light as possible (PDFs, compressed files, etc.), and key resources were also downloadable for offline use. In cases of online tests, the platform allowed enough time window or had contingency plans (like the possibility to resume an attempt if a connection dropped out momentarily, or the option to take a test on paper if a student had issues with the computer). These measures aimed to ensure no student was disadvantaged due to technical accessibility issues.

6. Quality Assurance and Feedback

- **Review Process:** Describe how materials were validated and tested.

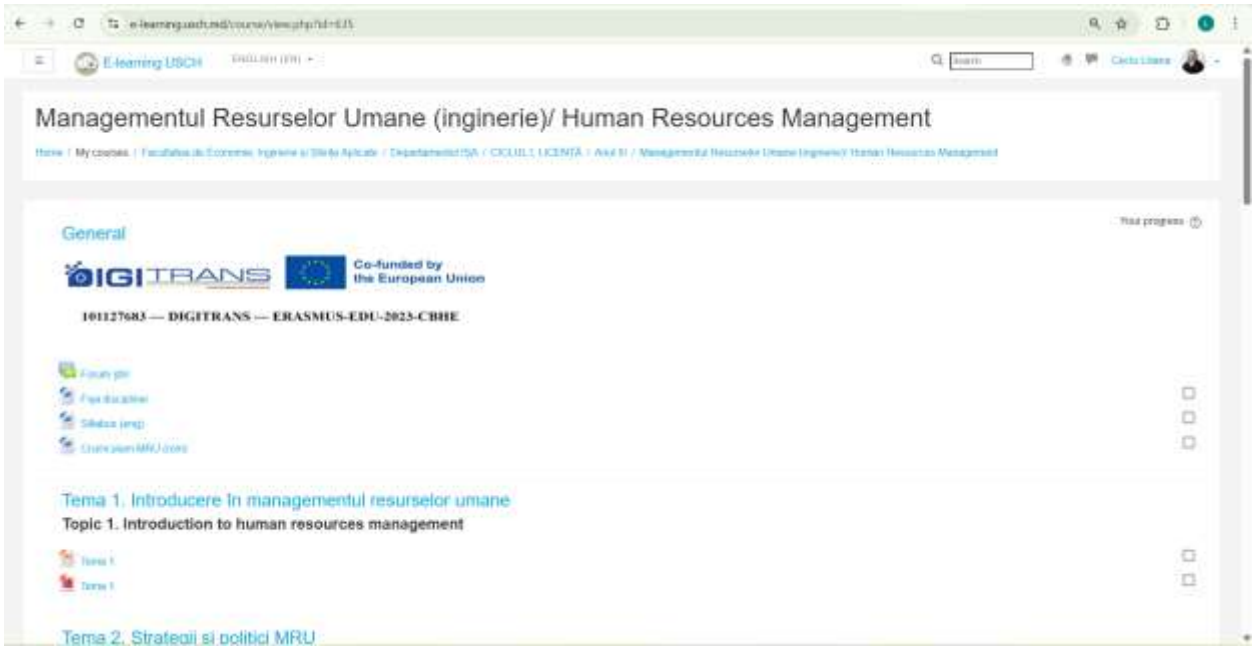
A robust review process was in place to ensure the quality and effectiveness of the learning materials developed. Initially, the syllabi and course plans were drafted by the respective course teachers, drawing on both their expertise and the objectives of the DIGITRANS project. These drafts then underwent scrutiny at multiple levels. Within the university, departmental committees examined the syllabi to ensure compliance with academic standards and alignment with the program curricula. This included checking that learning outcomes matched assessment methods and that the content was up to-date and relevant. Many of the courses, being newly updated or created, were also reviewed by the university's Quality Assurance (QA) office or curriculum committee, which is standard procedure for new course approvals. Any feedback from these internal reviews (such as clarifying the wording of an outcome, adjusting the ECTS credits distribution, or adding a reference) was incorporated before finalizing the materials.

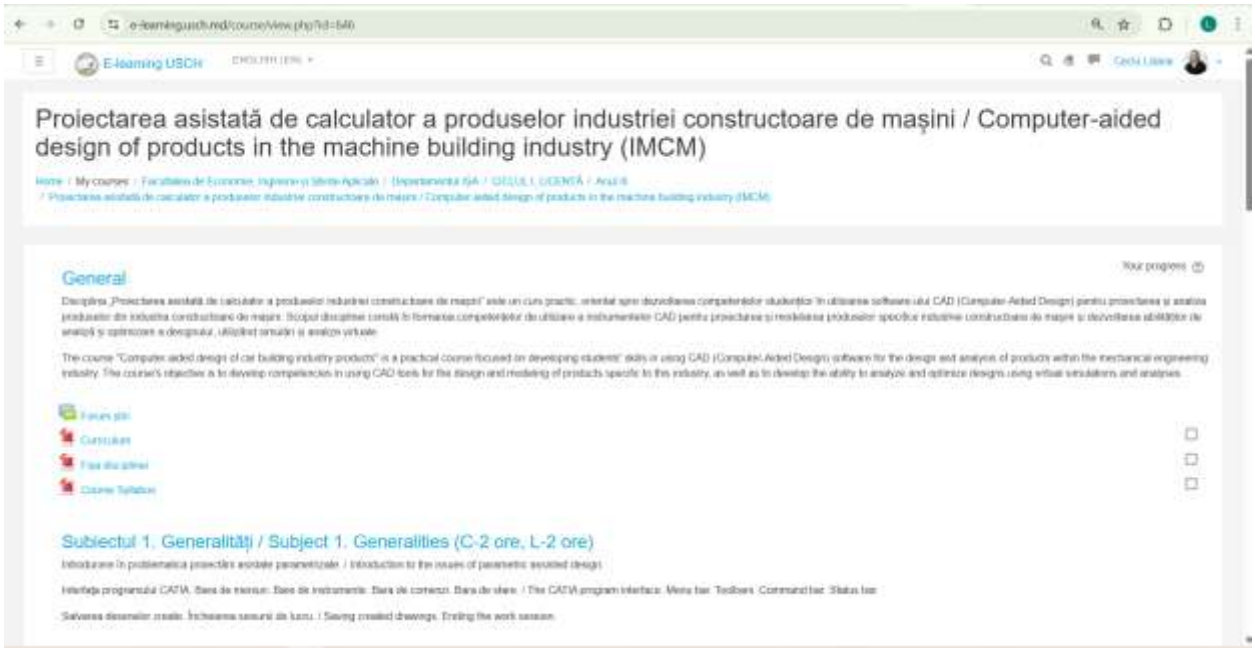
- **User Feedback:** Summarize feedback from teachers, students, and experts.
- **Continuous Improvement:** Outline plans for updates and enhancements.

7. Annexes

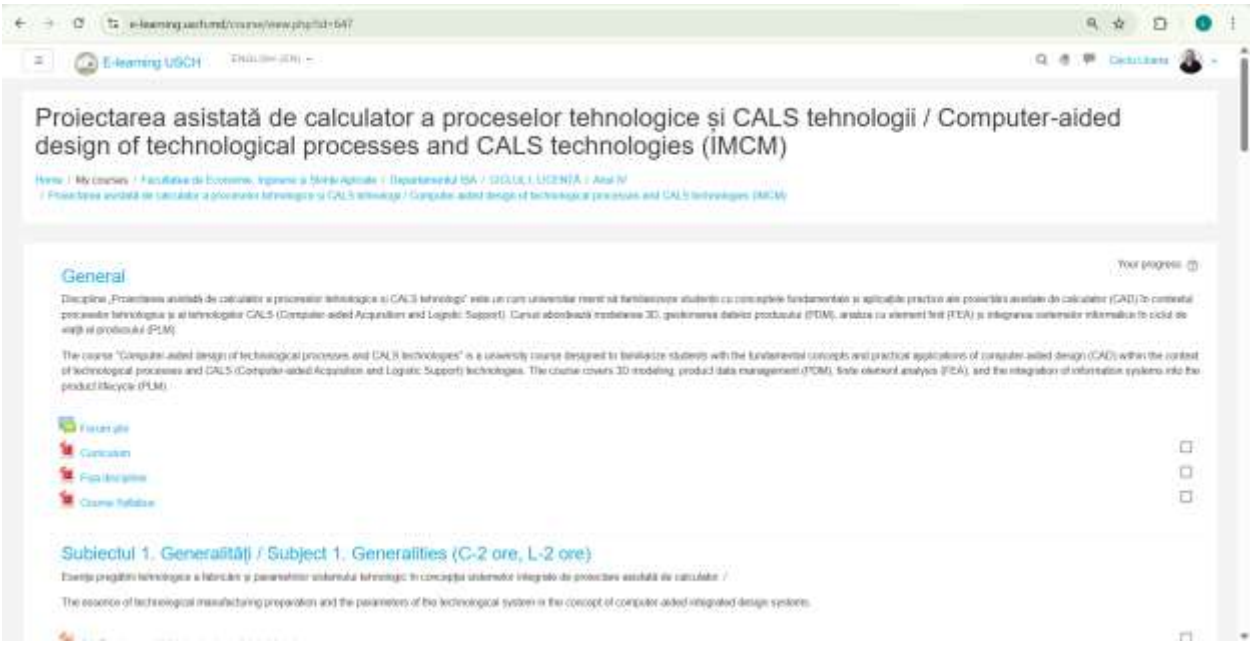
Include additional supporting materials such as:

- Sample lesson plans
- User guides for digital tools
- Screenshots and links to digital resources

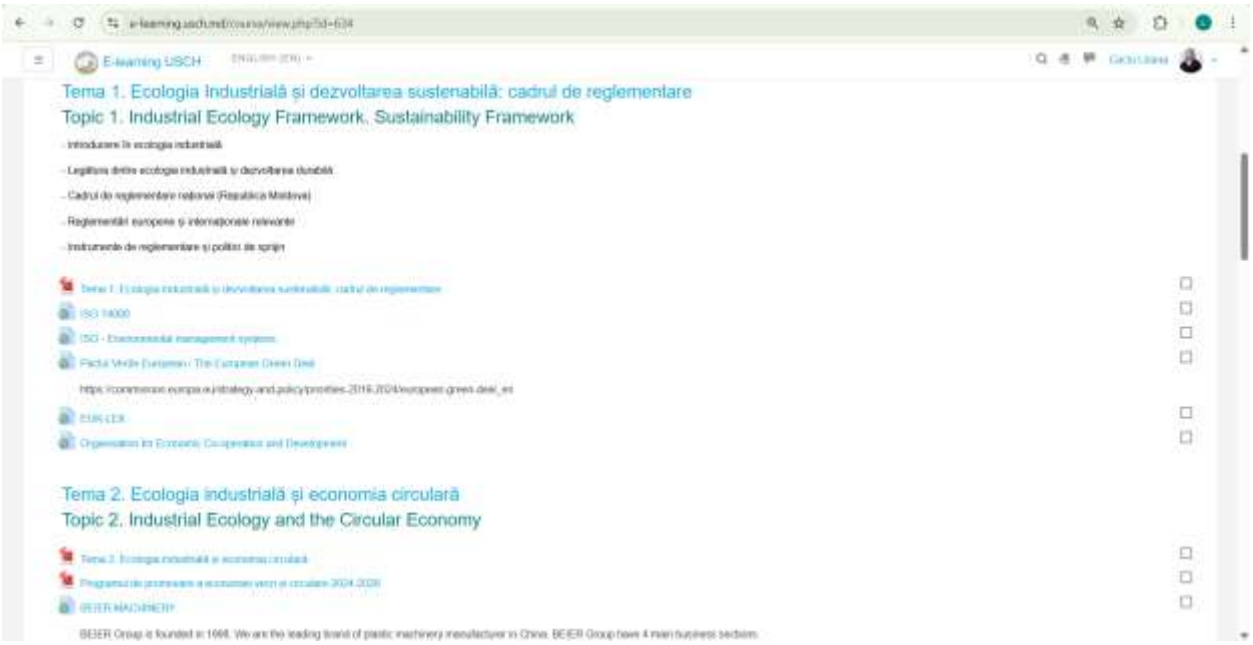

E-learning USCH
Managementul Resurselor Umane (inginerie)/ Human Resources Management
General
Co-funded by the European Union
101127683 — DIGITRANS — ERASMUS-EDU-2023-CBHE
Tema 1. Introducere în managementul resurselor umane
Topic 1. Introduction to human resources management
Tema 2. Strategii si politici MRU


E-learning USCH
Proiectarea asistată de calculator a produselor industriei constructoare de mașini / Computer-aided design of products in the machine building industry (IMCM)
General
Subiectul 1. Generalități / Subject 1. Generalities (C-2 ore, L-2 ore)


E-learning USCH
Proiectarea mașinilor electrice / Design of electric machines (IMCM)
General
Subiectul 1. Noțiuni introductive / Subject 1. Introductory notions (C-2 ore, L-2 ore)


E-learning USCH
Proiectarea asistată de calculator a proceselor tehnologice și CALS tehnologii / Computer-aided design of technological processes and CALS technologies (IMCM)
General
Subiectul 1. Generalități / Subject 1. Generalities (C-2 ore, L-2 ore)


E-learning USCH
INSTRUMENTE ALE PRODUCERII ECOLOGICE / TOOLS OF ECOLOGICAL PRODUCTION
General
DIGITRANS
Tema 1. Ecologia Industrială și dezvoltarea sustenabilă: cadrul de reglementare
Topic 1. Industrial Ecology Framework. Sustainability Framework


E-learning USCH
Tema 1. Ecologia Industrială și dezvoltarea sustenabilă: cadrul de reglementare
Topic 1. Industrial Ecology Framework. Sustainability Framework
- Introducere în ecologia industrială
- Legătura dintre ecologia industrială și dezvoltarea durabilă
- Cadrul de reglementare național (Republica Moldova)
- Reglementări europene și internaționale relevante
- Instrumente de reglementare și politici de sprijin
Tema 2. Ecologia industrială și economia circulară
Topic 2. Industrial Ecology and the Circular Economy


E-learning USCH
PLANIFICAREA ȘI GESTIUNEA ÎNTREPRINDERII INDUSTRIALE // Industrial Enterprise Planning and Management
General
Tema 1. PRINCIPIILE ȘTIINȚIFICE ALE MANAGEMENTULUI PRODUCȚIEI // Scientific principles of production management
Tema 2. ÎNTREPRINDEREA INDUSTRIALĂ - OBIECT AL ACTIVITĂȚII ANTREPRENORIALE // Industrial enterprise - an object of entrepreneurial activity

C. Lutsk National Technical University

1. Executive Summary

Provide concise review developed educational and methodical materials , including key target , target audience and main conclusions

In 2025, the Department of Automobiles and Transport Technologies of Lutsk National Technical University developed one and updated 5 methodological publications for applicants of the first (bachelor's) and second (master's) levels of study in the educational programs " Automobile Transport" and "Automobile Transport Engineering". The publications cover fundamental theoretical sections (vehicle theory, technical operation), issues of design and organization of motor transport enterprises, management, as well as quality management of production processes. The materials are focused on practical application in the educational process and have an applied focus - from theoretical justifications to diagnostic algorithms, calculation methods and management tools. A detailed list of publications and a brief summary are given in the " Appendices " section.

2. Introduction

Background and context: Explain importance developments high quality educational materials .

Modern education in the field of road transport requires a combination of classical theoretical base and practical competencies, especially in the context of digitalization (telematics, CMMS, BI tools) and the transition to electromobility. The development of methodological publications is designed to ensure the systematic training of specialists taking into account these challenges.

• Objectives: Define the purpose and scope materials .

The purpose of creating a set of methodological publications is to:

- formation of students' stable theoretical knowledge and practical skills in the operation, diagnostics and management of road transport;

- providing teachers with materials for planning lectures and practical classes;

- integration of modern digital tools and assessment methods into the educational process.

• Targeted users: Define target audience , such as students , teachers and others interested sides .

Target audience:

- Bachelor's level applicants (main volume of materials: lecture notes);

- Master's level students (advanced management courses);

- lecturers of the department and practitioners of the car service and transport industry.

3. Learning and Teaching Materials Overview

• Types materials: List and describe different resources (e.g. , textbooks , workbooks) notebooks , presentations , manuals).

The kit consists of six notes/methodological guidelines covering both technical and organizational and managerial issues:

1. **Car Theory** : [Text]: lecture notes for students of the first (bachelor's) level of higher education of the educational program "Automobile Transport" of the field of knowledge J Transport and Services, specialty J8 Automobile Transport of full-time and part-time forms of study / compiled by: O. SITOVSKYY - Lutsk: LNTU, 2025– 128 p. — analysis of operational properties, traction-speed calculations, dynamics, braking properties, etc. (a detailed structure of the sections is given in the appendix).

2. " **Road Transport Management**: [Text]: lecture notes for students of the second (master's) level of higher education of the educational program "Road Transport Engineering" of the field of knowledge of the field of knowledge J Transport and services of the specialty J8 Road Transport of full-time and part-time forms of study of all forms of study / compilers: V. KOTENKO, V. PRYDYUK, V. DEMBITSKY - Lutsk: LNTU, 2025. - 104 p. - management, organization, motivation, risk management.

3. " **Road transport enterprises. Part 1: Design**: [Text]: lecture notes for applicants of the first (bachelor's) level of higher education of the educational program "Road transport" of the field of knowledge J Transport and services of the specialty J8 Road transport of full-time and part-time forms of study / compiled by: V. PAVLYUK,– Lutsk: LNTU, 2025.– 52 p. — technological calculations, planning of the production and technical base.

4. **Road transport enterprises. Part 2: Organization and management:** [Text]: lecture notes for applicants of the first (bachelor's) level of higher education of the educational program "Road transport" of the field of knowledge J Transport and services of the specialty J8 Road transport of full-time and part-time forms of study / compilers: V. DEMBITSKY, – Lutsk: LNTU, 2025.– 192 p. — organizational structures, HR, digitalization, innovative models (car sharing, MaaS, EV/H2).

5. **Road transport enterprises. Part 3: Quality of production processes:** [Text]: lecture notes for applicants of the first (bachelor's) level of higher education of the educational program "Road transport" of the field of knowledge J Transport and services of the specialty J8 Road transport of full-time and part-time forms of study / compilers: V. DEMBITSKY, – Lutsk: LNTU, 2025.– 124 p. — quality management tools (5S, SPC, PFMEA, 8D), KPI, digital quality tools.

6. **Technical operation of cars:** [Text]: lecture notes for applicants of the first (bachelor's) level of higher education of the educational program "Motor transport" of the field of knowledge J Transport and services of the specialty J8 Motor transport of

full-time and part-time forms of study / compilers: V. DEMBITSKY, V. SAMOSTYAN, V. PRYDYUK, V. PAVLYUK – Lutsk: LNTU, 2025– 432 p. — a comprehensive course on diagnostics, maintenance, repair of internal combustion engines, electric vehicles and related systems.

- **Digital tools and methods: Outline used digital resources , platforms and methodologies .**

The materials include sections on digital enterprise management systems (ERP/CMMS/TMS), telematics solutions, and data analytics. These sections provide a basis for further adaptation of the materials into LMS and integration with electronic reference books and simulators.

- **E- books for teachers and students : Describe available e- books, their content and accessibility .**

Methodological texts contain numerous diagrams, tables, and algorithms that facilitate conversion to electronic formats (PDF, modules for Moodle/Google Classroom).

- **Multimedia Resources: Select interactive tools , video and simulations that are used in learning .**

It is recommended to supplement the kit with short video demonstrations of key practical procedures and simulators for practicing diagnostics. (Note: multimedia implementation is a recommendation for further work.)

4. Pedagogical approach

- **Instructional Design: Explain methodology content organization and structure .**

The materials are structured modularly: each module begins with a theoretical part, some methodological publications continue with calculations, in some the theoretical part ends with questions for self-testing. Such an architecture contributes to the gradual development of competencies in the disciplines being studied.

- **Strategies teaching : Describe such approaches, like upside down learning, blended teaching or problematic training .**

Learning strategies:

- problem-oriented training (analysis of real cases on technical operation and management);
- elements of blended learning (lectures + practical/laboratory work, possibility of remote access to materials);
- use of applied techniques (diagnostic algorithms, calculation examples, templates of management documents).

- **Assessment and Evaluation : Provide detailed information about the tools that used for measurement results teaching students .**

To control the results, control questions, practical tasks, calculation methods and criteria for evaluating the results are provided (it is recommended to formalize the rubrics for evaluating practical work). The quality publications contain KPI and SPC tools for quantitative assessment of processes.

5. Digital platforms and tools

- **Platforms electronic training: List and describe systems management learning (e.g. Moodle, Blackboard, Google Classroom).**
- **• Tools for cooperation: Remember digital tools for cooperation (for example , MS Teams , Zoom , Slack , Padlet).**
- **Accessibility and inclusivity: Explain measures taken for software inclusiveness and accessibility digital tools for all users.**

The materials are adapted for integration into LMS (Moodle, Google Classroom) and corporate systems (CMMS, ERP). The publications also consider telematics and IoT solutions, BI dashboards for data analytics, which allows combining training cases with real digital tools of enterprises. It is recommended to prepare material packages (PDF, slides, test tasks) for uploading to the LMS and create templates of practical laboratory tasks with tests for online verification.

6. Quality Assurance and Feedback

- **Process Inspections : Describe how materials were checked and tested** .

Methodological materials have undergone an internal review process (reviewers are teachers from related departments and industry practitioners), as well as external peer review for publications related to new technologies (EV, hydrogen, digitalization). All materials are checked for plagiarism before being recommended for publication.

- **Reviews users : Summarize reviews teachers , students and experts .**

After the materials are introduced into the educational process, feedback is collected from students and teachers (anonymous surveys, focus groups) to correct the content and teaching methods .

- **Permanent improvement : Outline plans updates and improvements .**

A cycle of publication updates is proposed - annual review of rapidly changing sections (norms, digital solutions, EV technologies), and versioned storage of materials in the department's repository.

All materials have undergone internal expert evaluation by the department's teachers. Positive feedback has been received from students, who note the structuredness, accessibility of the presentation, and practical orientation. Regular

updates of the publications are planned, taking into account new educational standards, digital technologies, and changes in the transport industry.

7. Conclusions and recommendations

Summarize key conclusions and provide recommendations of further development and improvement educational materials.

1. Conclusion. The set of six methodological publications provides a comprehensive basis for training specialists in the field of road transport - from technical operation to management and quality of production processes. The materials cover theoretical foundations, practical algorithms and management tools.

2. Implementation recommendations:

- prepare electronic packages (PDF + presentations + test tests) for LMS (Moodle/Google Classroom);

- develop 6–8 video lectures/demonstration videos for the most practical sections (diagnostics, maintenance);

- conduct pedagogical testing (pilot course) for one semester with subsequent collection of feedback;

- formalize the procedure for reviewing and annual updating of publications;

- consider the issue of providing publications with ISBNs and placing them in the university's electronic repository for open access.

3. Quality recommendations: include in the publication samples of practical assessment rubrics, worksheet templates, and tasks for automatic checking.

The developed methodological publications are comprehensive educational resources for training specialists in the field of road transport. They combine a theoretical base with practical tools that meet the modern requirements of the labor market. It is recommended to further expand multimedia and interactive materials (simulators, video lectures), as well as to provide for regular updating of the content in accordance with the latest trends in the development of the transport industry.

8. Appendices

Include additional supporting materials such as:

- Sample lesson plans
- User manuals for digital tools
- Pictures screen and links to digital resource

Appendix A. List of developed methodological publications (bibliographic data) and summary of methodological developments:

1. SITOVSKYY O. Theory of the car: lecture notes* for first (bachelor's) level students, educational program "Automobile transport", Lutsk: LNTU, 2025. - 128 p. (content: operational properties, dynamics, traction and speed properties, fuel economy, braking properties, stability, handling, etc.).

2. KOTENKO V., PRYDYUK V., DEMBITSKYY V. Management in road transport: lecture notes for second (master's) level applicants, Lutsk: LNTU, 2025. — 104 pp. (content: management concepts, management functions, motivation, forecasting, analysis, control and risk management).

3. PAVLYUK V. Road transport enterprises. Part 1: Design: lecture notes*, Lutsk: LNTU, 2025. — 52 p. (content: methods of technological calculations, layout of the production and technical base, general plan).

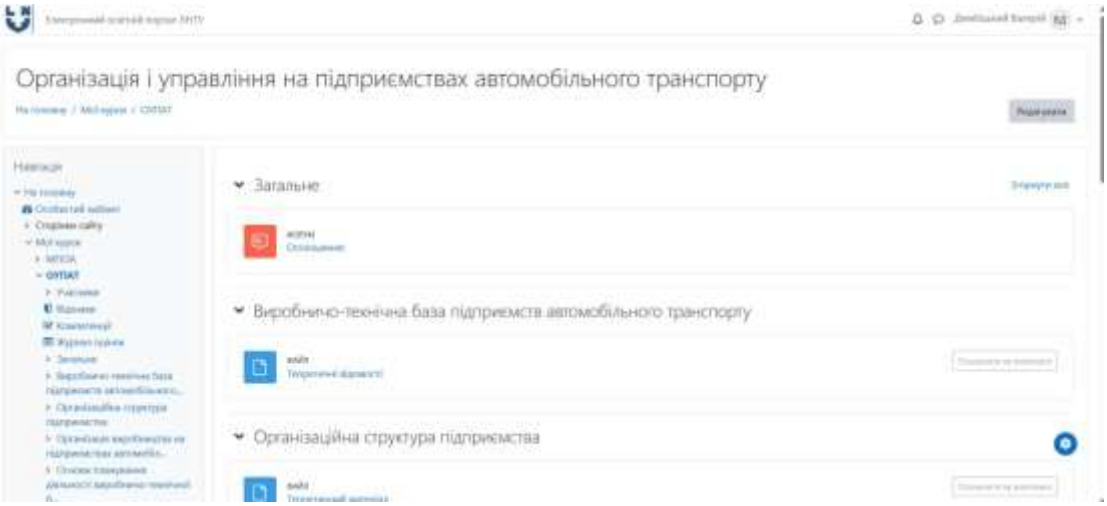
4. DEMBITSKY V. Road transport enterprises. Part 2: Organization and management: lecture notes*, Lutsk: LNTU, 2025. — 192 p. (content: organizational structures, HR, planning, digitalization, innovative models).

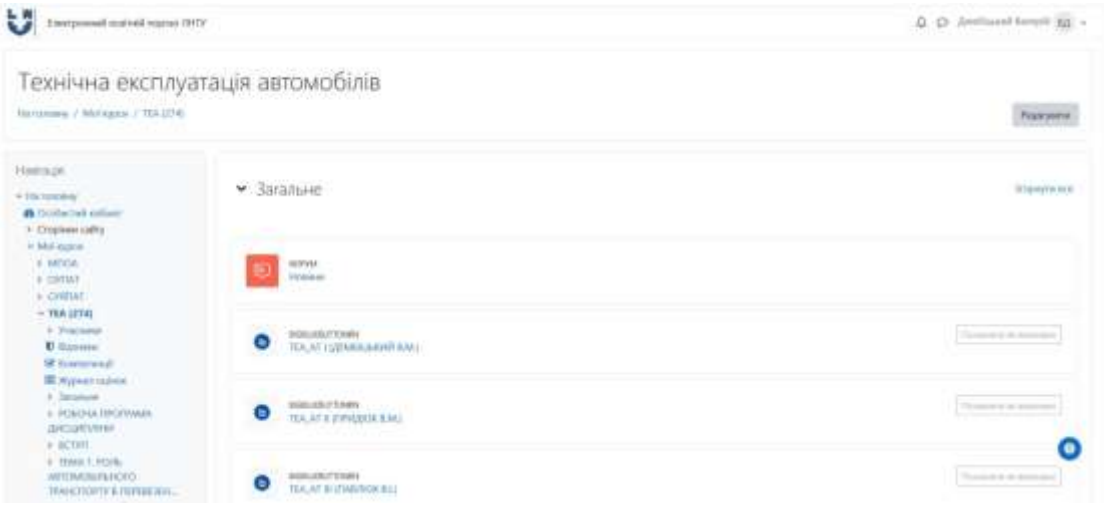
5. DEMBITSKY V. Road transport enterprises. Part 3: Quality of production processes: lecture notes*, Lutsk: LNTU, 2025. — 124 p. (content: quality management tools, SPC, PFMEA, 8D, digital quality tools).

6. DEMBITSKY V., SAMOSTIAN V., PRYDYUK V., PAVLYUK V. Technical operation of cars: lecture notes*, Lutsk: LNTU, 2025. — 432 p. (content of the comprehensive course : diagnostics, maintenance/repair of engines, transmissions, electric vehicles, high-voltage systems, recuperation, etc.).

Appendix B. The Moodle educational portal of LNTU contains instructions for teachers on creating and editing courses, creating tests on the platform, and more (https://mdl.lntu.edu.ua/mod/forum/view.php?id=2)

Appendix C. Screenshots of the course placement screen on the Moodle educational portal of LNTU:



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Компетенції
Журнал оцінок
Загальне
РОБОЧА ПРОГРАМА ДИСЦИПЛІНИ
ВСТУП
ТЕМА 1. РОЛЬ АВТОМОБІЛЬНОГО ТРАНСПОРТУ В ПЕРЕВЕЗЕН...
ТЕМА 2. НАДІЙНІСТЬ АВТОМОБІЛЯ
ТЕМА 3. ПРИЧИНИ ЗМІНИ ТЕХНІЧНОГО СТАНУ АВТОМОБІЛІВ
ТЕМА 4. ВИДИ ТО І РЕМОНТУ, ЇХ ХАРАКТЕРИСТИКА
ТЕМА 5. ПЕРІОДИЧНІСТЬ ТО. НОРМАТИВИ НА ТО І РЕМОНТ...
ТЕМА 6. ТЕХНІЧНА ДІАГНОСТИКА, ТЕРМІНИ ТА ВИЗНАЧЕННЯ
ТЕМА 7. ТЕОРЕТИЧНІ ОСНОВИ ТЕХНІЧНОЇ ДІАГНОСТИКИ
ТЕМА 8. МЕТОДИ ТА ЗАСОБИ ДІАГНОСТУВАННЯ ОСНОВНИХ А...
ТЕМА 9. ПІДГОТОВКА АВТОМОБІЛЯ ДО ПРОДАЖУ
ТЕМА 10. ЩОДЕННЕ ОБСЛУГОВУВАННЯ АВТОМОБІЛЯ
ТЕМА 11. ЗАГАЛЬНЕ ДІАГНОСТУВАННЯ ДВИГУНА
ТЕМА 12. ПОНЯТТЯ ПРО РІВНІ ВИКИДІВ. ЕКОЛОГІЧНІ НОРМИ.
ТЕМА 13. ПОГЛИБЛЕНЕ ДІАГНОСТУВАННЯ ДВИГУНА
ТЕМА 14. ТЕХНІЧНЕ ОБСЛУГОВУВАННЯ ТА ПОТОЧНИЙ РЕМОН...
ТЕМА 15. ТЕХНІЧНЕ ОБСЛУГОВУВАННЯ І РЕМОНТ СИСТЕМИ ...
ТЕМА 16. ТЕХНІЧНЕ ОБСЛУГОВУВАННЯ І РЕМОНТ СИСТЕМИ ...
ТЕМА 17. ТЕХНІЧНЕ ОБСЛУГОВУВАННЯ ТА ПОТОЧНИЙ РЕМОН...
ТЕМА 18. ТЕХНІЧНЕ ОБСЛУГОВУВАННЯ ТА ПОТОЧНИЙ РЕМОН...
ТЕМА 19. ТЕХНІЧНЕ ОБСЛУГОВУВАННЯ ТА ПОТОЧНИЙ РЕМОН...
ТЕМА 20. ТЕХНІЧНЕ ОБСЛУГОВУВАННЯ І ПОТОЧНИЙ РЕМОНТ...
ТЕМА 21. ТЕХНІЧНЕ ОБСЛУГОВУВАННЯ ТА ПОТОЧНИЙ РЕМОН...
ТЕМА 22. ТЕХНІЧНЕ ОБСЛУГОВУВАННЯ ТА ПОТОЧНИЙ РЕМОН...
ТЕМА 23. ТЕХНІЧНЕ ОБСЛУГОВУВАННЯ І РЕМОНТ ХОДОВОЇ ...
ТЕМА 24. ТЕХНІЧНЕ ОБСЛУГОВУВАННЯ І ПОТОЧНИЙ РЕМОНТ...
ТЕМА 25. ДІАГНОСТУВАННЯ АВТОМОБІЛІВ НА ПОСТАХ ЗАГА...
УСТАТКОВАННЯ ДЛЯ ВИКОНАННЯ ТЕХНІЧНОГО ОБСЛУГОВУВАН...
СИСТЕМА МАТЕРІАЛЬНО-ТЕХНІЧНОГО ЗАБЕЗПЕЧЕННЯ ПІДПРИ...
ЗБЕРІГАННЯ АВТОМОБІЛІВ
ЗБЕРІГАННЯ ЗАПАСНИХ ЧАСТИН ТА МАТЕРІАЛІВ
ЗАГАЛЬНІ ВІДОМОСТІ ПРО СТАНЦІЇ ТЕХНІЧНОГО ОБСЛУГОВ...
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ТЕХНОЛОГІЧНИЙ РОЗРАХУНОК АВТОТРАНСПОРТНОГО ПІДПРИЄ...
ТЕХНОЛОГІЯ ПОТОЧНОГО РЕМОНТУ АВТОМОБІЛІВ, ЇХ АГРЕГ...
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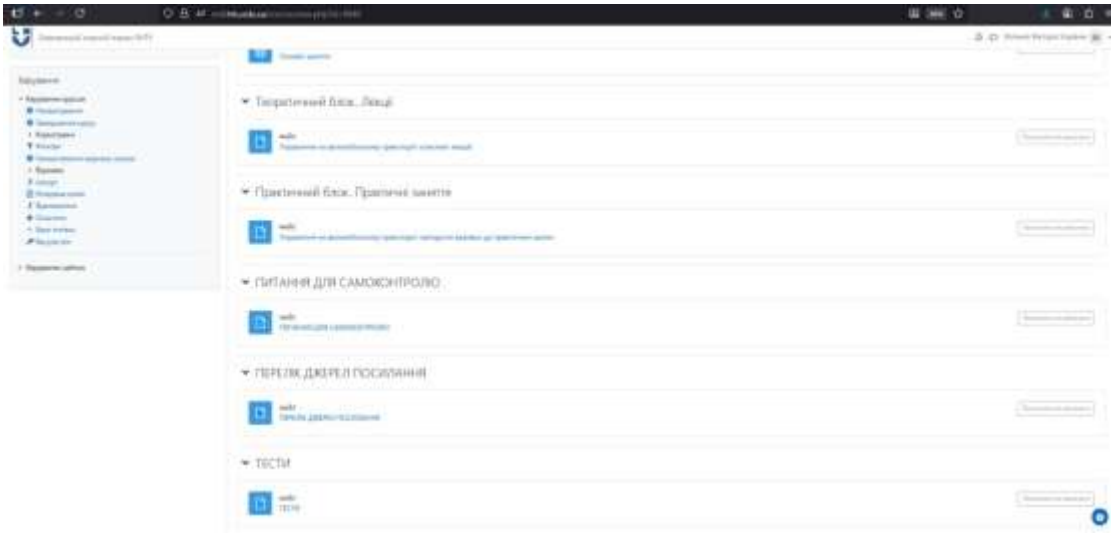
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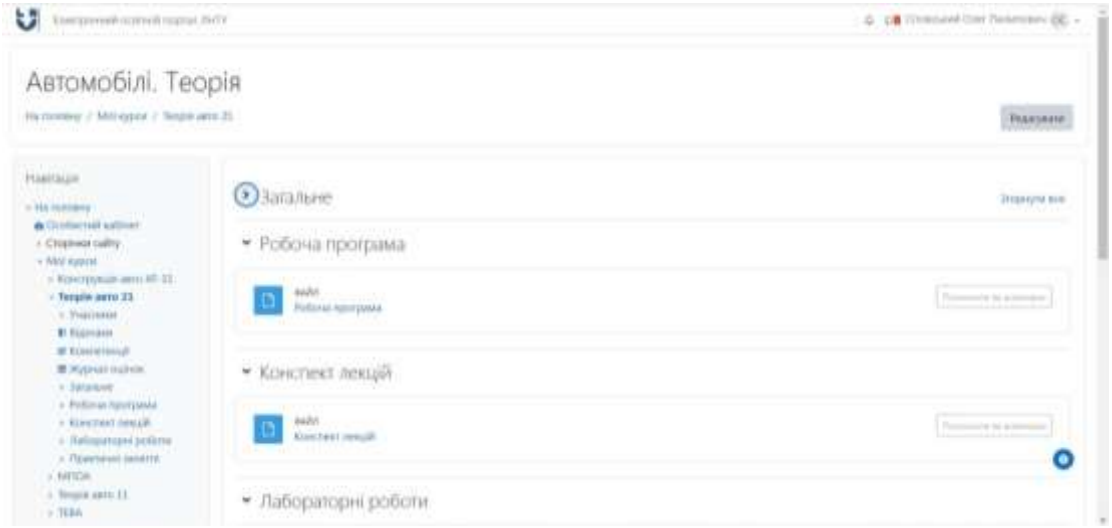
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Робоча програма
Конспект лекцій
Лабораторні роботи

D. Technical University of Moldova

1. Executive Summary

This report provides a comprehensive overview of the modernization of learning and teaching materials carried out within the DIGITRANS project at the Technical University of Moldova, Department of Electrical Engineering. The modernization process focused on aligning the content of four courses with modern pedagogical approaches, integrating digital technologies, and enhancing practical laboratory work through new equipment and simulation tools.

The courses were enhanced with modern pedagogical approaches and digital tools:

- Digital Control Systems - https://moodle.utm.md/course/view.php?id=2054
- Electric Vehicle powertrain – https://moodle.utm.md/course/view.php?id=6175
- Electrical and electronical equipment – https://moodle.utm.md/course/view.php?id=60
- Static power converters – https://moodle.utm.md/enrol/index.php?id=5595

The modernization has resulted in the digitalization of course content, the introduction of blended learning methods, and the incorporation of advanced laboratory equipment such as CompactRIO data acquisition systems and portable oscilloscopes. The aim was to improve the quality of teaching, strengthen the link between theory and practice, and equip students with the skills demanded by the labor market, particularly in the areas of electric mobility, power electronics, and control systems.

2. Introduction

The rapid digital transformation in higher education, combined with the evolving requirements of industry, has created an urgent need to update and modernize engineering curricula. Traditional teaching methods in engineering disciplines, although effective for delivering theoretical knowledge, often lag behind industrial innovations, leaving students insufficiently prepared for real-world challenges.

Through the DIGITRANS project, the Technical University of Moldova has revised and modernized four core courses within the Electrical Engineering Department. These updates include:

- the integration of digital platforms (Moodle UTM) for resource sharing, assessment, and student interaction;
- the digitalization of teaching materials (e-books, interactive presentations, simulation-based exercises);
- the use of industry-grade laboratory equipment (CompactRIO, oscilloscopes, traction system stands) to bridge the gap between academic learning and industrial practices;
- and the application of student-centered teaching methodologies such as problem-based learning (PBL), collaborative projects, and continuous assessment.

These efforts contribute to a more engaging and effective learning environment, while also ensuring that graduates are well-prepared for careers in engineering and technology-intensive industries.

- **Objectives:** Define the purpose and scope of the materials.

The modernization of the four courses pursued several key objectives:

- Improve teaching quality by updating course content and aligning it with recent scientific and technological developments.

- Enhance student engagement by integrating interactive digital resources, simulations, and multimedia into the learning process.
- Develop practical skills through laboratory activities with modern equipment, enabling students to apply theoretical knowledge in real-world scenarios.
- Promote interdisciplinary learning by linking concepts across electrical engineering, electronics, control systems, and sustainable transportation.
- Ensure resilience in education by enabling flexible learning modes, including blended and online learning, supported by the Moodle platform.

Support university–industry collaboration, ensuring that student competencies meet the requirements of employers in sectors such as power electronics, electric drives, and electromobility.

The modernized materials target a wide range of users:

Undergraduate students in electrical engineering and related specializations, who benefit directly from improved teaching resources, interactive laboratory sessions, and industry-relevant training.

Faculty members, who gain access to well-structured digital syllabi, updated lecture slides, and laboratory guides, facilitating more effective teaching and consistent assessment methods.

Industry partners and stakeholders, who are indirect beneficiaries through better-prepared graduates and closer collaboration with the university in terms of case studies, guest lectures, and applied research projects.

3. Learning and Teaching Materials Overview

The modernization of the four courses under the DIGITRANS project resulted in a diverse set of teaching and learning materials that combine traditional resources with digital and interactive tools. These materials were designed to support both theoretical instruction and practical training, ensuring consistency across different teaching methods and accessibility for students.

Types of materials developed and updated:

Course syllabi and lecture notes: revised to align with updated curricula, clearly outlining learning objectives, contents, and assessment methods.

Lecture presentations (PowerPoint, PDF): structured by topics, enriched with diagrams, graphs, and schematics to support visual learning.

Textbooks and e-books: required and recommended readings were updated with both classical references and modern resources, accessible in electronic format.

Laboratory guides and worksheets: digitalized instructions for experiments, including step-by-step tasks, calculation examples, and structured reporting formats.

Problem sets and case studies: designed to support problem-based learning (PBL) and interdisciplinary applications.

Multimedia resources: videos, animations, and simulations to illustrate complex physical and technical processes (e.g., arc extinction in switching devices, PWM control in converters, traction system simulations).

Assessment resources: digital tests, quizzes, and evaluation rubrics integrated into the Moodle platform, enabling continuous monitoring of student performance.

Digital integration:

All materials were uploaded to the Moodle UTM platform, which serves as the central repository for teaching and learning resources. Moodle also supports interactive learning through quizzes, discussion forums, and online submission of assignments. In addition, MATLAB/Simulink simulations and CompactRIO-based laboratory activities were integrated as practical extensions of the course content.

Overall, the teaching and learning materials developed under DIGITRANS ensure a balanced combination of theory and practice, while also encouraging active student participation, collaborative learning, and independent study.

4. Pedagogical Approach

The modernization process emphasized the use of innovative teaching methodologies:

- **Problem-Based Learning** (PBL) to encourage independent thinking and practical problem solving.
- **Collaborative projects** to simulate real-world engineering teamwork.
- **Blended learning**, combining in-person lectures with online components on Moodle.
- **Continuous assessment**, including quizzes, lab reports, and project evaluations, ensuring consistent feedback and tracking of student progress.

5. Digital Platforms and Tools

Moodle UTM: the primary learning management system, hosting syllabi, lecture slides, digital assignments, and quizzes.

CompactRIO and portable oscilloscopes: used in laboratories for real-time data acquisition and analysis.

MATLAB/Simulink: employed for simulations of power electronics and control systems.

Multimedia resources: interactive presentations, instructional videos, and digital lab guides to enhance student engagement.

6. Quality Assurance and Feedback

The modernization process included several measures to ensure quality and sustainability:

Peer review and validation of course content by project team members and subject experts.

Student feedback collected during pilot testing of modernized labs and integrated into revisions.

Continuous improvement plans to periodically update materials, incorporate new digital tools, and align with future industry trends.

7. Conclusions and Recommendations

The modernization of the four courses has significantly enhanced the educational process at the Technical University of Moldova by:

- improving the quality and accessibility of teaching materials;
- integrating advanced digital technologies into both theory and practice;
- preparing students with practical, industry-relevant skills, particularly in power electronics, automation, and electromobility.

Recommendations:

- Continue updating teaching materials to reflect new technological advancements.
- Extend the modernization approach to additional courses within the department.
- Strengthen partnerships with industry to provide more real-world case studies, internships, and collaborative projects.

Overall, the DIGITRANS project has created a sustainable framework for modern, digital, and practice-oriented education in electrical engineering, ensuring that graduates are better equipped to contribute to the innovation-driven economy of the region.

Courses on Moodlle:

- Digital Control Systems - https://moodle.utm.md/course/view.php?id=2054
- Electric Vehicle powertrain – https://moodle.utm.md/course/view.php?id=6175
- Electrical and electronical equipment – https://moodle.utm.md/course/view.php?id=60
- Static power converters – https://moodle.utm.md/enrol/index.php?id=5595

For verification:
Login as guest
Password: digitrans

E. Alecu Russo Balti State University

1. Executive Summary

This Report summarizes the activities, results, and implications of work package WP2.2 – Preparation of Learning and Teaching Materials, an integral part of WP2 of the DIGITRANS project. The main objective of WP2.2 is to develop a coherent set of learning and teaching materials (both printed and digital), designed to support the innovative curricula developed within the DIGITRANS project and to facilitate the transition to teaching practices oriented towards digital and sustainable competences.

Methodologically, the materials were designed through an cyiclic and collaborative process that combined stakeholder needs analysis, outcomes-based instructional design, and validation through piloting with teachers and students. The approach emphasized modularity, accessibility, and interoperability: the content is structured in modules/learning units, ready for integration into LMS, and available in electronic formats (e-books, guides, worksheets, PPTs) as well as multimedia (videos, simulations, interactive exercises).

USARB's contribution to WP2.2 is substantial, reflected in the modernization and development of seven courses and laboratory works for the bachelor's program Engineering and Management in Automotive Transport. These include fundamental and emerging disciplines such as Automotive Electrical and Electronic Equipment, Automatic Control Engineering, Electromobiles, and Automation in Production (all updated), as well as new courses such as Autonomous Vehicles, Hybrid Vehicles, and Engineering Bionics. Through these modernizations and curricular innovations, USARB has successfully aligned the academic content with the latest industry standards, national competence frameworks, and the strategic objectives of the green and digital transition.

In deliverable D.2.1, the USARB team presented an integrated vision of the modernized academic program, accompanied by detailed descriptions of the syllabi and teaching materials, highlighting the learning objectives, new practical components, and direct connections with labor market requirements. The curriculum update process was based on the analysis of feedback from employers, teachers, and students, which ensured the relevance and adaptability of the content.

USARB also developed and tested digital educational resources, using the Moodle platform, simulation applications, and interactive e-books. These digital tools not only complement traditional materials, but also facilitate access to updated content, increase student engagement, and support the implementation of innovative teaching methods such as active learning and collaborative projects. The digitalization of the training process for automotive engineers strengthens the development of essential digital skills,

prepares students for modern workplaces, and enhances in-depth understanding through virtual experiments and the modeling of complex systems.

The main deliverables of WP2.2 include:

- sets of e-books for students and teachers;
- practical textbooks and worksheets;
- multimedia packages and simulations for the virtual laboratory;
- methodological guides for blended teaching;
- formative and summative assessment tools.

The initial evaluation and pilot feedback indicated an improvement in the practical relevance of the courses, increased interactivity in the learning process, and satisfactory technical compatibility with the targeted platforms. At the same time, challenges related to unequal access to technological infrastructure and the need to strengthen partnerships with the economic environment for quality internships were identified.

The key recommendations resulting from WP2.2 are to:

- establish a continuous mechanism for updating materials (annual review and integration of feedback),
- strengthen teacher training in the use of digital resources,
- expand and formalize agreements with employers for internships, and
- ensure sustainability through the publication of Open Educational Resources (OER) and integration into accreditation processes.

Overall, WP2.2 provides a solid pedagogical and technical foundation for the implementation of the modernized curriculum, and USARB's contribution demonstrates how digitalization and content updating can be leveraged to connect university education with the evolving demands of the labor market and the green and digital transition.

2. Introduction

Background and Context

High-quality learning and teaching materials are essential for aligning higher education with the rapid technological, economic, and societal transformations of the 21st century. In the context of the DIGITRANS project, the modernization of study programs responds to the urgent need for digitalization, sustainability, and industry integration, ensuring that graduates are equipped with competences relevant for the labor market. Developing innovative curricula and resources contributes not only to knowledge transfer but also to fostering critical thinking, problem-solving skills, and adaptability among students. At USARB, the updated and newly designed courses in *Engineering and Management in Automotive Transport* reflect these principles, providing students with both theoretical foundations and hands-on experiences through laboratories, simulations, and practical training.

High-quality learning and teaching materials are essential for aligning higher education with the rapid technological, economic, and societal transformations of the 21st century. In the context of the DIGITRANS project, the modernization of study programs responds to the urgent need for digitalization, sustainability, and industry integration, ensuring that graduates are equipped with competencies relevant to the labor market. Developing innovative curricula and resources contributes not only to knowledge transfer but also to fostering critical thinking, problem-solving skills, and adaptability among students. At USARB, the updated and newly designed courses in Engineering and Management in Automotive Transport reflect these principles, providing students with both theoretical foundations and hands-on experiences through laboratories, simulations, and practical training.

Additionally, developing high-quality learning materials is directly connected to the Curriculum for the training of specialists in the field of professional training 0710 Engineering and Management, specialty 0710.1 Engineering and Management in Machine Building at USARB, as well as to the objectives of several relevant policy documents: the Development Strategy "Education 2030", the National Regional Development Strategy of the Republic of Moldova for 2022–2028, the Strategic Institutional Development Plan of the USARB for 2024–2029, and the USARB Action Plan on Internationalization. Through these strategic priorities, objectives, and performance indicators, USARB aims to strengthen its national and international position, continuously promote a culture of quality, and fulfill its role as a promoter of scientific, educational, and cultural excellence in society. Developing high-quality learning materials ensures the training of automotive engineers who are globally connected through local actions, while facilitating the green and digital transition.

Objectives

The purpose of the developed learning and teaching materials is to support a modern, competence-based, and student-oriented education aligned with European and national frameworks. Their scope covers both printed and digital resources, designed to enhance flexibility, accessibility, and relevance for students, teachers, and industry partners.

The learning and teaching materials developed within WP2.2 are designed to modernize higher education in line with digital, sustainable, and industry-oriented transformations. Their objectives are to:

- align academic content with national and European competence frameworks, ensuring relevance and quality;
- integrate digital tools, e-learning platforms, and virtual laboratories to expand accessibility, flexibility, and innovation in teaching;
- promote active and problem-based learning through collaborative projects, practical training, and laboratory-based activities;

- ensure inclusivity and adaptability of resources to diverse student needs, creating equal opportunities for access and success;
- strengthen the link between academic training and the requirements of the automotive industry, with a clear focus on supporting the Green and Digital transitions.

These objectives reflect both the institutional priorities of USARB and the broader strategic goals of the DIGITRANS project

Intended Users

The learning and teaching materials are tailored to a diverse group of users and stakeholders:

- Students, particularly those enrolled in the Bachelor program Engineering and Management in Automotive Transport, who benefit from updated theoretical content, laboratory activities, digital simulations, and e-books that foster both technical and transversal competences.
- Teachers and academic staff, who use the methodological guides, digital resources, and virtual laboratories to implement modern, competence-based teaching strategies and enhance instructional quality.
- Industry partners and employers, who are engaged through agreements for student internships and secondments, ensuring that the training provided is aligned with labor market requirements and the evolving needs of the automotive sector.
- Policy makers, accreditation bodies, and curriculum developers, who can draw on the developed materials and approaches as examples of good practice in integrating digitalization, sustainability, and competence-based education into higher education.
- Other higher education institutions, which may adopt or adapt the open educational resources (OER) created under the DIGITRANS project for their own programs.

3. Learning and Teaching Materials Overview

Types of Materials

Within WP2.2, a comprehensive set of learning and teaching resources has been developed and modernized to support both theoretical knowledge and practical skills acquisition.

These resources include:

- Textbooks and syllabi, updated to reflect the latest scientific and technological developments in automotive transport engineering, ensuring alignment with national and European competence frameworks. They provide a coherent structure for courses, define learning objectives, and guide both students and teachers throughout the semester. For example, USARB developed the syllabi for all courses planned in specialty *Engineering and Management in Automotive Transport*
- Laboratory manuals and workbooks – offering step-by-step guidance for practical exercises, simulations, and experiments. These resources are designed to promote hands-on learning and to strengthen students' problem-solving and critical-thinking skills in real and virtual laboratory environments. For example, USARB developed laboratory manuals for all planned courses: Automotive Electrical and Electronic Equipment, Automatic Control Engineering, Electromobiles (Electric cars), Automation in Production, Autonomous Vehicles, Hybrid Vehicles, and Engineering Bionics.
- Presentations and lecture notes – structured to support both traditional classroom teaching and blended learning approaches. They integrate diagrams, case studies, and real-world applications to increase student engagement and facilitate knowledge transfer. For example, USARB developed for the mentioned courses PPT presentations and lecture notes.
- Teacher guides and methodological handbooks – providing pedagogical recommendations and examples of innovative teaching methods, ensuring consistent delivery of content across different courses and instructors. For example, USARB developed teacher guides regarding all types of internships and methodological handbooks about developing teaching materials (syllabi, curricula, lecture notes, laboratory manuals and textbooks)
- Supplementary resources – such as practice tests, assignments, and project templates, developed to enhance formative assessment and to encourage independent and collaborative learning. For example, USARB developed practice tests, assignments, and project templates for all courses of the specialty *Engineering and Management in Automotive Transport*

Digital Tools and Methods

The DIGITRANS project emphasizes the integration of digitalization in education, ensuring flexibility, accessibility, and interactive learning. At USARB, a variety of tools and methods have been adopted to complement traditional teaching and to create modern, competence-based learning environments:

- LMS platforms (Moodle), serving as the central hub for course delivery, Moodle hosts syllabi, lecture notes, assignments, and discussion forums. Its modular structure allows for blended and asynchronous learning, enabling students to access materials at their own pace and ensuring inclusivity for those with different learning needs.
- Simulation software, providing opportunities for students to model and test automotive systems, autonomous vehicles, and hybrid technologies in safe, virtual environments. These tools reduce reliance on costly physical equipment, while allowing learners to experiment, visualize processes, and develop practical problem-solving skills.
- E-assessment tools, such as digital quizzes, online tests, and automated feedback systems, designed to measure learning outcomes in real time. These tools not only improve efficiency in evaluation but also support continuous monitoring of student progress, enabling adaptive learning approaches.
- Collaborative platforms (Google Workspace, Padlet), facilitating teamwork, joint projects, and knowledge sharing. By using cloud-based tools, students and teachers can co-create content, exchange ideas, and maintain communication beyond classroom hours, strengthening project-based learning.
- Interactive multimedia methods, including video tutorials, virtual labs, and interactive exercises that make complex technical concepts easier to grasp and enhance student engagement.

Overall, the integration of these digital tools ensures that students benefit from a flexible and engaging learning process, while teachers gain effective instruments for delivering content, monitoring progress, and fostering innovation in education..

E-books for Teachers and Students

As part of the modernization effort under the DIGITRANS project, digital e-books have been developed to complement and extend the functionality of traditional textbooks. These resources are designed to meet the needs of both students and teachers, while aligning with current trends in digital education:

- Student-focused e-books, delivering structured content aligned with study programs and competence frameworks. They include interactive examples, visual simulations, multimedia resources, and case studies relevant to the

automotive industry, thus bridging theory with practice and supporting self-paced learning.

- Teacher-focused e-books, providing methodological recommendations, innovative teaching strategies, and assessment models. These resources enable academic staff to integrate digital tools, collaborative learning, and problem-based approaches into their teaching practices.
- Accessibility and inclusivity features , all e-books are accessible online via Moodle and institutional repositories, ensuring free and continuous access for students and staff. The materials can also be downloaded for offline use and include options such as search functions, adaptive formats, and compatibility with assistive technologies, supporting diverse learning needs.
- Sustainability and innovation, by replacing or complementing printed textbooks, e-books contribute to environmentally friendly practices and enable continuous updating of content in line with scientific and technological progress.

Through these digital resources, USARB strengthens the digital dimension of education, enhances flexibility and inclusivity, and supports the transition toward modern, competence-based learning in the automotive engineering field.

Multimedia Resources

- To enhance student engagement, motivation, and practical understanding, a diverse range of multimedia resources has been integrated into the learning process. These resources complement traditional teaching methods, offering students interactive and flexible ways to acquire knowledge and apply it in practice.
- Interactive simulations and virtual laboratories, enabling experimentation with automotive systems, hybrid and electric vehicles, autonomous driving technologies, and automation processes in safe, controlled digital environments. These resources provide opportunities to model real-world scenarios and test solutions without the limitations of physical infrastructure.
- Instructional videos and tutorials, step-by-step guides that explain complex technical concepts, laboratory procedures, and engineering design processes. These resources allow students to revisit challenging content and strengthen their practical skills.
- Digital visualizations and animations, illustrating abstract engineering principles such as energy conversion, fluid dynamics, or mechanical design, helping students grasp difficult theoretical aspects through dynamic and intuitive representations.
- Recorded lectures and webinars, available on demand via LMS platforms, ensuring flexibility for self-paced and distance learning, while also facilitating the participation of external experts and industry representatives.

- Multimedia case studies and project showcases, documenting real-life applications, innovative research, and industry collaborations, inspiring students to connect their academic training with professional practice.

By integrating multimedia resources, the DIGITRANS project supports in USARB a student-centered, interactive, and inclusive learning environment, bridging the gap between theoretical knowledge and practical competencies required in the automotive engineering field.

4. Pedagogical Approach

Instructional Design

At Alecu Russo Balti State University (USARB), the instructional design of the updated and newly developed courses under the DIGITRANS project is grounded in a competency-based education model, ensuring coherence with both the European Qualifications Framework (EQF) and the National Qualifications Framework of the Republic of Moldova. Course content is organized progressively, moving from core theoretical foundations to advanced applications and specialized modules in automotive engineering and management. This structure guarantees a logical sequencing of knowledge, where lectures are directly connected with laboratory practicums, project-based activities, and simulations. Each syllabus includes explicit learning outcomes, practical components, and assessment criteria that integrate academic rigor with industry relevance, reflecting the university's mission to prepare graduates for the demands of the Green and Digital transitions.

Teaching Strategies

USARB applies a diverse set of innovative teaching strategies to respond to the rapid digital transformation in higher education and the specific needs of students:

- Blended learning – combining in-person lectures and seminars with Moodle-based modules, enhancing flexibility and continuous access to resources.
- Flipped classroom – students explore e-books, recorded lectures, and digital case studies independently, freeing up classroom sessions for debates, problem-solving, and practical experimentation.
- Problem-based learning (PBL) – centered on solving real-world engineering challenges in electromobility, hybrid technologies, automation, and intelligent transport systems, fostering critical and analytical thinking.
- Collaborative projects – encouraging interdisciplinary teamwork, often developed in cooperation with regional industry partners, to simulate workplace dynamics and strengthen employability skills.

Assessment and Evaluation

The evaluation framework at USARB integrates both traditional and digital tools to ensure a balanced measurement of knowledge, skills, and competencies:

- Formative assessments - quizzes, online self-tests, and immediate feedback functions embedded in Moodle to support ongoing learning.
- Summative assessments – written exams, project reports, and laboratory tests that validate cumulative knowledge acquisition.
- Practical evaluations – hands-on tasks in laboratories, simulation-based assessments, and project prototypes, testing the application of theoretical content in real-world contexts.
- Continuous feedback mechanisms – regular monitoring of student progress, peer assessment, and reflective exercises to stimulate self-directed learning and professional growth.

Through this pedagogical approach, USARB ensures that students go beyond content mastery, developing digital literacy, adaptability, problem-solving abilities, creativity, and teamwork skills. These competencies are indispensable for future engineers in the automotive sector, aligning education with the expectations of both the labor market and the broader European agenda for sustainable and digital transformation.

5. Digital Platforms and Tools

E-learning Platforms

Within the DIGITRANS project, **Moodle** serves as the primary Learning Management System (LMS) adopted by USARB and partner institutions. Moodle provides a flexible and structured environment for the delivery of courses and management of learning activities. Key functionalities include:

- Content management – uploading lecture materials, e-books, laboratory manuals, multimedia resources, and interactive exercises;
- Formative assessment tools – online quizzes, self-tests, and assignments that provide immediate feedback, supporting active and continuous learning;
- Discussion forums and collaborative spaces – enabling peer-to-peer learning, knowledge exchange, and teacher-student interaction;
- Grade tracking and analytics – monitoring student progress and providing insights for targeted support and continuous improvement.

In addition to Moodle, some partner institutions incorporate complementary LMS platforms such as **Google Classroom**, ensuring interoperability and smooth integration with existing institutional digital infrastructures. This multi-platform approach supports

diverse teaching practices, hybrid course delivery, and flexible access for all participants.

Collaboration Tools

To foster teamwork, communication, and cross-institutional collaboration, the project integrates a range of digital collaboration tools:

- Google Meet and Zoom – for virtual lectures, meetings, workshops, and seminars, enabling real-time, synchronous learning and remote participation;
- Google Drive, Viber, WhatsApp – supporting project coordination, group communication, and quick exchanges among students and faculty;
- Padlet and Miro – interactive visual collaboration platforms used for brainstorming, mapping ideas, co-creating content, and sharing resources in workshops and project-based activities.

These tools create an interactive and participatory ecosystem in which students and teachers can co-create knowledge, collaborate on assignments, and share best practices, independent of their physical location.

Accessibility and Inclusivity

Ensuring accessibility and inclusivity is a central priority for DIGITRANS. Digital platforms and tools are carefully selected and adapted to meet international accessibility standards and support diverse learner needs:

- Multiple content formats – materials are available as PDFs, ePubs, and videos with subtitles to accommodate different learning styles;
- User-friendly interfaces – accessible on desktop and mobile devices, enabling learning anytime and anywhere;
- Multilingual support and simplified navigation – catering to international students and users with varying levels of digital literacy;
- Assistive technologies integration – including screen readers, adjustable font sizes, and high-contrast modes to support students with disabilities.

By embedding accessibility and inclusivity into all digital teaching resources, USARB ensures that all learners, regardless of background or ability, can fully engage with the modernized educational environment, developing both digital and professional competencies in line with the objectives of the DIGITRANS project.

6. Quality Assurance and Feedback

Review Process

The learning and teaching materials developed within WP2.2 underwent a **multi-level validation process** to ensure academic quality, relevance, and alignment with industry

requirements. Draft versions of curricula, syllabi, and digital resources were first reviewed internally by course coordinators and subject-matter experts from USARB. These were then cross-validated by project partners and external stakeholders, including industry representatives, to guarantee consistency with the competence framework and labor market expectations. Pilot testing of selected modules and digital tools was conducted with student groups to assess usability and effectiveness.

User Feedback

Feedback was collected systematically from multiple stakeholders:

- Students highlighted the usefulness of interactive digital tools (Moodle resources, simulations) and appreciated the availability of e-books and blended learning opportunities.
- Teachers emphasized the improved structure of updated courses, the clarity of learning outcomes, and the practicality of laboratory components.
- Industry experts confirmed the relevance of the new topics (e.g., Autonomous Vehicles, Hybrid Vehicles, Engineering Bionics) for future engineers, and welcomed the integration of digital skills training.

Overall, feedback indicates that the modernized materials enhance engagement, foster independent learning, and strengthen employability.

Continuous Improvement

Quality assurance is treated as an ongoing process. Future plans include:

- periodic updates of e-books and digital resources to reflect technological innovations and changes in the automotive industry;
- integration of new simulation software and virtual labs to further enrich practical training;
- expanding multilingual support and accessibility features for international students;
- establishing a feedback loop where student and employer input is continuously collected and incorporated into course revisions.

This systematic approach ensures that learning materials remain dynamic, relevant, and aligned with both academic standards and labor market needs.

7. Conclusions and Recommendations

Conclusions

The analysis of WP2.2 demonstrates that the development and modernization of learning and teaching materials for the Engineering and Management in Automotive Transport program at USARB has been highly effective. Key findings include:

- Comprehensive Curriculum Update. Seven courses and laboratory practicums have been updated or newly created, aligning with industry standards, national competence frameworks, and the Green and Digital transition objectives.
- Digital Integration. E-books, simulations, and digital platforms such as Moodle have significantly enhanced student engagement and supported active, personalized learning.
- Practical Orientation. Laboratory practicums, internships, and project-based tasks ensure that students acquire hands-on skills relevant to the evolving automotive industry.
- Stakeholder Involvement. Continuous feedback from students, teachers, and industry partners has optimized content relevance and usability, supporting employability and professional readiness.
- Quality Assurance. Systematic review processes and pilot testing ensured the materials meet academic and professional quality standards.

Recommendations

To further strengthen the learning materials and ensure their ongoing relevance, the following recommendations are proposed:

1. Continuous Updating. Regularly revise curricula, e-books, and digital tools to incorporate emerging technologies, industry trends, and best practices in teaching.
2. Expand Digital Resources. Increase the use of interactive simulations, virtual labs, and blended learning methodologies to further enhance experiential learning.
3. Enhanced Accessibility. Implement additional multilingual support and accessibility features to accommodate diverse student needs.
4. Industry Collaboration. Deepen partnerships with automotive companies to provide real-world project opportunities and internships.
5. Feedback Mechanisms. Maintain a structured system for collecting and integrating student, teacher, and employer feedback into course updates.
6. Teacher Training. Offer continuous professional development for faculty on innovative teaching methodologies, digital tools, and e-learning practices.

These actions will ensure that USARB continues to provide high-quality, modern, and industry-relevant education, preparing students for successful careers in the automotive sector while supporting broader educational and societal goals.

8. Annexes

Include additional supporting materials such as:

- **Sample lesson plans**

Course Code	**Course Title**	**ECTS Credits**
S.06.A.051	Electromobiles	4
Department	**Semester**	**Prerequisites**
Physical and Engineering Sciences	VI	Materials Study, Materials Technology, Electrotechnics, Automotive Electrical and Electronic Equipment
Type of Course	**Field**	**Language of Instruction**
Oriented towards the specialty, optional	Engineering	Romanian
Level of Course	**Year of Study**	**Lecturer(s)**
Bachelor	III	Course – Ojegov Alexandr Laboratory – Pinzaru Natalia
Mode of Delivery	**Work Placement**	**Co-requisites**
Exam	USARB, Room 314	Electric vehicle training stand MSEV02 AutoEDU

Objectives of the Course:

The main objectives of the course are to:

develop the knowledge in the field of automotive engineering and the application of this knowledge in the design and construction of electric vehicles (electromobiles). Also, this course is aimed at acquiring attitudes regarding the specific operation of electric car components, their maintenance and repair.

Learning Outcomes:

After completion of the course students are expected to be able to:

- define the basic concepts regarding the construction and the principle of operation of the component parts of the electric vehicle;
- exemplify different electrical, non-electrical and electronic systems of the electric vehicle;
- design the construction and mode of operation of the components of the electric vehicle;
- apply the acquired knowledge in developing the fields of use of electric vehicles.

Course Contents:

Introduction. Definitions. Short history. Existing models of electric vehicles (electromobiles) and their prices

Advantages and disadvantages of the electromobiles

Construction of the electromobiles

The principle of operation of the electromobiles

Construction and principle of operation of the electromobiles' battery

The construction and operating principle of the supercapacitor

The inverter. The converter. Electrical circuits and the principle of operation

The lighting and signaling system of the electromobiles. Dashboard

Electric engines and generators for electromobiles

Lab Contents:

Construction and principle of operation of the electromobiles

Study of electromobiles battery charging devices

The construction and operating principle of the supercapacitor

Studying electrical circuits and the principle of operation of the inverter and converter of the electromobiles

Construction and principle of operation of electric motors for electromobiles

Learning Activities and Teaching Methods:

Differentiated instruction, critical thinking development techniques, problem-based instruction, use of creative problems and various forms of work: face-to-face, in groups, in pairs, individually

Assessment Methods:

Current evaluations of laboratory work reports, Periodic evaluation, Exam – test.

Required Textbooks/Reading:

Authors	Title	Publisher	Year	ISBN

CHAU, K.T.	*Electric Vehicle Machines and Drives*	John Wiley & Sons Inc, 424 p.	2015	111875252X
DENTON, T.; PELLS, H.	*Electric and Hybrid Vehicles*	Taylor & Francis Ltd, 296 p.	2023	9781032556796
NIKOWITZ, M.	*Advanced Hybrid and Electric Vehicles*	Springer International Publishing AG, 211 p.	2018	9783319799261
PAWAR, S.R.	*Electrical Vehicle Technology*	Notion Press, 132 p.	2021	1685545610
ENGE, P.; ENGE, N.; ZOEPF, S.	*Electric Vehicle Engineering (Pb)*	MCGRAW HILL BOOK CO, 210 p.	2020	1265900523
IQBAL, H.	*Electric and Hybrid Vehicles*	Taylor & Francis Ltd, 498 p.	2021	0367693933
BHOI, A.K.; PADMANABAN, S.	*Electric Vehicles*	Springer Verlag, Singapore, 300 p.	2020	9811592500
ДЖУТОН, Э.	*Электромобиль. Устройство, принцип работы, инфраструктура*	ДМК-Пресс, 440 с.	2022	978-5-93700-101-6
КАШКАРОВ, А.П.	*Современные электромобили*	ДМК-Пресс, 92 с.	2018	978-5-97060-568-4
RACICOVSCHI, V.; DANCIU, G.; CHEFNEUX, M.	*Automobile electrice şi hibride*	Electra (ICPE), 216 p.	2007	978-973-7728-98-2

Recommended Textbooks/Reading:

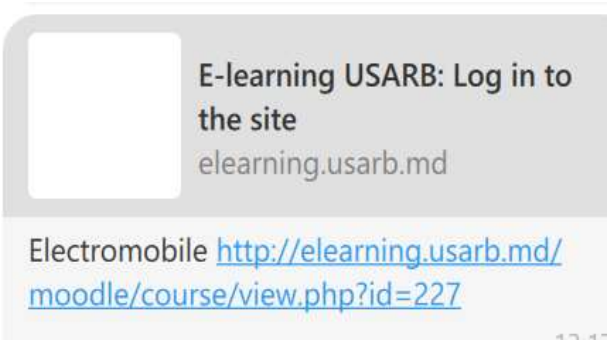
Authors	**Title**	**Publisher**	**Year**	**ISBN**
VIVEKCHAND, S.R.C.; ROUT, Ch.S.; SUBRAHMANYAM, K.S.;	*Graphene-based electrochemical supercapacitors*	J. Chem. Sci., Indian Academy of Sciences,	2008	ISSN 0974-3626

GOVINDARAJ, A.; RAO, C.N.R.		no. 120, p. 9−13.		
BIRKE, K.P.	*Modern Battery Engineering: A Comprehensive Introduction*	World Scientific Publishing Co Pte Ltd, 304 p.	2019	9811215987

- **User guides for digital tools**

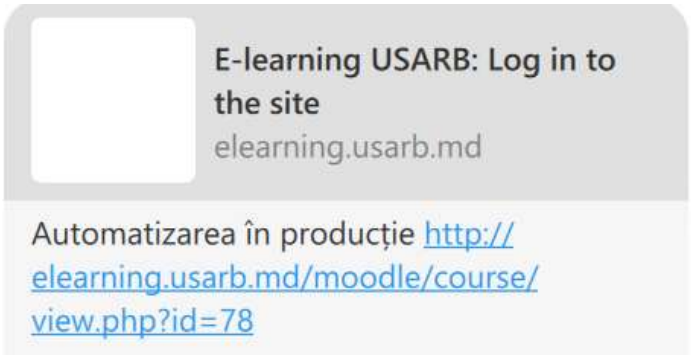
- **Screenshots and links to digital resources**

1. **MOODLE platform, USARB, Course unit "Electromobiles"**



Electromobile http://elearning.usarb.md/moodle/course/view.php?id=227

2. **MOODLE platform, USARB, Course unit "Automation in production "**



Automatizarea în producție http://elearning.usarb.md/moodle/course/view.php?id=78

- Fisa Automatizarea in productie
- Curriculum Automatizarea in productie
- Curriculum Automatizarea proceselor tehnologice
- Curriculum Automatizarea in productie fr/red
- Curs Automatizarea proceselor in MSP
- Noțiuni generale Automatizare
- Test Automatizarea in productie exemplu 1
- Test Automatizarea in productie exemplu 2
- Test Automatizarea proceselor tehnologice

Calculul şi analiza lanţurilor de dimensiuni

- Calculul şi analiza lanţurilor de dimensiuni
- Exemplu de calculul şi analiza lanţurilor de dimensiuni

Tema 1. Conceptele de bază ale tehnicii de automatizare

- Tema 1. Conceptele de bază ale tehnicii de automatizare

Tema 2. Elementele sistemelor automatizate

- Tema 2. Elementele sistemelor automatizate

Tema 3. Calculul cinematic al mecanismelor

- Tema 3. Calculul cinematic al mecanismelor

Tema 4. Transmisii pentru sisteme automatizate

- Tema 4. Transmisii pentru sisteme automatizate

Tema 5. Organele de lucru ale manipulatorului. Apucătoarele

F. Chernihiv National Technological University

1. Executive Summary

Provide a concise overview of the learning and teaching materials developed, including key objectives, target audience, and main findings.

This report contains a comprehensive review of educational and methodological materials developed within the DIGITRANS project for six courses in four undergraduate and graduate educational programs at the Chernihiv Polytechnic National University (CPNU) as it is presented in table below:

The CPNU training programs and courses developed and accredited in the project DIGITRANS

	Study program/ Course name	**Updated or new**	**Level: Bachelor, Master**	**ECTS credit points**	**Mandatory or elected course**
Study program "Computer Engineering (Bc)					
1	Microcontroller Systems Programming	new	Bachelor	5	elected
2	Systems on Chip	new	Bachelor	5	elected
3	Design of Digital Devices	new	Bachelor	5	elected
Study program "Telecommunications and Radio Engineering (Bc)					
4	Electrical Circuit Design	updated	Bachelor	12	Mandatory
Study program "Telecommunications and Radio Engineering (Ms)					
5	Digital Systems of Telecommunications	updated	Master	5	Mandatory
Study program "Electronics of robotic systems and complexes (Bc)					
6	Digital electronics devices	updated	Bachelor	11	Mandatory
	Total			**43**	

The courses were developed according to internal regulations and methodical guidelines of CPNU:

- Mission and strategy - https://stu.cn.ua/universytet/misiya-ta-strategiya/
- Recommendations for the development of educational programs - https://stu.cn.ua/wp-content/stu-media/normobaza/normdoc/norm-osvitproces/metod-rekom-z-rozrobky-op-dlya-npp.pdf
- Methodological recommendations on the development, structure and content of curriculum for training of higher education students - https://stu.cn.ua/wp-content/stu-media/normobaza/normdoc/norm-osvitproces/metod-rekom-rozr-struktury-ta-zmistu-np-zvo.pdf
- Regulations on the electronic database of educational and methodological support of academic disciplines - https://stu.cn.ua/wp-content/stu-

media/normobaza/normdoc/norm-osvitproces/polozhennya-pro-elektronu-bazu-zabezpechennya-navch-dysczyplin.pdf
- Regulations on curriculums and syllabuses of academic courses - https://stu.cn.ua/wp-content/stu-media/normobaza/normdoc/norm-osvitproces/p-pro-sylabusy-navchalnyh-dysczyplin.pdf
- Regulations on distance learning - https://stu.cn.ua/wp-content/stu-media/normobaza/normdoc/norm-osvitproces/polozhennya-pro-dystanczijne-navchannya.pdf
- Concept of introducing artificial intelligence into the educational process and scientific activities - https://stu.cn.ua/wp-content/stu-media/normobaza/normdoc/norm-osvitproces/konczepczia-vprovadgennya-shi.pdf .

Key objectives of implementation the courses:
- to strengthen the digitalization in educational process regarding to modern challenges and strategy of CPNU;
- to improve teaching quality through establishment of novel approaches withing developed Digital Learning Ecosystem (DLE) integrated with Moodle Learning Management System;
- to update the educational content by improving the topics and teaching methods;
- to increase the practical component in the training of specialists in the fields of computer, electronic and radio engineering;
- to expand the practical base of training through the use of modern techniques and tools including developed Sharing Modeling and Simulation Environment (SMSE) and Sharing Remote Experiment Environment (SREE) as parts of DLE.

The target audience includes:
- undergraduate and graduate students in computer engineering, electrical power engineering, electrical engineering and electromechanics, telecommunications and radio engineering
- teachers of Information and computer systems department and Electronics, Automation, Robotics and Mechatronics department;
- DIGITRANS project partners;
- Stakeholders interested in highly qualified specialists;
- indirect beneficiaries of modern industry.

Overall, the developed educational materials combine traditional lecture notes, presentations, methodological guidelines for laboratory and practical works, tests and modular control tasks, electronic and printed textbooks. The methodological principles are based on the widespread use of modern design and modeling tools such as Matlab, Chuartus, OpenModelica, TINA, Altium Designer, AVR Studio, Microchip Studio and original laboratory stends. On-line learning process is supported by developed in DIGITRANS project two labs with Internet access via SREE for remote performing of laboratory works on MCU and FPGA demo boards.

The main findings indicate that using developed Digital Learning Ecosystem with SMSE and SREE in combination with complex of learning and teaching materials ensures students acquire the competencies defined by educational programs. The content of each course, as well as the forms of its acquisition, are aligned with the

real needs of the labour market and stakeholder requests. The final assessment of the effectiveness and quality of the developed courses will be carried out by surveying stakeholders from industry and academic institutions.

2. Introduction

- **Background and Context:** Explain the importance of developing high-quality learning materials.

The courses developed by the CPNU within the framework of the DIGITRANS project are aimed at fulfilling the university's strategic goal of meeting Ukraine's needs for highly qualified personnel for the IT, electronics and telecommunications industries.
Widespread digitalization in all spheres of life also requires the use of the latest educational technologies using modern tools offered for study in the developed courses.
Another important aspect is the implementation of online learning in the conditions of war state introduced in Ukraine as a result of aggression by Russia. The ability to study these courses remotely using a specially developed Digital Learning Ecosystem, which includes software and hardware environment, provides the opportunity to carry out continuous learning even in wartime. In addition, the developed tools make the assessment process automated and more objective.

- **Objectives:** Define the purpose and scope of the materials.

The purpose of creating the presented course materials is to meet the modern challenges dictated by the era of Cyber-Physical Systems (CPS). Proceeding from this goal, the course content covers the issues of computing, communications and management inherent in the CPS in an integrated manner, with an unconditional interpretation of these components to the goals and objectives of the relevant courses. Such a systemic orientation of the educational material ensures its holistic perception and provides a strategic vision.
The second aspect of the course content is compliance with current national standards and internal documents. This ensures that students acquire regulated professional and professional competencies specified in the relevant curricula.
A feature of the developed courses is also the flexibility of their assimilation both offline and online, which is achieved through the use of developed tools to support the learning process, integrated with the general university learning management system - Moodle.

- **Intended Users:** Identify target audiences such as students, teachers, and other stakeholders.

The main target audience of developed materials are undergraduate and graduate students who choose the appropriate courses for study. Undergraduate courses are tied to the logical scheme of obtaining basic education in certain specialties. The materials of the Digital Systems of Telecommunications master's course are adapted taking into account the possibility of separate admission to the Telecommunications and Radio Engineering specialty from other of bachelors programs.
Teachers of graduate departments who provide training in these courses are another key group of users. They can be both developers and, if necessary, teachers involved, which ensures compatibility between them to maintain continuity of education in the some conditions.

Also, the high professional orientation of the courses makes them interesting for representatives of industry and companies from the point of view of cooperation with the university for training personnel.
Of course, the courses developed within the DIGITRANS project are a common acquisition of all partners, which contributes to integration within the framework of the European educational space.

3. Learning and Teaching Materials Overview

- **Types of Materials:** List and describe various resources (e.g., textbooks, workbooks, presentations, guides).

All six developed courses are presented electronically in the Moodle system and are available to students and involved teachers. Regarding the curricula, some of the courses have already been taught to students since the beginning of the academic year, while others will begin teaching from the next spring semester. Each course contains a general part with a syllabus and curriculum, links to launch the involved electronic systems and a user guide for them. The content part is divided into modules, which include lecture notes, presentations on topics, a list of laboratory and practical classes with relevant tasks and links to methodological instructions, sections for downloading reports and tests, descriptions of the tools involved. Individual courses, such as Digital electronics devices, also contain developed video materials. All involved educational resources, including the launch of remote access to SMSE and SREE systems are available directly from Moodle. A list of basic and supplementary literature in the form of textbooks, textbooks and methodological guidelines is presented in the course structure and in the curricula available on the course pages.

- **Digital Tools and Methods:** Outline digital resources, platforms, and methodologies used.

Thanks to the DIGITRANS project, CPNU has developed and deployed DLE, which includes two SMSE and SREE environments to support online learning both during classroom sessions and for independent study by students. DLE is integrated with the Moodle system, thanks to which all educational materials are available in them. This ensures interactive work with both software tools and hardware boards in remote mode. The DLE has implemented a set of virtual servers containing software kernels with pre-installed tools, such as, MATLAB, OpenModelica, interpreters of various programming languages, including Python. Directly from the learning document, access can also be opened for laboratory work with hardware in two remote MCU and FPGA laboratories, each with five workplaces. The teacher can flexibly manage collective access to this equipment using a web interface.
During online classes teacher uses the Teams program, in which all students and teachers are registered. Thanks to the existing in CPNU Microsoft Office 365 license, this system is constantly available both for conducting classes and storing course materials in the cloud. Partners and stakeholders have access to all training materials after appropriate registration in the system.

- **E-books for Teachers and Students:** Describe the available e-books, their content, and accessibility.

E-books are one of the most active forms of presenting educational materials. Their development and use at the CPNU is regulated by the “REGULATIONS on educational electronic publications" – https://stu.cn.ua/wp-content/stu-media/normobaza/normdoc/norm-osvitproces/polozh-pro-navchalni-elektronni-vydannya.pdf .
E-books are presented in form textbooks and methodological guidelines published by both the CPNU and our partners. The general database of electronic publications includes, among others, books published during the previous Erasmus + projects. Thus, the popular in developed courses e-book with title “Model-oriented control in Intelligent Manufacturing Systems” is the one developed by CPNU together with partners in the CybPhys project. The main focus of this book is the theoretical justification of methods for modelling CPS. Currently, the second edition of the e-book “Digital control systems: modern aspects in modeling and implementation”, developed in accordance with the plan of the current DIGITRANS project, is being prepared to publish. It contains theoretical and practical material for building digital control systems based on the MCU and FPGA. The guidelines are narrowly focused on the tools used in the labs, as outlined above.

- **Multimedia Resources:** Highlight interactive tools, videos, and simulations used in teaching.

The developed courses largely use multimedia resources presented on YouTube to supplement text-based learning. This mainly concerns the use of modeling and development environments on the subject of the courses. The created User Guides are used to use the environments developed at the university. Also, the course materials provide useful links for studying publicly available Coursera courses, including obtaining certificates. Another type of multimedia resources are prepared video materials and recordings of lectures and practical classes held at Teams.

4. Pedagogical Approach

- **Instructional Design:** Explain the methodology behind content organization and structure.

Courses are developed in accordance with the accredited educational program and approved curriculum. The educational program contains a logical scheme of course study, which helps to orient the material of the developed course in relation to previous and subsequent disciplines. The content of the courses is focused on the achievement of competencies and learning outcomes, as established by the educational program. The development of course materials by the teacher, as well as its assimilation by students, occurs in modules that contain a theoretical and practical part, including control measures.
All course materials, as well as reports on the tasks completed by students, are uploaded to the Boodle, where the teacher checks them and assigns grades. Thus, the entire process of implementation and evaluation is absolutely transparent for checking success.
The modular system also helps students to exercise self-control over the assimilation of the course. As a rule, all tasks are individual, and their evaluation is accompanied by a plagiarism check by the teacher using free software. For masters, given the short term of study (1.5 years), the tasks are tied to the topics of the qualification papers, which helps them accumulate material for writing the qualification paper.

In accordance with the “regulation on the individual educational trajectory of higher education applicants" – https://stu.cn.ua/wp-content/stu-media/normobaza/normdoc/norm-osvitproces/polozhennya-pro-indyvidualnu-osvitnyu-trayektoriyu.pdf - individual attendance of classes by students working in their specialty or unable to attend classes is allowed after drawing up an individual plan, which is agreed with the teachers and approved by the management of the educational institute within the university.

- **Teaching Strategies:** Describe approaches such as flipped classrooms, blended learning, or problem-based learning.

The basic learning strategies for the developed courses are project-based learning and dual education. Under these strategies, the control measures provided for can be carried out through the implementation of group projects carried out according to the discipline plan, research works or grant projects in which students participate. Project training takes place in accordance with the “REGULATIONS on project training" - https://stu.cn.ua/wp-content/stu-media/normobaza/normdoc/norm-osvitproces/p-pro-proektne-navchannya.pdf . Dual education requires coordination of the topic of tasks with the place of practical training, which is regulated by the “REGULATIONS on the dual form of obtaining higher education " - https://stu.cn.ua/wp-content/stu-media/normobaza/normdoc/norm-osvitproces/p-pro-dualnu-formu-zdobuttya-vo.pdf .

- **Assessment and Evaluation:** Provide details on tools used for measuring student learning outcomes.

The assessment methods used are specified in the curriculum of each course and include ongoing and final control, which is carried out by uploading test papers and posting grades in the appropriate course section on the Moodle. The final grade is posted after semester control in the form of a test or exam with a grade posted in an electronic statement. In addition to the ongoing and final control grades, the credit or exam also takes into account students' participation in research topics, scientific and practical conferences and their publication in scientific journals and conference materials.

5. Digital Platforms and Tools

- **E-learning Platforms:** List and describe LMS systems (e.g., Moodle, Blackboard, Google Classroom).

Teaching and learning of the materials of the developed courses is carried out using various tool platforms provided by the course, as well as a general DLE.
The foundations of the DLE for online education of engineers were laid in an earlier Erasmus+ project “Development of practice-oriented student-cantered education in the field of modelling cyber-physical systems” (CybPhys) in the framework of which SMSE was created. The purpose of SMSE is to provide the possible digitalization of online learning in various technical courses with the support of the necessary computer simulation environments. In order to organize students' access to educational materials, there was the envisaged the integration of SMSE with the Moodle Learning Management System (LMS). The SMSE itself was developed on the basis of the

Jupyter platform, which made it possible to use the Jupyter Notebook as the basic educational document of the courses.
In the DIGITRANS project, DLE is extended the scope of the basic SMSE architecture by beyond the use not only virtual software kernels but to remote use of physics laboratories with installed hardware for conducting full-scale experiments with it in remote mode. For this purpose, the SREE platform is developed, which provides:

- On-line laboratory works with physical equipment of remote laboratories for learning and teaching practical topics in computer and electronic engineering.
- Integrating SREE with SMSE that affords virtual laboratories based on virtual software kernels and hardware devices using Jupiter Notebooks.

Now, two physical remote laboratories are located in the CPNU. This provides performing laboratory works with digital integrated circuits and microcontrollers such as FPGA and MCU remotely, namely to test the operation of digital circuits implemented on related demo boards but the student has only PC with Internet access.

- **Collaboration Tools:** Mention digital collaboration tools (e.g., MS Teams, Zoom, Slack, Padlet).

In addition to the DLE, which integrates SMSE and SREE with Moodle, online interactive environments Teams and Zoom are used to conduct classes. Work in Teams is carried out only by users registered in the Office 365 system, and Zoom is used for a wider audience, including invited stakeholders and other external users during joint discussions of course materials and conferences on their topics.

- **Accessibility and Inclusivity:** Explain measures taken to ensure digital tools are inclusive and accessible to all users.

The materials of the developed courses are currently presented mainly in Ukrainian, with the exception of English-language syllabi. Teaching is also conducted in Ukrainian. Some courses include English-language multimedia materials for independent study of additional sections. Also, it is a mandatory requirement to include English-language sources (textbooks or articles) in the list of recommended literature. This corresponds to the university's general strategy to expand the use of English in the educational process in accordance with the ‘Program for improving the level of english language proficiency by participants of the educational process " - https://stu.cn.ua/wp-content/stu-media/normobaza/normdoc/norm-osvitproces/programa-pidvyshhennya-rivnya-volodinnya-anglijskoyu-movoyu-uchasnykamy-op.pdf . Support for people with disabilities is provided in accordance with the “Procedure for the support (provision of assistance) of people with disabilities and other low-mobility groups" - /https://stu.cn.ua/wp-content/stu-media/normobaza/normdoc/norm-osvitproces/poryadok-suprovodu-osib-z-invalidnistyu-ta-inshyh-malomobilnyh-grup-naselennyav.pdf and includes providing separate access to course materials, ensuring offline classes and using individual learning trajectories.

6. Quality Assurance and Feedback

- **Review Process:** Describe how materials were validated and tested.

Validation and testing of courses takes place in accordance with the “REGULATION on the assessment of the quality of educational activities " - https://stu.cn.ua/wp-content/stu-media/normobaza/normdoc/norm-

osvitproces/polozhennya-pro-oczinyuvannya-yakosti-navchalnyh-zanyat.pdf and includes such forms as:

- discussion of course content at methodological meetings of departments
- discussion of course content with stakeholders
- internal quality control of developed documents and their compliance with established standards by the educational department
- review of prepared electronic and printed editions of course materials
- verification of the content, provision and compliance of courses with educational programs during their internal and external accreditation
- surveying of students, teachers and stakeholders on the content of courses and the use of digital educational platforms
- annual update of curricula and course content in accordance with the trends of subject fields, new publications, and comments and suggestions from students, faculty, and stakeholders.

- **User Feedback:** Summarize feedback from teachers, students, and experts.

In progress

- **Continuous Improvement:** Outline plans for updates and enhancements.

In progress

7. Conclusions and Recommendations

Summarize key findings and provide recommendations for future development and improvement of learning materials.

The experience of teaching the courses and using the developed training tools should be used to further develop and improve the courses, as well as the planned survey of target groups and stakeholders.

8. Annexes

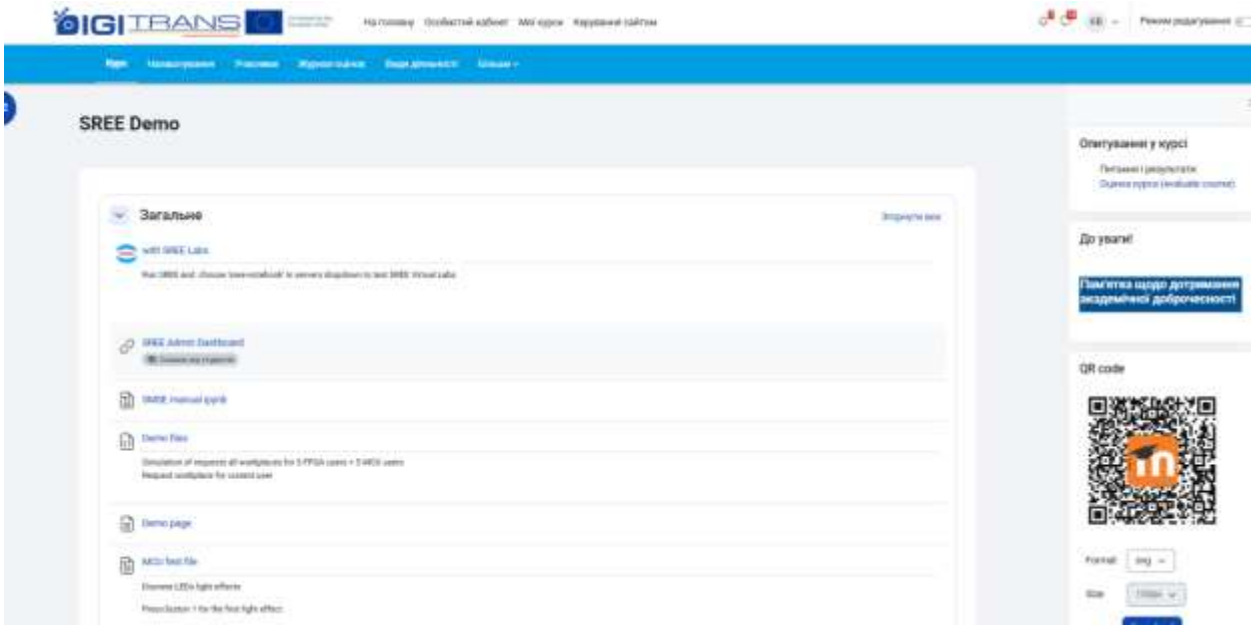
Include additional supporting materials such as:

- Sample lesson plans

  Given in courses' presentations

- User guides for digital tools

  SMSE user manual.pdf



- Screenshots and links to digital resources

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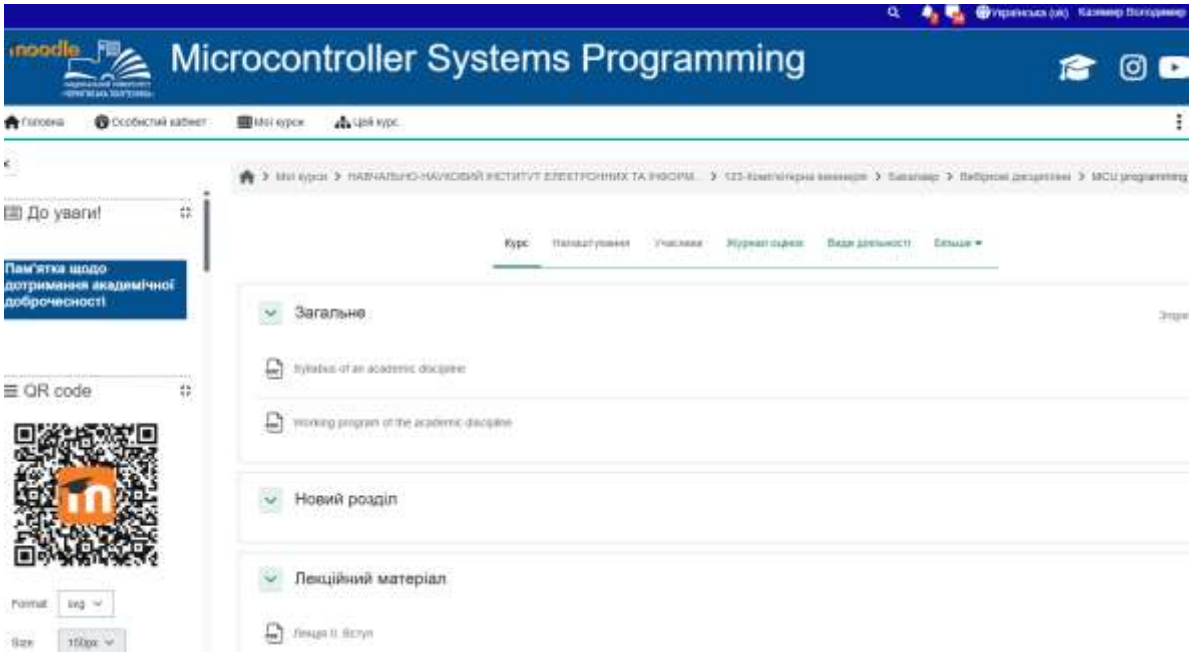

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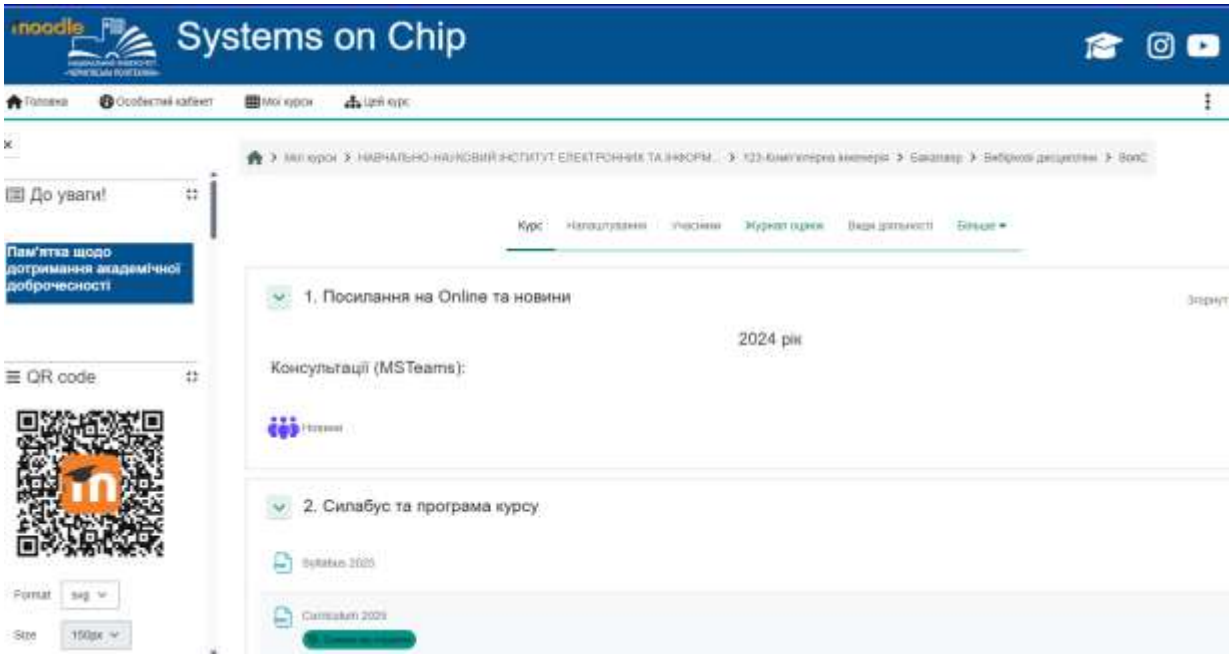

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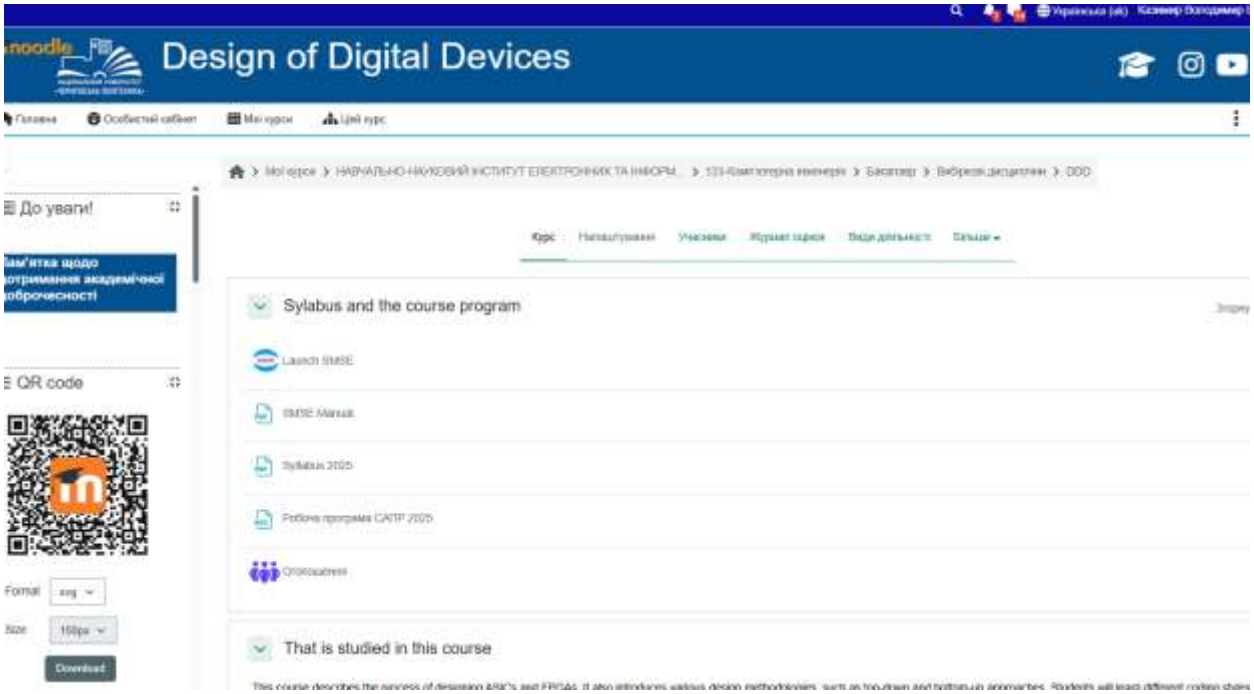

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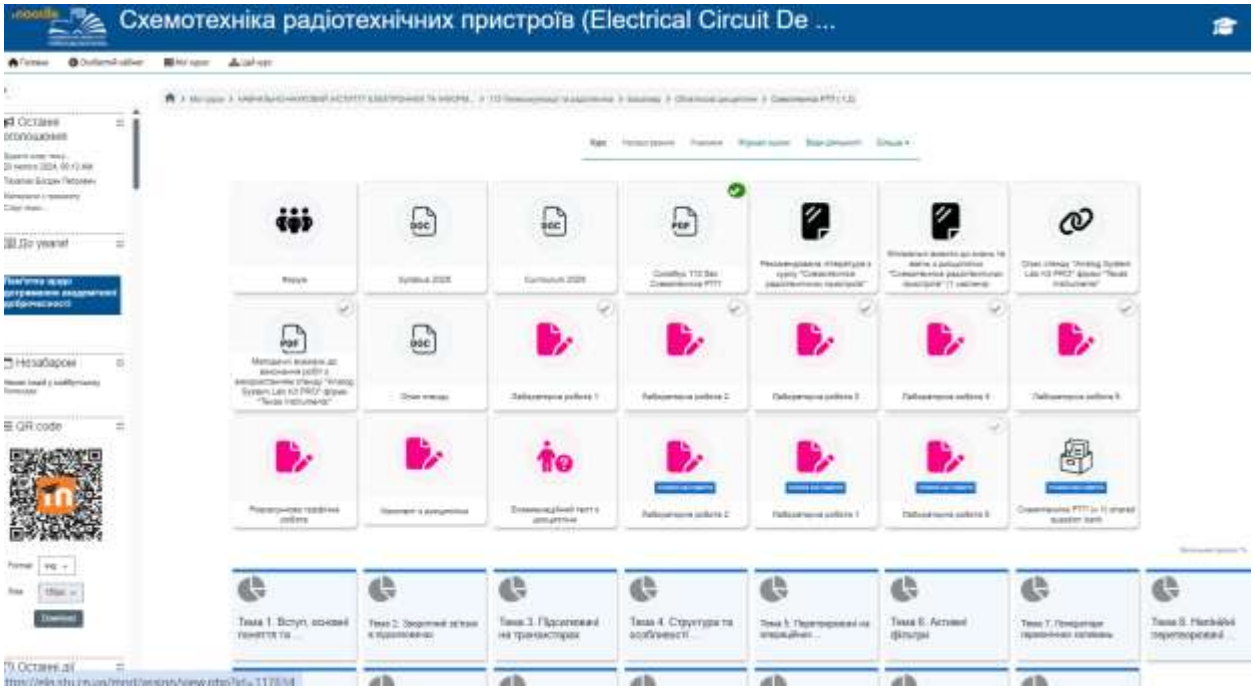

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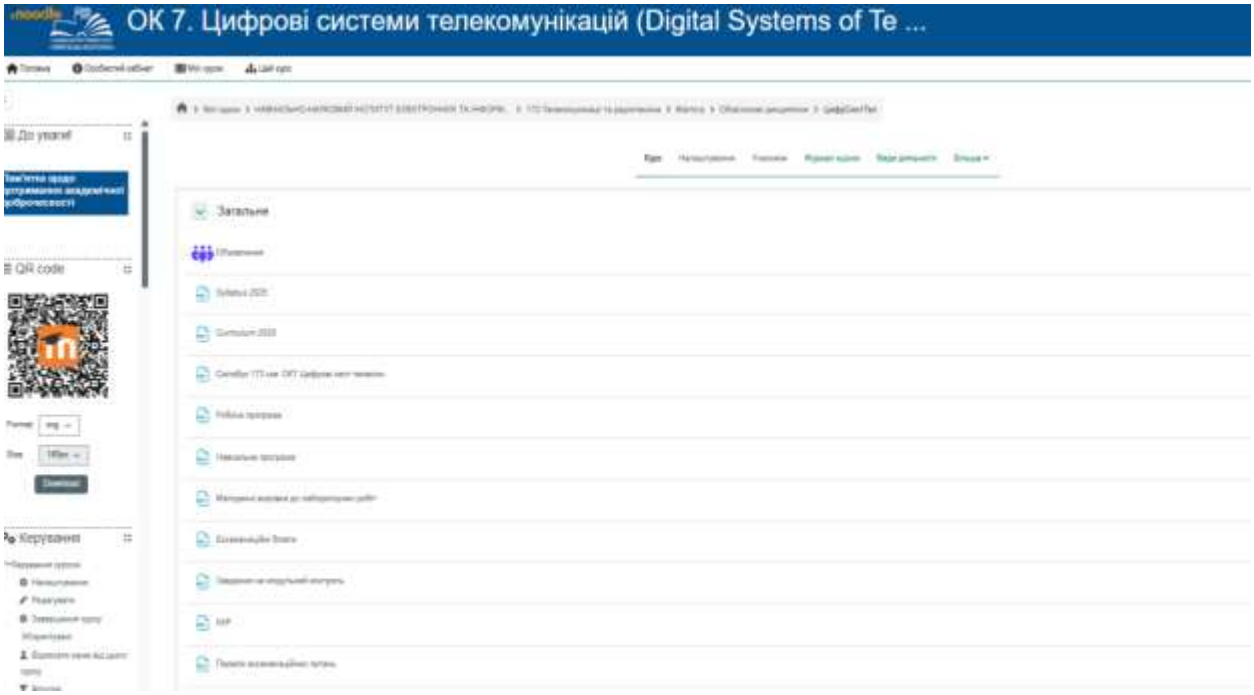

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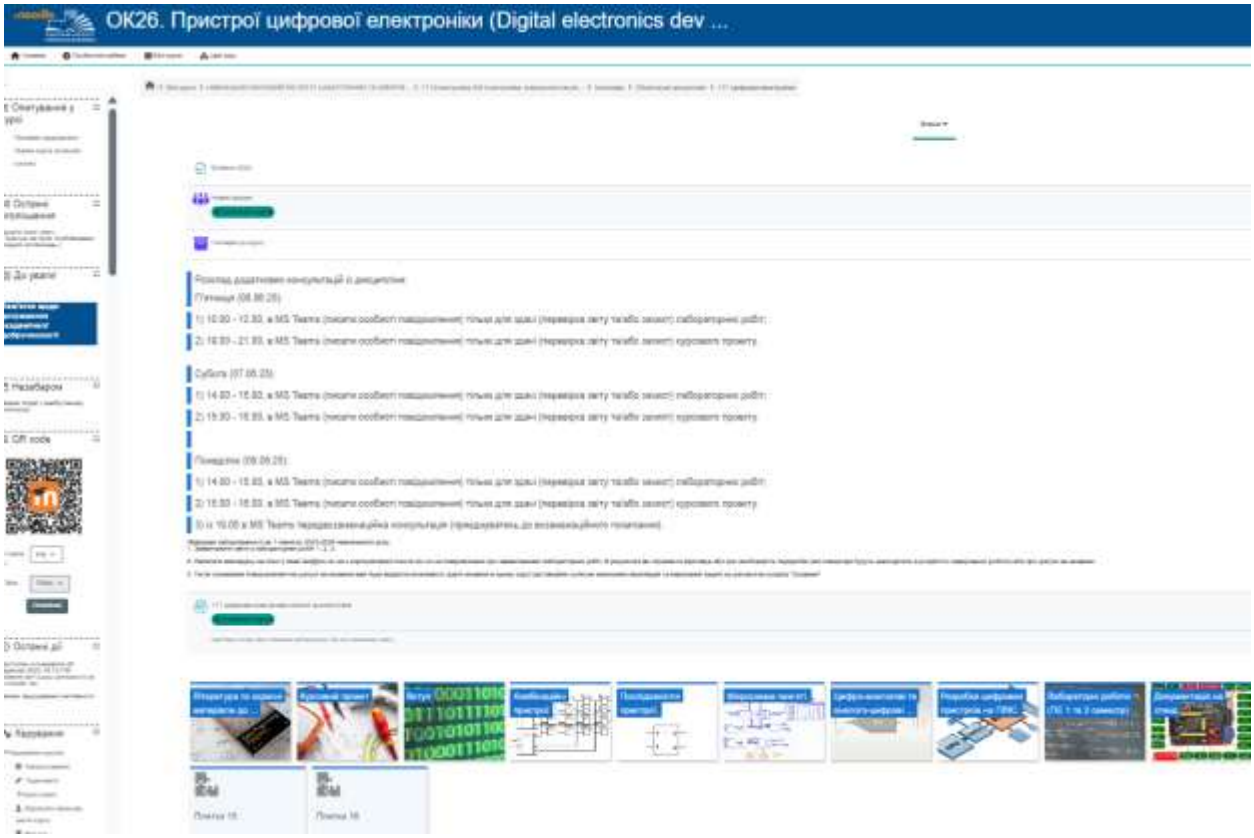
ОК26. Пристрої цифрової електроніки (Digital electronics dev ...

Developing four text e-books for students' education

Summary

The four text books where development Developing text 4 e-books for students' education. The target of task was development of e-books in English with the translation to Moldavian or Ukrainian languages for students. All partners participated and contribute to the development of e-books in accordance with the new / modernized courses, and the application of innovative teaching and learning methods

The four e-books for teachers and students are uploaded to e-Library on the Google Drive of the DIGITRANS project:

1. Electric drive, automotive electronics and Energy-saving technologies for Modern transport, 137pp. Editor A. Hnatov
2. Integrated course "Automotive transport", 556 pp. Editors Ion V. Ion and Volodymur Sakhno.
3. Digital control systems: Modern aspects in modeling and implementation, pp.178. Editors: Volodymyr Kazymyr, Nadezhda Kunicina, Anatolijs Zabasta,.
4. Sustainable Digital Transformation in Automotive Industry, 163 pp. Editors: Leonids Ribickis, Nadezda Kunicina.

1. Book Electric drive, automotive electronics and Energy-saving technologies for Modern transport

Rīga Tehniskās university printing house: Electric drive, automotive electronics and Energy-saving technologies for Modern transport

ISDN 978-9934-37-194-3, 137p. editor A. Hnatov

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Abstract:

This textbook, Electric Drive, Automotive Electronics, and Energy-Saving Technologies for Modern Transport, provides a comprehensive overview of key concepts, technologies, and methodologies shaping the next generation of transport systems. It is designed to equip students, researchers, and practitioners with the foundational knowledge and practical insights needed to understand, design, and optimize electric and hybrid vehicles.

Keywords

EV charging, e- mobility, electrical engineering, power electronics, transport, Electric drive, automotive electronics and Energy-saving technologies

2. Book Integrated course “Automotive transport”

Editors-reviewers:

Ion V. Ion, Prof. Dr. Ing. Habil. Dunarea de Jos of Galati, Romania, Department of Thermal Systems and Automotive. Volodymur Sakhno, Doctor of Technical Science, Professor, Head of Automobiles Department, National Transport University, Kyiv, Ukraine (556 pages).

Authors:

B.P. Hasdeu Michael FRATITA, Chivu ROBERT-MADALIN, Viktor SAMOSTIAN, Serhiy FEDOSOV, Marina BUNEA, Oleg SITOVSKYI, Vasyl PAVLIUK, Stanislav PRYSTUPA, Valentyn ZABLOTSKYI, Andrii HNATOV, Arhun SHCHASIANA, Olha ULIANETS, Pavli SOKHIN, Valerii DEMBITSKYI, Valentyn PRYDIUK, Nadezhda KUNICINA, Nadezda ZENINA, Andrejs ROMANOVS, Jelena CAIKO, Igor MUROVANYI, Irina PAVLOVA.

UDC 629.331 S 7 Recommended by the Academic Council of Lutsk National Technical University, protocol № 10, 29.08.2025 Reviewer: Ion V. Ion, Prof.dr.ing.habil. Dunarea de Jos of Galati, Romania, Department of Thermal Systems and Autimotive. Volodymur Sakhno, Doctor of Technical Science, Professor, Head of Automobiles Department, National Transport University, Kyiv, Ukraine. Team of authors S7 Integrated course «Automotive Transport»: e-book / Team of authors. Lutsk : Vezha-Druk, 2025. – 556 pp.

Format 60×84 1/16. Volume 6.97 standard printed sheets, 6.28 regional printed sheets
Circulation 100 copies. Order 80. Publisher and manufacturer – Vezha-Druk
(Lutsk, 12 Chopina St., tel. (0332) 29-90-65).
Certificate of the State Committee of Television and Radio Broadcasting of Ukraine
DK No. 4607.

Abstract:

The textbook "Integrated Course in Automotive Transport" is intended for students of higher education institutions of transport and engineering profile. It aims to form in students a holistic understanding of the functioning, organization and development of road transport as an important component of the state's transport system.

The textbook provides integration of knowledge on technical, economic, organizational and environmental aspects of road transport activities.

The textbook can be used when studying basic and special academic disciplines, performing course and diploma projects, as well as reference material in the practical activities of young specialists in the transport industry.

Key words:

KA2 - Collaboration for innovation and exchange of best practices. Capacity building in higher education.

3. Book Digital control systems: modern aspects in modeling and implementation

Editors: Volodymyr Kazymyr, Nadezhda Kunicina, Anatolijs Zabasta, pp.178. Printing House of the Riga Technical University.

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Abstract (long):

The e-book highlights the main theoretical and applied aspects related to the modeling and implementation of digital control systems (DCSs) from the perspective of their application in the Cyber-Physical Systems. The main attention is paid to the construction of MCU-based DCSs: from DC motor control system and network to intelligent control systems of UAV swarm with using of embedded models, artificial neural networks and fuzzy control. A separate section presents DCSs based on programmable logic devices, namely FPGA. Hardware and software components of considered DCSs' examples is accompanied by a comparative analysis of modern technologies and tools their modeling and implementation.

This e-book can be served a textbook for graduate and postgraduate students as well as teachers in computer and electrical engineering to a better understanding of the current trends and prospects for digitalization in the field of control, responding to the challenges of Industry 5.0. The e-book was developed within the EU-supported ERASMUS+ project.

Abstract (short):

This e-book highlights for students and teachers the modern aspects in modeling and implementation of digital control systems from the perspective of their application in the industry 5.0.

Keywords:

Digital control systems, microcontroller, FPGA, modeling, artificial neural networks, fuzzy control, cyber-physical systems, Industry 5.0.

4. Book Sustainable Digital Transformation in Automotive Industry

Editors: Leonids Ribickis, Nadezda Kunicina, 163.p. Printing house of the Riga Technical University.

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Abstract:

The textbook “Sustainable Digital Transformation in the Automotive Industry” provides an overview of the key concepts, technologies, and practices related to electric drive systems, automotive electronics, and energy-efficient transport solutions. It highlights the role of digitalization, automation, and sustainability in shaping modern automotive production, business planning, and human resource management. The book also addresses ecological challenges, cybersecurity issues, and the rise of online marketplace platforms as part of digital transformation. Combining theoretical foundations with practical case studies, it equips students, researchers, and industry professionals with the tools needed to innovate and adapt in a rapidly evolving automotive ecosystem. The textbook was developed within the EU-supported ERASMUS+ project.

Key words:

Digital transformation, automotive industry, sustainability, digitalization, automation, energy efficiency, cybersecurity, ERP, online marketplaces.

Discussion

The joint evolution of WP2 and WP3 underscores a systemic approach to higher education modernization. WP2 modernized curricula and produced accessible digital learning materials aligned with EU priorities, while WP3 delivered the digital infrastructure necessary for applying these materials in practice. This synergy ensures that theory and practice are integrated within a coherent Digital Learning Ecosystem (DLE).

WP2 partners developed syllabi, manuals, bilingual textbooks, and digital resources, integrated into Moodle and complemented by interactive content. WP3 partners created SREE, enabling remote laboratory work, virtual mobility, and collaborative experimentation. Together, these packages address key challenges: disruptions due to conflict, limited laboratory access, and the need for scalable, inclusive digital learning. The DLE provides continuity of education for displaced students, promotes resilience, and fosters collaboration across borders.

Feedback from faculty members highlight the enhanced opportunities for remote experimentation introduced through WP3. The inclusion of industry partners in curriculum and platform development ensures relevance to labour market needs and supports employability. The alignment with EU strategies, including the Green Deal and Fit for 55, ensures that modernized curricula not only address current academic demands but also anticipate future societal and economic challenges.

The interplay of WP2, WP3, and WP4 demonstrates the value of a phased yet overlapping approach. WP2 produced updated and new learning materials, WP3 delivered the infrastructure to support their application, and WP4 is now validating these efforts in real-world conditions. This ongoing piloting creates a feedback loop that informs refinements to both content and infrastructure.

As WP4 continues, more structured data will be collected, allowing for deeper analysis of the pedagogical impact, inclusivity measures, and labour market relevance. This ongoing process ensures that the DIGITRANS project remains adaptive and responsive to stakeholder needs.

Conclusion

The integration of WP2 and WP3 has delivered a powerful, interconnected framework for modernizing education in Ukraine and Moldova. WP2 achievements provide students with comprehensive, industry-aligned teaching materials, while WP3 establishes the infrastructure for digital, remote, and blended experimentation.

Together, these outcomes represent a best-practice model for higher education modernization, addressing both the **content** and the **delivery mechanisms** of learning.

The dual focus on resilience and innovation is particularly timely given the destruction of physical facilities and the mobility challenges faced by students and staff in Ukraine. By providing both learning content and a distributed digital ecosystem, the project ensures continuity of education, inclusivity, and alignment with global green and digital transitions.

Looking ahead, the consortium partners emphasize the importance of embedding sustainability and adaptability into the project's achievements. Across all contributions, a shared set of recommendations emerged. First, courses and materials must be continuously updated through structured review cycles, ensuring their alignment with technological progress, labor market needs, and student expectations. Second, digital and interactive resources—including simulations, animations, and remote labs—should be further expanded to increase interactivity and experiential learning opportunities. Third, accessibility and inclusivity remain central priorities: teaching materials must comply with international accessibility standards, be available in multiple languages, and support mobile and low-bandwidth access.

In addition, partners recommend strengthening structured feedback mechanisms, such as student satisfaction surveys, peer exchanges, and employer consultations, to guide continuous improvement. The professional development of teaching staff is also critical; faculty should be supported through ongoing training in digital pedagogy, innovative resource design, and e-learning practices. Industry collaboration must be deepened to embed case studies, internships, and applied projects, thereby reinforcing the connection between academic programs and the workplace. Finally, the introduction of micro-credentials and digital certification linked to recognized frameworks will further enhance student motivation and employability.

Taken together, these recommendations ensure that the DIGITRANS project will not only deliver immediate benefits but also establish the foundations of a resilient and future-ready higher education system. By combining innovative teaching materials (WP2) with digital infrastructures for learning and experimentation (WP3), the consortium has created a dynamic model of modernization that can be sustained, scaled, and replicated across borders.

The consolidated achievements of WP2 and WP3, together with the ongoing activities of WP4, demonstrate a holistic approach to higher education modernization. WP2 provided content innovation, WP3 built the enabling digital ecosystem, and WP4 is ensuring that these outputs are validated in practice.

Sustaining and scaling these results will depend on the full institutionalization of WP4's feedback mechanisms, the continued updating of WP2 course materials, and the further development of WP3's digital infrastructure. Together, these dimensions will ensure a resilient, inclusive, and future-ready higher education system.

Moving Forward

Building on the outcomes of WP2 and WP3, the next steps will consolidate and expand the Digital Learning Ecosystem. Priorities include scaling up SREE-based laboratories across all institutions, embedding micro-credentials and digital badges into WP2-developed curricula, and strengthening integration with the forthcoming Ukrainian Open University Platform. Further work will enhance inclusivity, expand international partnerships, and deepen collaboration with industry, ensuring that digital education ecosystems remain responsive to emerging technological and labour market needs.

The ongoing progress of WP4 represents the bridge between innovation and sustainability. The next phase will focus on expanding student enrolments, deepening staff training, and strengthening employer engagement. Additional piloting cycles will allow for refinement of both materials and infrastructure, ensuring that the final outcomes of WP4 are robust and scalable.

The swim lane timeline (Figure 1) highlights how WP2 (content creation), WP3 (infrastructure development), and WP4 (ongoing piloting and feedback) overlap and reinforce one another. This visualization underscores that modernization is not linear but cyclical, with feedback continuously informing improvements.

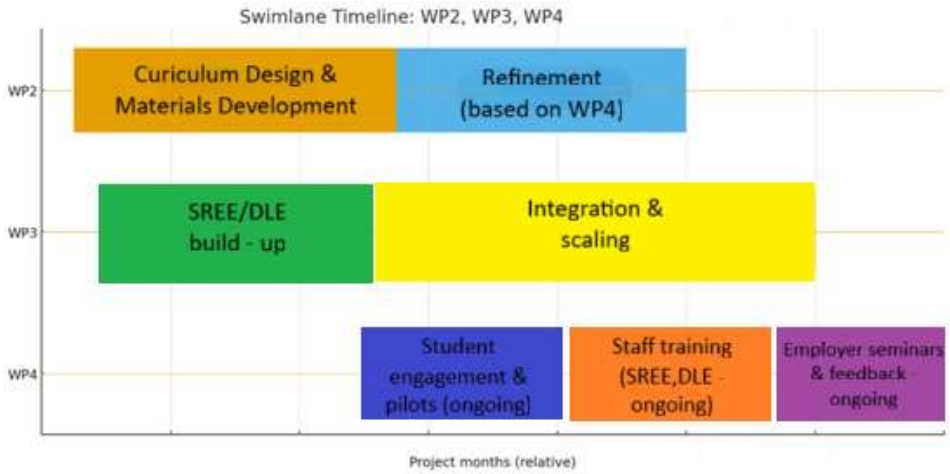

Figure 1: DIGITRANS WP2–WP4 Swimlane Timeline

DIGITRANS thus continues to evolve dynamically: WP2 and WP3 outputs are already available and in use, while WP4 is actively validating and refining them. This ensures that the final results will not only meet academic and technological standards but also align with the real needs of students, staff, and employers.