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CONN'COR - Connect, Compare and Repair for a Common Future with Ukraine:
A Focus on Electrical Engineering Teaching

Project No. 2024-1-FR01-KA220-HED-000250882

WP2: Strengthening the coherence of teaching on a certain set of subjects

Activity 2.2: Statement, exchange and new propositions on good practices for teaching coherence

R2.2c Report on propositions for teaching coherence with aim to improve the quality and consistency of teaching across institutions

Contents:

Co-funded by the European Union

Report on propositions for teaching coherence with aim to improve the quality and consistency of teaching across institutions (CentraleSupélec)

General purpose of the activity

The general purpose of the activity for each partner is to identify the key courses provided at the same semester that require a stronger correlation of content and way of teaching, as well as to create a framework for exchanging and developing good practices based on regular meetings (if possible with teachers who provide courses for the same group of students).

Context of the implementation of R2.2 for CentraleSupélec

After several years of discussion between Centrale and Supélec the new engineering school **Centralesupélec was officially born the 1st of January 2015**. These two schools have always been in the top 5 of the Engineering school in France regarding many criteria like employment, salaries, and successful carriers. These two school were recruiting the students based on a competition after two years of the very selective preparatory classes in France. Despite some similarities, these two schools had two different cultures.

Supélec, founded in 1894 claims to be a generalist school. Nevertheless the school was particularly recognized in the field of Energy, Information sciences and Systems. Supélec graduated 500 engineers per year.

Centrale Paris, founded in 1829, had for founding vision to train multidisciplinary engineers. This school was more generalist than Supélec and they were more leadership oriented.

The new school of engineering CentraleSupélec has the following vision of teaching:

1. The new academic content must be **multidisciplinary and generalist** (not electrical, not mechanical, not chemical engineering but multidisciplinary).
2. The **students will build their own path in the academic program**, depending on what they plan to do later. Certain discipline remains mandatory like Mathematics but Electronics is optional and to be chosen among a list. **So each course must be independent from one another.**
3. Specific teaching « Séquence Thématiques », (Thematic sequence) are to be chosen by the students, like « autonomous vehicles ». In these thematic sequences the projects are **transdisciplinary projects**.
4. Specific teaching « Projects within a project pole ». These projects are dedicated to groups of 5 students. Together with these mandatory projects the students must participate to **soft skills development activities** in 1st and 2nd year.

To materialize this vision, CentraleSupélec has over the last years created a completely new academic program:

2018-2019: creation of a new academic program for the 1st year in CentraleSupélec
2029-2020: creation of a new academic program for the 2nd year in CentraleSupélec
2020-2021: creation of a new academic program for the 3rd year in CentraleSupélec
2023-2024: in electronics and electromagnetism: new version of the 3rd year in CentraleSupélec
2023-2024: revised version of the 1st academic year with a reduced number of hours

Also a new specialized Diploma was under creation during the time of CONN'COR project and **opened for the first time to first year students in September 2025**.

This is why, CentraleSupélec provide in this workpackage an **"Experience sharing"** and **"Exchange of good practices"** through two cases:

- The creation of the new course "Electronics Systems" who involved more than ten teachers during two years with regular meetings
- The creation of a new Diploma and associated challenges who involved more than ten teachers at different locations (CS Gif-sur-Yvette, CS Rennes and CS Metz).

Additionally to this experience sharing, CentraleSupélec conducted a survey among industrial partners about the coherence between their seminar and the rest of the pedagogical content.

Experience 1 in course alignment : Creation of the course "Electronic systems"

This experience has been shared during a webinar the 29th of January 2025.

<table>
<tr><td>4 Initial courses</td><td>Logical Systems
(32 hours)

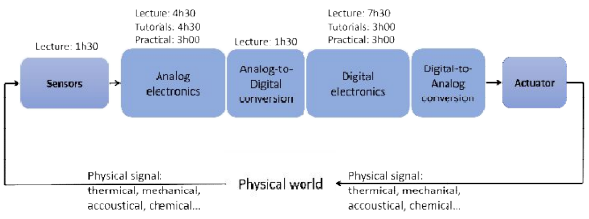
1st year Students

mandatory</td><td>Analog Electronics
(32 hours)

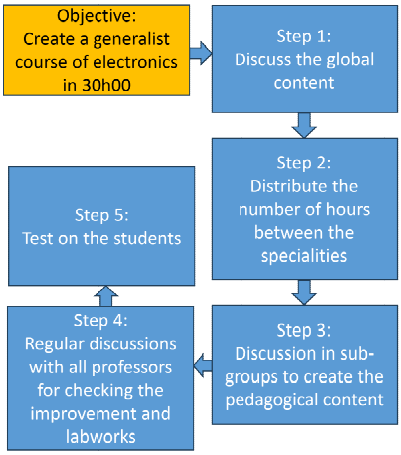
1st year students

mandatory</td><td>Analog-to-Digital conversion
(20 hours)
3rd year students

Depending on specialization</td><td>MEMS (Micro-Electro-Mechanical Systems)
(20 hours)
3rd year students

Depending on specialization</td></tr>
<tr><td>1 Resulting course</td><td colspan="4">Electronic systems
(28h30 hours)
Optional
Content of the created course
Total: 28h30 « Electronic systems » in 2023-2024
Office hours to replace in presence work (1h30 in Analog, 3h00 in Digital, 1h30 in ADC)
 
</td></tr>
</table>

Main questions during creation	• Physics of semi-conductors to be included? • Transistor based circuits? Opamp based circuits? • MEMS design or instrumentation with off-the-shelves components? • Models of components? • Basics in integrated circuits? Is it to specialized? • FPGA and VHDL? • Arduino? • More advanced concepts? • What is the part of lectures/tutorials/labworks? • What kind of labwork can we propose to represent each part of electronics? • What kind of evaluation for the global course and the weight of each part in this evaluation? • What is an « electronic systems » course for non-specialist student? • What is the background and the difference of background between students?
Main problems during creation	Professors must agree on the content, but it is not easy: Among professors in the same field different opinion What is the importance of each topic (digital vs analog) 2. What happen if the course is not chosen by the students? Will I keep my job? 3. The number of hours is reduced Will I keep my hours of teaching? Will I keep some visibility among the students? Will the field I am teaching be considered relevant? 4. The course content appears really light, what about the level of the students With a reduced number of hours, will a CentraleSupélec student have the same level as a Supélec student before? What about the feedback of the industry on this new academic content? 5. Human resource problems The creation of the course may have emphasized the rivalry, the competition among certain professors and partially damaged the working atmosphere.

Number of teachers involved	Analog (5) : MR, PMF, AD, EAM, FVDS Digital (3) : PB, AK, CLP MEMS/sensors (2) : JJ, LB ADC (4) : CLP, PB, PMF, MR **Total number of teachers involved : 10**
Applied Methodology	 The methodology is illustrated by this diagram on the left and on the right there are the question we asked during the different meetings. So the step 1 is to gather all the professors from the different fields to brainstorm about the global content of the new course. After several meetings it has been decided that the electronic Systems course will be composed of analog electronics digital electronics but also Analog to digial conversion and sensors. In step 2, Once the global content has been decided, we had to distribute the number of hours for each area of expertise and also the number of labworks, tutorials and lectures. **The two first steps necessitated 4 meetings with all the 10 professors.** After in step 3 we started the discussion by small sub-groups In step 4 it was mandatory to have regular discussions with all professors at least for the creation of the labworks because we wanted the labworks to be really transdisciplinary. So it contains a sensor part (ultrasonic sensor), an analog part and a digital part with an ADC and a FPGA.

Conclusion	1. Less specialized course, like an introduction to electronics in general. 2. Optional when all specialized course were mandatory. Nevertheless, more than 350 students follow this course each year!

Surveys conducted on this experience 1

Surveys on students

1st group of students: appendix Students_survey_course_alignement_1st class.pdf : survey about course alignment in "Electronics systems" : **38 students responded to the survey**

For this first class **73%** thought that the course "Electronic Systems" is transversal and provide a good overview of all electronics domains. **76%** of the students agreed that the course allow to understand the role of each electronics discipline. **68%** of the students agreed that the multidisciplinary project reveals the coherence between the different disciplines. Detailed results below.

Résumé pour Q14(SQ001)[Systèmes Électroniques est un cours transverse à tous les aspects de l'électronique et donne une bonne vision du domaine qui nous sera utile dans le monde professionnel]

Questions sur l'aspect transverse du cours dans le cadre du projet Erasmus+ CONN'COR

Réponse	Décompte	Pourcentage
tout à fait d'accord (AO01)	9	26.47%
plutot d'accord (AO02)	16	47.06%
plutot pas d'accord (AO03)	2	5.88%
pas d'accord du tout (AO04)	1	2.94%
sans opinion (AO05)	6	17.65%
Sans réponse	0	0.00%

Résumé pour Q14(SQ002)[Grâce au cours de systèmes électroniques j'ai compris précisément le rôle de chaque discipline enseignée (électronique analogique, électronique numérique, ADC, capteur) dans une chaîne électronique globale des applications qui nous entourent]

Questions sur l'aspect transverse du cours dans le cadre du projet Erasmus+ CONN'COR

Réponse	Décompte	Pourcentage
tout à fait d'accord (AO01)	11	32.35%
plutot d'accord (AO02)	15	44.12%
plutot pas d'accord (AO03)	1	2.94%
pas d'accord du tout (AO04)	2	5.88%
sans opinion (AO05)	5	14.71%
Sans réponse	0	0.00%

Résumé pour Q14(SQ003)[Systèmes Électroniques présente une bonne cohérence grâce à l'enchaînement des disciplines et le TP « fil rouge » impliquant les différentes disciplines]

Questions sur l'aspect transverse du cours dans le cadre du projet Erasmus+ CONN'COR

Réponse	Décompte	Pourcentage
tout à fait d'accord (AO01)	9	26.47%
plutot d'accord (AO02)	14	41.18%
plutot pas d'accord (AO03)	4	11.76%
pas d'accord du tout (AO04)	1	2.94%
sans opinion (AO05)	6	17.65%
Sans réponse	0	0.00%

2nd group of students: appendix Students_survey_course_alignement_2nd class.pdf : survey about course alignment in "Electronics systems" : **38 students responded to the survey**

For this first class **55%** thought that the course "Electronic Systems" is transversal and provide a good overview of all electronics domains. **77%** of the students agreed that the course allow to understand the role of each electronics discipline. **77%** of the students agreed that the multidisciplinary project reveals the coherence between the different disciplines. Detailed results below.

Résumé pour Q8(SQ001)[Systèmes Électroniques is a cross-curricular course on all aspects of electronics and gives a good vision of the field that will be useful to us in the professional world]

Questions on the traversal aspect of the course in the framework of the Erasmus+ CONN'COR project

Réponse	Décompte	Pourcentage
Strongly agree (AO01)	4	12.90%
Somewhat agree (AO02)	13	41.94%
Somewhat disagree (AO03)	11	35.48%
Strongly disagree (AO04)	1	3.23%
No opinion (AO05)	2	6.45%
Sans réponse	0	0.00%

Résumé pour Q8(SQ002)[Thanks to Systèmes Électroniques course, I understood precisely the role of each discipline taught (analog electronics, digital electronics, ADC, Sensor) in a global electronic chain of the applications around us]

Questions on the traversal aspect of the course in the framework of the Erasmus+ CONN'COR project

Réponse	Décompte	Pourcentage
Strongly agree (AO01)	9	29.03%
Somewhat agree (AO02)	15	48.39%
Somewhat disagree (AO03)	4	12.90%
Strongly disagree (AO04)	2	6.45%
No opinion (AO05)	1	3.23%
Sans réponse	0	0.00%

Résumé pour Q8(SQ003)[Systèmes Électroniques has good coherence through the sequence of disciplines and the common theme Lab involving the different disciplines]

Questions on the traversal aspect of the course in the framework of the Erasmus+ CONN'COR project

Réponse	Décompte	Pourcentage
Strongly agree (AO01)	6	19.35%
Somewhat agree (AO02)	18	58.06%
Somewhat disagree (AO03)	5	16.13%
Strongly disagree (AO04)	1	3.23%
No opinion (AO05)	1	3.23%
Sans réponse	0	0.00%

Surveys on professors

The survey has been sent to the professors who participated in the creation of the course "Electronic systems". Four professors answered the survey. From the survey it appears that the main difficulties, by order, in creating the coherent course "Electronic Systems" are :

1. Define a coherent content based on previous specialized courses.
2. Define the importance and number of hours for each part of the course
3. Synchronize the actions of professors for creating a coherent content
4. Read, correct and enhance each pedagogical content of each team member
5. Define a common practical work involving equally each part of the course

The main concern of all professors is that the creation of this coherent and generalist course reduced the number of hours of each specialty. The professors think that each specialty is less represented.

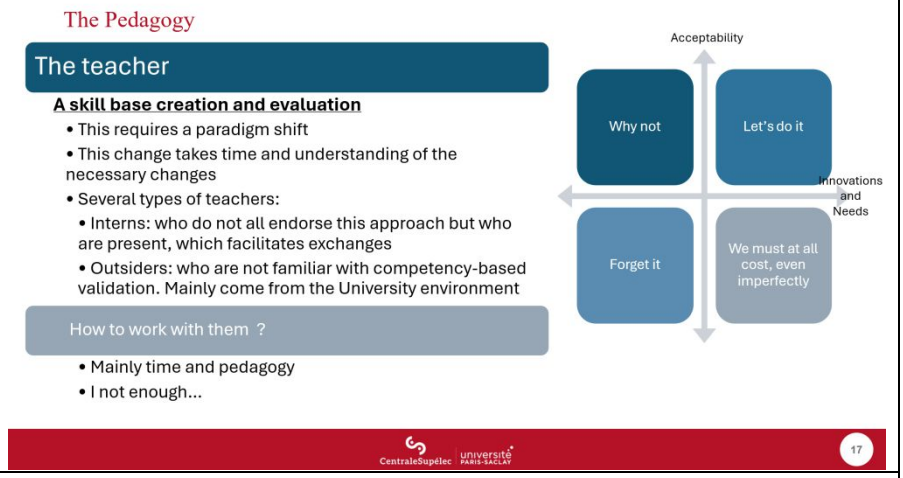
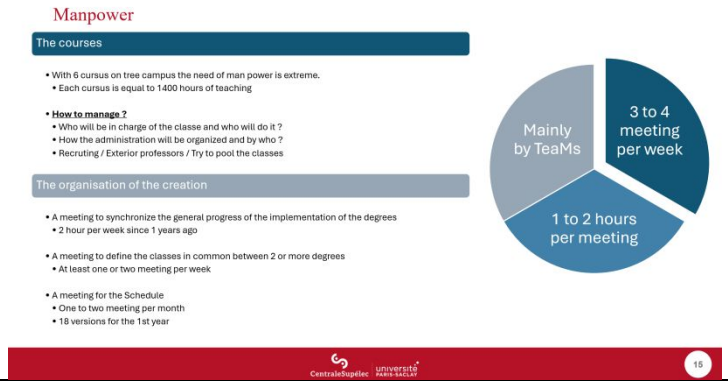
The complete survey in French is provided in "Results_survey_professors_creation_coherent_course.pdf".

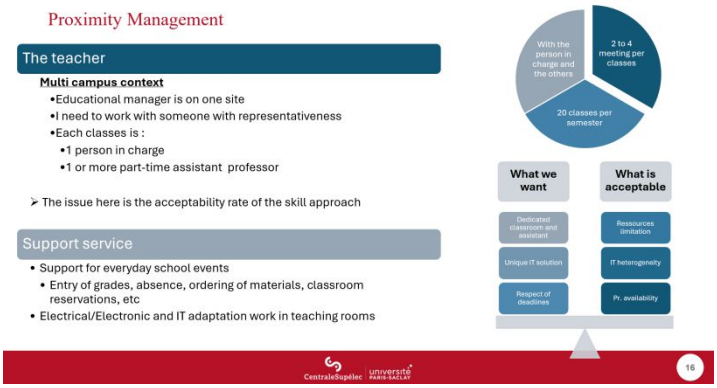
Experience 2 in course alignment: "Creation of a new diploma and associated challenge"

This experience is still ongoing and has been shared during a webinar in July 2025 the 7th. The first year of this new Diploma started in September 2025 for the first time.

This experience has been shared during a webinar the 29th of January 2025.

Initial courses	Not defined It could be considered all the courses from the three CentraleSupélec Campus
Resulting new diploma	20 new courses in the 5th semester 25 new courses in the 6th semester 37 new courses in the 7th semester 46 new courses in the 8th semester 36 new courses in the 9th semester 27 new courses in the 10th semester
Context of the creation of the new diploma	• Need from industry to get more specialized students in all the field of Electronics • Complementarity with the CS generalist Diploma

Specificity of the creation of the new Diploma	• Skills-based creation: what is needed today by the industrial partners? • Multi-campus coordination: 3 CentraleSupélec campus participated to the creation in Rennes, Metz and Paris Saclay • New and specific evaluation skills •
Main difficulties during creation	Main difficulties encountered during the creation are: • The skills-based evaluation which is not familiar to lecturer outside of CentraleSupélec • The material needed at several places in sufficient number 
Number of teachers involved	More than 20 from CS and also external lecturer.
Applied Methodology	A local and a multi-campus management 

	
Conclusion	The new diploma has welcome 16 students for the first time in September 2025.

Survey among industrial partners teaching in CentraleSupélec

For the creation of the new academic program, it was a requirement for each course at Master level to involve industrial partners. In this context, CentraleSupélec involved two industrial partners from X-FAB foundry to provide seminars on the topic of modeling and process.

These two industrial partners have been involved since 2023 and **provided their seminar for more than 95 students each year**. The survey that was conducted was about the coherence between their course and the rest of the pedagogical content.

Their opinion from industrial partners is that the global content is coherent. Each pedagogical content from CS professors use the Process Design Kit from XFAB.

The survey is available in the document “Results_survey_industrial_partners_XFAB.pdf”.

REPORT ON COURSE ALIGNMENT

of the **Physics** and **Theoretical Fundamentals of Electrical Engineering** courses

Lviv Polytechnic National University

Spring semester 2024/2025

Project CONN'COR no. 2024-1-FR01-KA220-HED-000250882
WP2: Strengthening the coherence of teaching on a certain set of subjects

Classes in the courses Physics and Theoretical Fundamentals of Electrical Engineering (TOE) began on February 24, 2025. Four teachers from each department took part in this event.

Following an oral announcement in the groups of first-year students of electrical engineering in February 2025, it was 38 students interested in such an activity.

The course alignment goal was to create a unified understanding of electrical phenomena and to connect theory with real-world technical applications.

The LIST of MAIN OUTCOMES:

- Joint work by Physics and Electrical Engineering departments;
- Reorganization of course content and structure;
- Improvement of sequence of key physics concepts teaching;
- Stronger links between physics and electrical engineering topics;
- Clear connection from theory to practice
- Better support for professional-oriented learning

In the framework of this workpackage 6 working meetings were conducted.

MEETING 1: Discussion of topics that require alignment between the disciplines of Department of Physics and Department of Theoretical and General Electrical Engineering of LPNU.

MEETING 2 - 5: Aligning teaching materials and methodologies between physics and electrical engineering courses: defining shared goals, key topics, and coordinated lab sessions for curriculum Integration

FORMS OF COLLABORATION BETWEEN WORKING GROUPS: creation of interdisciplinary teams, developing of shared teaching resources, co-teaching, peer observation, creation of unified assessment tools.

ANALYSIS of SURVEY RESULTS: The survey results demonstrate strong student support for the coordinated Physics and TOE laboratory sessions. Most respondents (70%) found the sessions very helpful and 30% helpful in deepening their understanding of both theoretical and practical aspects of electrical phenomena. Furthermore, 89% of students expressed interest in having more interdisciplinary courses combining physics and engineering, while 81% showed enthusiasm for future joint laboratory tasks or workshops, confirming the value of collaborative and cross-disciplinary learning experiences.

SUMMARY of COMPLETED WORK: The goal of alignment between courses has been achieved. The assimilation of the material has improved, as evidenced by the results of a survey conducted among students.

PARTNER'S REPORT (BUT)

R2.2c Report on proposals for teaching coherence aimed at improving the quality and consistency of teaching across institutions.

1. Basic Information

- Name of the institution: Bialystok University of Technology, Faculty of Electrical Engineering
- Program: Electronics and Telecommunication (Ist level, 1st and 2nd semesters)
- Coherent courses: Mathematics 1, Introduction to Electronics, Methodology of Studying (1st semester -27 students); Signal Processing, Mathematics 2, Metrology (2nd semester -26 students).

2. Justification for the choice of subjects

The selection of subjects, whose coherence was being developed, was based on two pillars: the logical consistency of implementing mathematical concepts in the fundamentals of electronics, signal processing and theory of measurements, and the willingness of the teachers of the mentioned subjects to collaborate. Since in high schools a holistic approach to the subjects taught practically does not exist, in Methodology of Study students were informed, among other things, on the necessity of using mathematical tools in solving engineering problems in electronics.

Important remark: The problem of lack of consistency in courses must be recognized by the teachers who provide them, because only then does the desire to solve it arise. Without mutual sympathy and a willingness to compromise, such cooperation is impossible.

3. Description of Implemented Collaboration Forms

During the academic year 2024/2025, in the frame of the CONN'COR project, for realisation of WP2.2 activities, we chose the mentioned courses to make their content and teaching methods consistent and closely connected with each other. For the implementation of this task, we have adopted the following forms and methods of collaboration:

- **Interdisciplinary Teams:**

By decision of the dean of the faculty, a team of teachers (8 persons) conducting courses in the first semester was appointed in 7th of October 2024. This team met few times to discuss the following topics: establishing a template for laboratory exercise reports, exchanging information about the order and scope of covered topics, familiarizing themselves with the requirements of individual teachers, and so on. The main aim of these meetings was to coordinate curriculum content, identify overlapping topics and gaps.

The greatest work was done by the team of 3 teachers (including the mathematics teacher prof. M. Wyrwas) who taught the mentioned subjects in the first semester, as well as by another 3 teachers in the second semester.

- **Peer Reviewing:**

Mutual review of presentation content prepared for students in mathematics, introduction to electronics and metrology courses. Result: supplementing lesson content with examples from other subjects and disciplines.

- **Joint Design of Assessment Tools:**

Development of common evaluation problems. Adding practical (electronic, statistics, tools for signal processing) context to math tasks.

- **Role of Communication:**

Continuous (even twice per week) teacher communication via online platform and a minimum one face-to-face meeting per two weeks. These meetings (total 30) result from the desire and need of the involved teachers, not from any orders from the authorities.

4. Effects and Outcomes of Collaboration

- **Curriculum Changes:**

Identification and deleting of unnecessary content (e.g. in mathematics) and a consistent approach to overlapping elements (e.g. statistics as a tool for calculating the uncertainty of measurements).

- **Implementation of Teaching Innovations:**

Introducing the active team methods. Mathematics tasks were given a practical context related to the field of electronics and the processing of measurement results.

- **Impact on Student Performance:**

Thanks to demonstrating the applications of theoretical concepts in practical problems in electronics, signal processing, and metrology, students were more motivated and engaged during classes.

Compared to other fields of study at this faculty, based on the analysis of exam results, it can be observed that they achieved better outcomes in the mentioned subjects. Additionally, comparing these results with the previous academic year, there is a clearly higher average grade across all these subjects.

The survey results conducted among students after the first and second semesters also confirm their positive opinion on the usefulness of the changes applied to the content and the way the courses are conducted.

- **Impact on Teacher Professional Development:**

In the frame of realization this activity teachers from partner's institutions attended the training on course alignment (webinar at 29th January 2025) and on mutual collaboration (webinar at 7th of July 2025). The surveys' results confirm the usefulness of the training conducted.

Increasing the knowledge and understanding of mathematics teachers about the use of mathematical concepts and tools in specific problems in the field of electronics

5. Challenges and Barriers Encountered

Challenges*:*

- Satisfaction with students' interest in the content of the courses.
- Higher course grades and student feedback confirm the correctness of the implemented changes.
- Increased job satisfaction among teachers involved in this project.
- Achieving excellent communication with other teachers stemming from a desire to work together.

Barriers:

- Time constraints and teaching workload.
- Resistance to change, differing teaching philosophies.
- Lack of appreciation for such initiatives by the faculty and university authorities.

6. Conclusions and Recommendations

- Working on the coherence of core subjects is particularly important in the first year of studies to show students the practical learning objectives of mathematics and other theoretical content. Students in higher years recognize this connection on their own.
- Meetings of all teachers teaching subjects in a given semester are not as effective as close cooperation between 2-3 teachers based on a shared willingness, ability to compromise, and readiness to implement changes in the subject being taught.
- The role of the faculty and university authorities is not to formally initiate these changes, but rather to recognize grassroots initiatives and support them.

7. Results of Inter-Institutional Collaboration

- Realisation of this part of WP2 made the possibility to exchange the experience of partners in the field of teachers' cooperation focused on courses coherence. Taking into account the varying levels of knowledge and experience of the partners in this area, the CONN'COR project enabled the exchange of experiences, familiarization with the obtained results, and above all, the building of relationships between teachers from partner universities, leading to mutual contacts and the sharing of personal ideas.
- The implementation of the CONN'COR project was important for drawing attention to the didactic cooperation among academic teachers and for developing and applying in the future at least a few activities leading to better consistency of courses.

8. Indicators

Teachers taking part in "course alignment" (BUT)	9 (winter) + 3 (summer)
Number of students from correlated courses (BUT)	27 (winter) + 26 (summer)
Number of teachers meetings (BUT)	30
Number of participants at webinar on course alignment (29/01/2025) - all partners	19
Number of participants at webinar on mutual collaboration (07/07/2025) - all partners	15

9. Attachments:

- Results of student surveys (after 1st and after 2nd semester) (Google Drive).
- Results of teachers surveys (after 1st and after 2nd semester) (Google Drive).
- Links to the recorded webinars:
  - Webinar no. 1: https://box.biaman.pl/f/66a9fc9f2acb4b8fbe7a/
  - Webinar no. 2: https://box.biaman.pl/f/49f11ae9cd3048d2a72c/
- Dean's decision from 7th of Oct 2024 (in Polish) (Google Drive)

Note: *The quotes from student and teacher feedback is recommended.*

Report prepared by: Jaroslaw Makal, PhD Eng. Date of report preparation: 27.12.2025

Report on Harmonization of Course Content for Four University-Level Subjects and mutual collaboration of teachers (UNI)

During the implementation of the project, the curricula of four courses at the undergraduate academic studies level within the *Electrical Engineering and Computer Science* study program, offered at the Faculty of Electronic Engineering in Niš, were harmonized. The harmonization of these courses was performed in the period from November 15, 2024, to June 1, 2025. During this period, six teachers, who have been participating in CONN'COR project, held weekly based meetings to discuss this item. The presentation used during the initial meeting was given in file COURSE_CORRELATION_UNI.pdf. After set of meetings, the courses harmonized are as follows: **Fundamentals of Telecommunications** (6 ECTS, Semester 3), **Telecommunication Theory** (6 ECTS, Semester 5), **Wireless Communication Technologies** (5 ECTS, Semester 5), and **Optical Communications** (5 ECTS, Semester 6). The first two courses are theoretical, while the latter two are application-oriented. Following the harmonization of course content, teaching materials for a book of courses were developed. These materials were submitted to the national accreditation agency on September 20, 2025, and the new study program is currently in the accreditation process. The courses have been harmonized in both Serbian and English. An excerpt from the book of courses is provided in PDF files.

In addition to harmonizing the content of four courses, six teachers from the Department of Telecommunications also collaborated on establishing close cooperation in the delivery of teaching in the fourth year of studies within the Telecommunications module. Students attended the following courses during the spring semester of the 2024/25 academic year and the autumn semester of the 2025/26 academic year: Software–Hardware Interface in Telecommunications, Information Theory and Applications, Optical Telecommunications, Laboratory Practicum 1, VoIP, Radar Engineering and Radiolocation, and Satellite Telecommunications. The six lecturers involved in these courses held meetings during which they compared students' results achieved in midterm exams and exchanged opinions on the progress of each student. In addition, they coordinated the conducting lab exercises. Five laboratory exercises were carried out as part of two courses.

On May 20, 2024, one Telecommunications Department (15 teachers) meeting was held where discussions were held about overlapping of the content of different courses with aim to omit these overlapping in preparing the official documentations for accreditation process.

In addition, some discussions were carried out with a teacher of Electromagnetics to define necessary knowledge in that area required for students attending the Module of Communications and Information Technologies. One teacher from the Faculty of Pedagogy had discussions with Iryna Moroz from LPNU, related to the content of the book Collection of solved problems in Physics for students at the Faculty of Pedagogy.